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CALENDAR OF AMS MEETINGS

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

ABSTRACTS OF CONTRIBUTED PAPERS should be submitted on special forms which are available in most departments of mathematics; forms can also be obtained by writing to the headquarters of the Society. Abstracts of papers to be presented at the meeting *in person* must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline for the meeting. Note that the deadline for abstracts to be considered for presentation at special sessions is three weeks earlier than that given below. For additional information consult the meeting announcement and the list of organizers of special sessions.

MEETING NUMBER	DATE	PLACE	ABSTRACTS DEADLINE	for ISSUE
767	June 15-16, 1979	Vancouver, Canada	APRIL 24	June
768	August 21-25, 1979 (83rd Summer Meeting)	Duluth, Minnesota	JUNE 12	August
769	October 20-21, 1979	Washington, D. C.	AUGUST 22	October
770	November 2-3, 1979	Kent, Ohio	AUGUST 27	
771	November 9-10, 1979	Birmingham, Alabama	SEPTEMBER 19	November
772	November 16-17, 1979	Riverside, California	SEPTEMBER 24	
773	January 3-7, 1980 (86th Annual Meeting)	San Antonio, Texas	OCTOBER 22	January 1980
	March 28-29, 1980	Boulder, Colorado		
	April 25-26, 1980	Davis, California		
	August 18-22, 1980 (84th Summer Meeting)	Ann Arbor, Michigan		
	January 7-11, 1981 (87th Annual Meeting)	San Francisco, California		

DEADLINES listed above for abstracts are also the deadlines for other information intended for publication in the same issue: news items and announcements of special meetings. There are separate deadlines for *Classified Advertising* and for abstracts of papers presented to the Society for publication *by title* (rather than for presentation in person at a meeting). They are as follows:

ISSUE	BY TITLE ABSTRACTS	CLASSIFIED ADVERTISING
JUNE 1979	April 17	April 27
AUGUST 1979	June 5	June 22

OTHER EVENTS SPONSORED BY THE SOCIETY

		ANNOUNCEMENT APPEARS
June 19-30, 1979	Seminar/Workshop on Algebraic and Geometric Methods in Linear Systems Theory Harvard University, Cambridge, Massachusetts	February 1979 p. 96
June 25-July 20, 1979	Summer Research Institute on Finite Group Theory, University of California, Santa Cruz, California	February 1979 p. 96
August 19-20, 1979	AMS Short Course: Operations Research: Mathematics and Models University of Minnesota, Duluth, Minnesota	April 1979 p. 167

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All orders must be prepaid

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Requests for information:

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New York City, April 19–20, 1979, Biltmore Hotel

Program for the 765th Meeting

The seven hundred sixty-fifth meeting of the American Mathematical Society will be held at the Biltmore Hotel, Madison Avenue at 43rd Street, New York City, on Thursday and Friday, April 19 and 20, 1979.

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be five invited one-hour addresses and six special sessions of twenty-minute papers. Three of the invited addresses and a special session will be devoted to the theme "Probability theory and applications to contiguous branches of mathematics." The invited addresses will be presented by **Richard M. Dudley**, Massachusetts Institute of Technology, who will speak on "Empirical measures on Vapnik-Chervonenkis classes"; **Eugene B. Dynkin** of Cornell University, who will speak on "Markov processes and random fields"; and **Richard F. Gundy** of Rutgers University, New Brunswick, whose lecture is titled "Recent developments in probability and classical analysis."

Harry Kesten of Cornell University and **Donald Dawson** of Carleton University have organized a special session on Probability theory inspired by applications; the speakers will be Maury Bramson, Richard Ellis, Stewart N. Ethier, Uriel Frisch, Leonard Gross, Gregory Lawler, Charles Newman, George Papanicolaou, Murad Taqqu, John Weirman, and Sandy Zabell.

The second theme is "Algebraic geometry", for which the invited speakers are **Heisuke Hironaka** of Harvard University, who will speak on "Equisingular stratifications of an algebraic variety"; and **George R. Kempf** of Johns Hopkins University, whose lecture will be on "Inversion of Abelian integrals." Professors **Hironaka** and **Kempf** are also organizing a related special session on Algebraic geometry; twenty-minute papers will be presented by H. H. Anderson, Avner Ash, William Lang, Henry B. Laufer, Rick Miranda, Shigefumi Mori, Ulf A. Perssen, S. Shatz, J. Wahl, Stephen S.-T. Yau, and Steven Zucker.

The organizers and speakers for the other five special sessions are as follows: **Harold M. Hastings** of the University of Georgia has organized a special session on Homotopy theory; the speakers will be Ralph L. Cohen, Steven Ferry, Peter Freyd, Ross Geoghegan, Jack Hollingsworth, J. F. Jardine, Tsau-Young Lin, S. J. Lomonaco, Jr., John McCleary, C. A. McGibbon, Michael L. Mihalik, Joseph A. Neisendorfer, and T. B. Rushing. **Gangaram S. Ladde**, State University of New York, College at Potsdam, has organized a special session on Mathematical modelling; the speakers will be Carl M. DeSilva, Jerome Eisenfeld, Lev R. Ginzburg, Louis J. Gross, Okan Gurel, Thomas G. Hallam, Nicholas D. Kazarinoff, V. Lakshmikantham, M. Zuhair Nashed, Robert Rosen, Heang Tuy, and David J. Wollkind. A special session on Algebraic and topological semigroups has been organized by **Gerard J. Lallement** of Pennsylvania State University; the speakers will be John F. Berglund, Karl Byleen, J. H. Carruth, C. E. Clark, Winston Crawley, Deborah Gale, George Graham, Karl H. Hofmann, Hugo D. Junghenn, Gerianne M. Krause, Bao T. Lerner, John Luedeman, Kenneth Magill, Stuart W. Margolis, Paul Milnes, William R. Nico, F. Pastijn, Mohan S. Putcha, Russell Remage, Howard Straubing, S. Subbish, R. Venkataraman, and Charles Wells. **Louis F. McAuley** of the Institute for Advanced Study and State University of New York, Center at Binghamton, has organized a special session on Monotone and open mappings; the speakers are P. T. Church, Wayne Lewis, Joseph Martin, Louis F. McAuley, Eric E. Robinson, Michael Starbird, Gerard Venema, John J. Walsh, David C. Wilson, and Edythe Woodruff.

There will also be sessions for contributed ten-minute papers. Late papers will be accepted for presentation at the meeting, but will not be listed in the printed program.

The Council of the Society will meet at 1:00 p.m. on Friday, April 20, in the Biltmore Suite (Rooms G, H, I) at the Biltmore Hotel.

REGISTRATION

The registration desk will be located in the Vanderbilt Suite on the first floor of the Biltmore Hotel, and will be open from 8:00 a.m. to 4:30 p.m. on Thursday, and from 8:00 a.m. to 3:00 p.m. on Friday. The registration fees will be $5 for nonmembers, $3 for members, and $1 for students or unemployed mathematicians.

ACCOMMODATIONS

A block of rooms has been set aside at the Biltmore Hotel for use by participants attending the meeting. Persons planning to stay at the Biltmore should make their own reservations with the hotel and should be sure to mention the mathematics meeting in order to obtain the special rates, which are $36 for single occupancy or $42 for double occupancy. For your convenience, a reservation form will be found on page A-190 in the January issue of the NOTICES, or you may call the room reservations office at the Biltmore, telephone 212-687-7000. The deadline for reservations is April 4.

TRAVEL

The Biltmore Hotel is located on Madison Avenue at 43rd Street, on the east side of New York City. Walkways from Grand Central Station connect with the hotel, and signs are posted directing persons to the hotel lobby.

Those arriving by bus at the Port Authority Bus Terminal may take the Independent Subway System, a taxi, or bus to the hotel. There is shuttle bus service directly to Grand Central

Station from LaGuardia, Kennedy, and Newark Airports, and starters will direct passengers to the correct bus.

Persons arriving by car will find several parking garages in the area, in addition to the garage at the Biltmore Hotel. Parking service can be arranged through the hotel doorman. The present rate for parking in the hotel garage is $12.50 for each 24-hour period, and there is an additional charge for extra pickup and delivery service if it is required. The parking fee is subject to New York City taxes.

MAIL ADDRESS

Registrants at the meeting may receive mail addressed to them in care of the American Mathematical Society Meeting, Biltmore Hotel, Madison Avenue at 43rd Street, New York, New York 10017.

PROGRAM OF THE SESSIONS

The time limit for each contributed paper in the general sessions is ten minutes and in the special sessions is twenty minutes. To maintain the schedule the time limits will be strictly enforced.

THURSDAY 9:00 A.M.

Session on Algebra and Number Theory, Biltmore Suite (G,H,I)

9:00- 9:10	(1)	An algorithm to determine self-producing r-digit g-adic integers. Preliminary report. Dr. G.D. PRICHETT*, Dr. A.L. LUDINGTON, and Mr. J.F. LAPENTA, Hamilton College (765-A1)
9:15- 9:25	(2)	Generalizations of the bracketing process applied to the commutator calculus. Preliminary report. Professor ANTHONY M. GAGLIONE*, U.S. Naval Academy, and Professor HERMANN V. WALDINGER, Polytechnic Institute of New York (765-A27)
9:30- 9:40	(3)	Parametrized ring class fields and the icosahedron. Preliminary report. Professor HARVEY COHN, City University of New York, City College (765-A24)
9:45- 9:55	(4)	The Cartan map $K_*(R) \longrightarrow G_*(R)$ factors through the map $K_*(R) \longrightarrow KV_*(R)$. CHARLES A. WEIBEL, University of Pennsylvania (765-A39)
10:00-10:10	(5)	Going down in differential polynomial rings. Preliminary report. Professor WILLIAM F. KEIGHER, Rutgers University, Newark (765-A34)
10:15-10:25	(6)	Totients and unitary totients with respect to a set of polynomials. Professor J. CHIDAMBARASWAMY, University of Toledo (765-A28)
10:30-10:40	(7)	Variations on the Cauchy-Schwartz inequality. Professor MARVIN MARCUS, University of California, Santa Barbara (765-A18)
10:45-10:55	(8)	A determinant formula for inverses of banded matrices. Dr. WAYNE W. BARRETT*, Texas A&M University, and Dr. PHILIP J. FEINSILVER, Southern Illinois University, Carbondale (765-A25)
11:00-11:10	(9)	A determinant of a matrix. Professor JIN BAI KIM*, West Virginia University, and Dr. YONG M. LEE, Trenton State College (765-A41)
11:15-11:25	(10)	On $(\lambda,1)$-designs. Dr. R.K. JAIN, Memorial University of Newfoundland (765-A26) (Introduced by Professor S.P. Singh)
11:30-11:40	(11)	Some combinatorial identities generated by a problem in characterization. R. SHANTARAM, University of Michigan, Flint (765-A30)
11:45-11:55	(12)	Introducing a new type of problem and researches on an old Diophantine problem by Fermat. Professor JOSEPH ARKIN*, Spring Valley, New York, Professor VERNER E. HOGGATT, Jr., San Jose State University, and Professor E.G. STRAUS, University of California, Los Angeles (765-A11)

THURSDAY, 9:00 A.M.

Session on Geometry and Topology, Music Room

9:00- 9:10	(13)	Differential geometric aspects of billard ball dynamical systems. Preliminary report. Mr. PHILIP H. TURNER, Wesleyan University (765-D3)
9:15- 9:25	(14)	Geodesic fields with singularities. Mr. ALAN H. KAFKER, University of Pennsyvlania (765-D4)
9:30- 9:40	(15)	Involutions fixing the disjoint union of a point and a real projective space. Preliminary report. Dr. DAVID C. ROYSTER, University of Virginia (765-G21)

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

9:45- 9:55 (16) Some groups of PL self-knottings. Professor DOUGLAS S. MEADOWS, University of Rochester (765-G22) (Introduced by Professor David Prill)

10:00-10:10 (17) A theorem on separation is equivalent to the Axiom of Choice. Preliminary report. Professor STEWART M. ROBINSON, Cleveland State University (765-G23)

10:15-10:25 (18) A simple genus one knot with incompressible spanning surfaces of arbitrarily high genus. Preliminary report. Professor RICHARD F. GUSTAFSON, State University of New York, Oneonta (765-G24)

10:30-10:40 (19) A Banach space characterization of local connectedness. Preliminary report. Professor D.G. HARTIG, U.S. Naval Academy (765-G25)

10:45-10:55 (20) A covering property which implies isocompactness, II. Professor H.H. WICKE* and Professor J.M. WORRELL, Jr., Ohio University, Athens (765-G34)

THURSDAY, 9:30 A.M.

Session on Differential Equations, Suite C

9:30- 9:40 (21) The behavior of the Laplacian on weighted Sobolev spaces. Dr. ROBERT C. McOWEN, Courant Institute of Mathematical Sciences, New York University (765-B23)

9:45- 9:55 (22) On the determination of the density of a vibrating string from its asymptotic phase. Preliminary report. Dr. HIMAT S. BATRA, Marist College (765-B27)

10:00-10:10 (23) ODE approximating PDE in unbounded domains: the elliptic case. Professor C. CORDUNEANU, University of Tennessee, Knoxville (765-B22)

10:15-10:25 (24) Energy inequalities for ultrahyperbolic operators in a Hilbert space. Preliminary report. Professor HAJIMU OGAWA, State University of New York, Albany (765-B21)

10:30-10:40 (25) Periodic solutions of nonlinear delay equations. Mr. WILLIAM J. LAYTON, University of Tennessee, Knoxville (765-B18)

10:45-10:55 (26) Existence of extremal solutions and comparison results for delay differential equations in abstract cones. Preliminary report. Professor A.S. VATSALA*, University of Texas, Arlington, and Professor R.L. VAUGHN, Texas Christian University (765-B16)

11:00-11:10 (27) Uniqueness of Dirichlet and mixed boundary value problems for the biharmonic equation for a rectangle. Preliminary report. Professor R.B. RAM, State University of New York, Oneonta (765-B15)

11:15-11:25 (28) Best L^p -approximation of generalized biaxisymmetric potentials. Professor PETER A. McCOY, U.S. Naval Academy (765-B4)

11:30-11:40 (29) Asymptotic behavior of solutions of a certain second order differential equation. Professor T.K. PUTTASWAMY, Ball State University (765-B2)

THURSDAY, 9:30 A.M.

Special Session on Modeling, I, Suite S

9:30- 9:50 (30) Modelling of natural selection. Preliminary report. LEV R. GINZBURG, State University of New York, Stony Brook (765-C2) (Introduced by Professor Gangaram S. Ladde)

9:55-10:15 (31) System identification modeling. Dr. JEROME EISENFELD, University of Texas, Arlington (765-C3)

10:20-10:40 (32) Modeling the dynamics of photosynthesis. Mr. LOUIS J. GROSS, Cornell University (765-C1)

10:45-11:05 (33) Persistence-extinction mechanisms in ecosystem models. Professor THOMAS G. HALLAM, University of Tennessee, Knoxville (765-C6)

THURSDAY, 9:30 A.M.

Special Session on Semigroups, I, L & M

9:30- 9:50 (34) The double four-spiral semigroup. KARL BYLEEN*, Marquette University, JOHN MEAKIN, University of Nebraska, Lincoln, and FRANCIS PASTIJN, Rijksuniversiteit te Gent, Belgium (765-A21)

9:55-10:15 (35) Biordered sets and complemented modular lattices. FRANCIS PASTIJN, Rijksuniversiteit te Gent, Belgium (765-A32) (Introduced by Professor Gerard J. Lallement)

10:20-10:40 (36) Applications of categorical extension theory to monoid extensions. Preliminary report. Professor WILLIAM R. NICO, Tulane University (765-A19)

10:45-11:05 (37) Linear algebraic semigroups. Professor MOHAN S. PUTCHA, North Carolina State University (765-A7)

11:10-11:25 (38) Green's $\mathscr{R}$-relation and climbing mountains. Preliminary report. Professor BRIDGET B. BAIRD, University of Florida, and Professor K.D. MAGILL*, State University of New York, Buffalo (765-A17)

11:30-11:50 (39) Finitely generated semigroups of continuous selfmaps. Preliminary report. Professor SARASWATHI SUBBIAH, Daemen College (765-A5)

THURSDAY, 9:30 A.M.

Special Session on Homotopy Theory, I, Suite R

9:30- 9:50 (40) Free-homotopy idempotents. Professor PETER FREYD*, University of Pennsylvania, and Professor ALEX HELLER, City University of New York, Graduate School and University Center (765-G38)

9:55-10:15 (41) Splitting homotopy idempotents which have essential fixed points. Professor ROSS GEOGHEGAN, Institute for Advanced Study (765-G10)

10:20-10:40 (42) The converse of the Vietoris-Smale theorem and strong shape theory. Professor STEVEN C. FERRY, Institute for Advanced Study (765-G12)

10:45-11:05 (43) A characterization of inverse limits of n-disk bundle maps. Preliminary report. Professor T. BENNY RUSHING, University of Utah (765-G27)

THURSDAY, 11:10 A.M.

Invited Address, Music Room

(44) Inversion of Abelian integrals. Professor GEORGE KEMPF, Johns Hopkins University (765-A29)

THURSDAY, 1:10 P.M.

Invited Address, Music Room

(45) Recent developments in probability and classical analysis. Professor RICHARD GUNDY, Rutgers University, New Brunswick (765-F21)

THURSDAY, 2:15 P.M.

Invited Address, Music Room

(46) Equisingular stratifications of an algebraic variety. Professor HEISUKE HIRONAKA, Harvard University (765-A40)

THURSDAY, 2:15 P.M.

Special Session on Semigroups, II, Suite C

2:15- 2:35 (47) Recognizable sets and power sets of finite semigroups. Mr. HOWARD STRAUBING, Reed College (765-A2)

2:40- 3:00 (48) On $\tilde{n}$-free transformation semigroups. STUART W. MARGOLIS*, University of California, Berkeley, and Professor BRET R. TILSON, City University of New York, Queens College, (765-A16)

3:05- 3:25 (49) Extension theories for monoids and small categories. Preliminary report. CHARLES WELLS, Case Western Reserve University (765-A8)

3:30- 3:50 (50) On $Z(p^{\infty})$-$\mathfrak{N}$-semigroups. Preliminary report. Professor TAKAYUKI TAMURA, University of California, Davis, and Professor DEBORAH GALE*, Montana State University (765-A20)

3:55- 4:15 (51) Torsion theories and semigroups of quotients. Dr. JOHN K. LUEDEMAN, Clemson University (765-A6)

4:20- 4:40 (52) Algebras of functions on semidirect products of semigroups. Professor H.D. JUNGHENN and Ms. BAO T. LERNER*, George Washington University (765-G4)

THURSDAY, 3:00 P.M.

Special Session on Probability Theory Inspired by Applications. I, Biltmore Suite (G, H, I)

3:00- 3:20 (53) Asymptotic behavior of the d-dimensional biased voter model. MAURY BRAMSON*, Courant Institute of Mathematical Sciences, New York University, and DAVID GRIFFEATH, University of Wisconsin, Madison (765-F1)

3:25- 3:45 (54) Self-similar random fields in mathematical physics. Professor CHARLES M. NEWMAN, University of Arizona (765-F12)

3:50- 4:10 (55) The asymptotics of certain random fields defined on a circle. Preliminary report. Professor RICHARD S. ELLIS, University of Massachusetts, Amherst (765-F3)

4:15- 4:35 (56) Decay of correlations in classical statistical mechanical lattice models. LEONARD GROSS, Cornell University (765-F15)

4:40- 5:00 (57) Properties of some diffusions that arise in the analysis of waves in random media. Professor GEORGE C. PAPANICOLAOU, Courant Institute of Mathematical Sciences, New York University (765-F9)

THURSDAY, 3:30 P.M.

Special Session on Algebraic Geometry. I, Suite L&M

3:30- 3:50 (58) Projective manifolds with ample tangent bundles. Professor SHIGEFUMI MORI, Harvard University and Kyoto University, Japan (765-A36)

3:55- 4:15 (59) New invariants for isolated singularities. Professor STEPHEN S.-T. YAU, Harvard University (765-A37)

4:20- 4:40 (60) On the Euler number of algebraic surfaces in characteristic p. Preliminary report. Dr. WILLIAM E. LANG, Institute for Advanced Study (765-A15)

4:45- 5:05 (61) Cohomological representations of algebraic groups. Dr. H.H. ANDERSEN, Institute for Advanced Study (765-A3)

THURSDAY 3:30 P.M.

Special Session on Modeling. II, Suite S

3:30- 3:50 (62) Models with exploded points. Dr. OKAN GUREL, IBM Corporation, White Plains, New York (765-B7)

3:55- 4:15 (63) On anticipatory systems. Dr. ROBERT ROSEN, Dalhousie University (765-C7) (Introduced by Professor Gangaram S. Ladde)

4:20- 4:40 (64) What Hopf bifurcation analyses may suggest to experimental scientists. Professor NICHOLAS D. KAZARINOFF, State University of New York, Buffalo (765-H2)

4:45- 5:05 (65) A mathematical theory for the elastic response of the aorta in vivo. Professor CARL N. DeSILVA, Wayne State University (765-C4)

5:10- 5:30 (66) Quasi-solutions and their role in initial and boundary value problems. Preliminary report. Professor V. LAKSHMIKANTHAM, University of Texas, Arlington (765-B11)

THURSDAY, 3:30 P.M.

Special Session on Homotopy Theory. II, Suite R

3:30- 3:50 (67) Ends of fundamental groups in shape and proper homotopy. Mr. MICHAEL MIHALIK, State University of New York, Binghamton (765-G5)

3:55- 4:15 (68) Simple shape theory. Preliminary report. Professor JOHN HOLLINGSWORTH, University of Georgia (765-G33)

4:20- 4:40 (69) How to compute the algebraic 3-type of 2-knots. Professor S.J. LOMONACO, Jr., State University of New York, Albany (765-G19)

4:45- 5:05 (70) Algebraic homotopy theory. Preliminary report. Mr. J.F. JARDINE, University of British Columbia (765-G2)

(71) WITHDRAWN

FRIDAY, 8:30 A.M.

Session on Probability and Statistics, Music Room

8:30- 8:40 (72) On a continuous analogue of the stochastic difference equation $X_n = \rho X_{n-1} + B_n$. Professor STEPHEN JAMES WOLFE, University of Delaware (765-F5)

8:45- 8:55 (73) Limit theorems with random sample sizes. Preliminary report. Professor JANOS GALAMBOS, Temple University (765-F6)

9:00- 9:10 (74) Waiting times related to order statistics. Dr. R.D.S. WENOCUR, Drexel University (765-F7)

9:15- 9:25 (75) An analytic approach to multivariate probability distributions. PHILIP FEINSILVER, Southern Illinois University, Carbondale (765-F19) (Introduced by Professor Harry Kesten)

9:30- 9:40 (76) Rate of convergence in the weak law of large numbers in Banach spaces. Preliminary report. Professor WOJBOR A. WOYCZYNSKI, Cleveland State University (765-F18)

9:45- 9:55 (77) The convergence of a branching Brownian motion used as a model describing the spread of an epidemic. Dr. FRANK J. WANG, University of Montana (765-F14)

10:00-10:10 (78) Ranking by inversion: A note on C.L. Dodgson, Professor FRANCINE ABELES, Kean College of New Jersey (765-F17)

FRIDAY, 9:00 A.M.

Special Session on Semigroups, III, Suite C

9:00- 9:20 (79) The local Lie group embeddability of certain local C^{∞} monoids. Preliminary report. GEORGE GRAHAM, University of Houston, Houston (765-G11)

9:25- 9:45 (80) Problems about semitopological semigroups. Dr. JOHN F. BERGLUND, Virginia Commonwealth University (765-G1)

9:50-10:10 (81) Lie semigroups in Lie groups. Preliminary report. KARL H. HOFMANN*, Tulane University, and JIMMIE D. LAWSON, Louisiana State University, Baton Rouge (765-G18)

10:15-10:35 (82) Generalized Green's theories. Dr. C.E. CLARK* and Dr. J.H. CARRUTH, University of Tennessee, Knoxville (765-A9)

10:40-11:00 (83) Constructing generalized Green's theories. Preliminary report. Dr. J.H. CARRUTH* and Dr. C.E. CLARK, University of Tennessee, Knoxville (765-A10)

11:05-11:25 (84) Topological left amenability of locally compact Borel subsemigroups. Professor H.D. JUNGHENN, George Washington University (765-B3)

FRIDAY, 9:00 A.M.

Special Session on Monotone and Open Mappings, I, Suite R

9:00- 9:20 (85) Certain point-like decompositions of E^3 with 1-dimensional images of non-degenerate elements. Professor LOUIS F. McAULEY, Institute for Advanced Study, and Professor E.P. WOODRUFF*, Trenton State College (765-G29)

9:25- 9:45 (86) Decompositions of E^3. Professor LOUIS F. McAULEY, Institute for Advanced Study (765-G35)

9:50-10:10 (87) Monotone mappings onto manifolds. Preliminary report. Professor JOSEPH MARTIN, University of Wyoming (765-G32)

10:15-10:35 (88) Pushing shrinkable decompositions into non-shrinkable ones. Preliminary report. MICHAEL STARBIRD, Institute for Advanced Study (765-G31)

10:40-11:00 (89) A disjoint 2-disk characterization of Q-manifolds. Preliminary report. JOHN J. WALSH, University of Tennessee, Knoxville (765-G26)

FRIDAY, 9:00 A.M.

Special Session on Homotopy Theory, III, Suite J

9:00- 9:20 (90) On injective stable homotopy modules and a solution to the generating hypothesis. Professor T.Y. LIN, National Taiwan University and University of South Carolina, Aiken (765-D1)

9:25- 9:45 (91) On the mod p decompositions of certain spaces. Dr. JOHN McCLEARY, Bates College (765-G6)

9:50-10:10 (92) Multiplicative properties of power maps. Preliminary report. Dr. C.A. McGIBBON, University of Pennsylvania (765-G7)

10:15-10:35 (93) A periodicity map for the homotopy of the 3-sphere. Preliminary Report. JOSEPH A. NEISENDORFER, Fordham University (765-G37)

FRIDAY, 9:00 A.M.

Special Session on Modelling. III, Suite K

9:00- 9:20 (94) On the dilemma and methodologies of mathematical modeling of ill-posed problems. Professor M. ZUHAIR NASHED, University of Delaware (765-C16)

9:25- 9:45 (95) A tectonophysical phenomenon: The onset of folding viewed as an instability in a layered Newtonian fluid involving surface tension. Preliminary report. DAVID J. WOLLKIND, Washington State University (765-C8) (Introduced by Professor H.C. Wiser)

9:50-10:10 (96) A mathematical model in computerized transmission tomography. Preliminary report. Dr. HEANG TUY, State University of New York, Buffalo (765-H1)

10:15-10:25 Discussion

FRIDAY, 9:00 A.M.

Special Session on Algebraic Geometry. II, Suite L&M

9:00- 9:20 (97) The moduli of rational elliptic surfaces with section. Preliminary report. Mr. RICK MIRANDA, Massachusetts Institute of Technology (765-A31)

9:25- 9:45 (98) On Chern numbers of surfaces of general type. Preliminary report. Dr. ULF PERSSON, Columbia University (765-D2) (Introduced by Professor George R. Kempf)

9:50-10:10 (99) Cohomology of congruence subgroups of $SL(3,\mathbb{Z})$. Preliminary report. Dr. AVNER ASH, Columbia University (765-G28)

10:15-10:35 (100) The geometry of certain 3-folds. Preliminary report. Professor STEPHEN S. SHATZ, University of Pennsylvania (765-A42)

10:40-11:00 (101) Hodge theory with degenerating coefficients: L_2 cohomology in the Poincaré metric. STEVEN ZUCKER, Rutgers University, New Brunswick (765-A4)

11:05-11:25 (102) Projective one-space as an exceptional set. Preliminary report. Professor HENRY B. LAUFER State University of New York, Stony Brook (765-B28)

11:30-11:50 (103) Elliptic deformations of unimodal singularities. Professor JONATHAN M. WAHL, University of North Carolina, Chapel Hill (765-A33)

FRIDAY, 9:00 A.M.

Session on Complex Analysis, Suite S

9:00- 9:10 (104) The modulus of the Schwarzian derivative for several classes of analytic functions. Preliminary report. Professor E.J. MOULIS, Jr., U.S. Naval Academy (765-B30)

9:15- 9:25 (105) Mappings between CR manifolds. HOWARD JACOBOWITZ, Rutgers University, Camden (765-B24)

9:30- 9:40 (106) Zeros of successive derivatives of entire functions of the form $h(z)\exp(-e^z)$. Professor ALBERT EDREI, Syracuse University (765-B17)

9:45- 9:55 (107) A smoothing property of the Henkin and Szegö projections. Professor PATRICK AHERN, University of Wisconsin, Madison, and Professor ROBERT SCHNEIDER*, City University of New York, Herbert Lehman College (765-B8)

10:00-10:10 (108) Spherical harmonic expansions. Professor ALLAN J. FRYANT, U.S. Naval Academy (765-B29)

10:15-10:25 (109) Models of analytic function theory. Professor CHARLES R. DEETER and Mr. KIRITKUMAR K. TALATI*, Texas Christian University (765-B12)

10:30-10:40 (110) Final sets for operators on balanced entire functions. Preliminary report. CARL PRATHER, Virginia Polytechnic Institute and State University (765-B35)

FRIDAY, 10:15 A.M.

Invited Address, Music Room

(111) Empirical measures on Vapnik-Chervonenkis classes. Professor R.M. DUDLEY, Massachusetts Institute of Technology (765-F20)

FRIDAY, 11:20 A.M.

Invited Address, Music Room

(112) Markov processes and random fields. Professor EUGENE B. DYNKIN, Cornell University (765-F8)

FRIDAY, 1:30 P.M.

Special Session on Probability Inspired by Applications. II, Music Room

1:30- 1:50 (113) Diffusion approximations of Markov chains with two time scales. Professor S. N. ETHIER*, Michigan State University, and Professor THOMAS NAGYLAKI, University of Chicago (765-F10)

1:55- 2:15 (114) Renormalization group transformation and the central limit theorem. Professor MURAD S. TAQQU, Cornell University (765-F13)

2:20- 2:40 (115) First-passage percolation on the square lattice. Preliminary report. Professor JOHN C. WIERMAN, University of Minnesota, Minneapolis (765-F2)

2:45- 3:05 (116) Scaling limits and weak convergence. Preliminary report. Professor DAVID ISAACSON and Professor SANDY ZABELL*, Rutgers University, New Brunswick (765-F16)

3:10- 3:30 (117) A self-avoiding random walk. Preliminary report. Mr. GREGORY F. LAWLER, Princeton University (765-F4)

3:35- 3:55 (118) A nonlinear stochastic ODE as a model of high-frequency intermittency in turbulent flows. Dr. URIEL FRISCH*, Harvard University and CNRS, Observatoire de Nice, France, and Dr. RUDOLF MORF, Harvard University (765-F11) (Introduced by Professor Harry Kesten)

FRIDAY, 1:30 P.M.

Session on Analysis, Suite J

1:30- 1:40 (119) A Tauberian theorem for the Radon transform. Preliminary report. Dr. JAMES V. PETERS, State University of New York, Purchase (765-B19)

1:45- 1:55 (120) Semigroup-valued Baire and Borel measures. JEAN-MARC BELLEY and PEDRO MORALES*, Université de Sherbrooke (765-B25)

2:00- 2:10 (121) On qualitative properties of abstract differential equations. Preliminary report. Professor S. ZAIDMAN, Université de Montréal (765-B1)

2:15- 2:25 (122) A remark on the spaces $V^p\Lambda_\alpha$. Professor CASPER GOFFMAN, Purdue University, Professor FON-CHE LIU, Academia Sinica, Taipei, Taiwan, and Professor DANIEL WATERMAN*, Syracuse University (765-B6)

2:30- 2:40 (123) Decomposability and a separation theorem. Preliminary report. LEONARD ASIMOW and ANDREW SIMOSON*, Syracuse University (765-B14)

2:45- 2:55 (124) Spectral resolutions of operators with disconnected spectra. Professor I. ERDELYI, Temple University (765-B13)

3:00- 3:10 (125) Extending the Ovsjannikov theorem to a scale of Fréchet spaces. Dr. JOHN SCHMEELK, Virginia Commonwealth University (765-B5)

3:15- 3:25 (126) A class of Markov-operators on C(X). Dr. ROBERT ATALLA Ohio University, Athens (765-B31)

3:30- 3:40 (127) The distribution modulo 1 of unbounded real sequences. Dr. BENJAMIN LEPSON*, Dr. CHARLES F. OSGOOD and Dr. CHUNG-CHUN YANG, U.S. Naval Research Laboratory, Washington, D.C. (765-B26)

3:45- 3:55 (128) Necessary and sufficient conditions for the convergence of the extended Hermite-Fejér interpolation. Professor R. BOJANIC, Ohio State University, Columbus (765-B9)

4:00- 4:10 (129) Fixed points in l_1. STEPHEN F. ROEHRIG, University of Rhode Island (765-B32)

4:15- 4:25 (130) Spectral invariance for normal operators under trace class perturbations. Preliminary report. SCOTT O'HARE, State University of New York, Stony Brook (765-B20)

4:30- 4:40 (131) On approximation by translates in $L_2(\mathbb{R})$. Preliminary report. Professor JAMIL A. SIDDIQI, Laval University (765-B33)

4:45- 4:55 (132) Idempotent elements of $\tau_{T,L}$-semigroups of distribution functions. Preliminary report. Professor CLAUDI ALSINA, Universidad Politécnica de Barcelona Spain (765-B34)

FRIDAY, 2:00 P.M.

Special Session on Semigroups. IV, Suite C

2:00- 2:20 (133) Pontryagin duality of topological semigroups. R. VENKATARAMAN, University of Manitoba (765-G17)

2:25- 2:45 (134) On pointwise recurrent locally compact totally disconnected semigroups. Professor RUSSELL REMAGE, University of Delaware (765-G14)

2:50- 3:10 (135) Continuity properties of compact right topological groups. Dr. PAUL MILNES, University of Western Ontario (765-G9)

3:15- 3:35 (136) On a theorem of Ling concerning representation of associative functions. Preliminary report. Ms. GERIANNE M. KRAUSE, Illinois Institute of Technology (765-G13)

3:40- 4:00 (137) Epimorphisms and semilattices of semigroups. Dr. WINSTON CRAWLEY, Shippensburg State College (765-G16)

FRIDAY, 2:00 P.M.

Session on Algebraic Geometry. I, Suite L & M

2:00- 2:10 (138) Generalized Weierstrass points and fixed points of automorphisms on closed Riemann surfaces. Preliminary report. ROBERT D.M. ACCOLA, Brown University (765-A13)

2:15- 2:25 (139) On the p-divisible groups arising from the Fermat curves. Dr. NORIKO YUI, University of Ottawa (765-A23)

2:30- 2:40 (140) Elliptic curves over quadratic fields. Preliminary report. KENNETH KRAMER, City University of New York, Queens College (765-A35)

2:45- 2:55 (141) Hodge theory of singular curves. Professor JEROME HOFFMAN, University of Pennsylvania (765-A38)

3:00- 3:10 (142) Universal cycle classes. Dr. HENRI A. GILLET, Princeton University (765-A14)

3:15- 3:25 (143) Elliptic curves over function fields and Picard numbers. Dr. PETER F. STILLER, Texas A&M University (765-A22)

3:30- 3:40 (144) Computing the bilinear pairing on rational sections of certain elliptic surfaces. Preliminary report. Mr. MICHEAL J. KENT, Rutgers University, New Brunswick (765-A12)

3:45- 3:55 (145) Simple complex singularities are Brieskorn. Professor DENIS BLACKMORE and Mr. MARK COOPER*, New Jersey Institute of Technology (765-B10)

FRIDAY, 2:00 P.M.

Special Session on Monotone and Open Mappings. II, Suite R

2:00- 2:20 (146) Spaces which are not hereditarily indecomposable. Preliminary report. Dr. DAVID C. WILSON, University of Florida (765-G20)

2:25- 2:45 (147) Dimension of hyperspaces of hereditarily indecomposable continua. WAYNE LEWIS, Texas Tech University (765-G15)

2:50- 3:10 (148) Inverse systems for light-open mappings onto polyhedra. Mr. ERIC E. ROBINSON, Ithaca College (765-G30)

3:15- 3:35 (149) A new proof of Štan'ko's approximation theorem. Mr. GERARD A. VENEMA, Institute for Advanced Study (765-G36)

3:40- 4:00 (150) Deficient points of discrete maps on manifolds. Professor P.T. CHURCH*, Syracuse University, and Professor J.G. TIMOURIAN, University of Alberta (765-G3)

FRIDAY, 2:00 P.M.

Session on Applied Mathematics, Suite K

2:00- 2:10 (151) Approximation of improper integrals. Preliminary report. Professor JOE B. THRASH, University of Southern Mississippi (765-C9)

2:15- 2:25 (152) On optimality of control systems in infinite time intervals. Ms. LYNNELL E. STERN, University of Rhode Island (765-C10)

2:30- 2:40 (153) Differential games in infinite time intervals. Professor EMILIO O. ROXIN, University of Rhode Island (765-C11)

2:45- 2:55 (154) Fuzzy relational and L relational data bases. Preliminary report. Professor C.R. GIARDINA, Singer-Kearfott Division, Wayne, New Jersey, Fairleigh Dickinson University and Stevens Institute of Technology (765-C12)

3:00- 3:10 (155) Convergence of block spins defined by a random field. Ms. CARLA C. NEADERHOUSER, Texas A&M University (765-C14)

3:15- 3:25 (156) Fast algorithms for singular matrices. Preliminary report. Mr. ERIC S. ROSENTHAL, Princeton University (765-C15)

3:30- 3:40 (157) Some economic parallels to equilibrium thermodynamics. Dr. HERBERT E. SALZER, Brooklyn, New York (765-C5)

3:45- 3:55 (158) Tomographic reconstruction with limited angles of view. Professor F. ALBERTO GRÜNBAUM, University of California, Berkeley (765-H3) (Introduced by Professor J. Feldman)

FRIDAY 2:00 P.M.

Session on Logic and Foundations, Suite S

2:00- 2:10 (159) Complexity of two model-theoretic predicates. Preliminary report. Dr. RUSSELL W. MYERS, Jr., Southampton College, New York (765-E1)

2:15- 2:25 (160) A topological proof for the inconsistency of ZFC. Dr. GERHARD F. KOHLMAYR, Mathmodel Consulting Bureau, Glastonbury, Connecticut (765-E2)

Raymond G. Ayoub
Associate Secretary

University Park, Pennsylvania

PRESENTERS OF PAPERS

Following each name is the number corresponding to the speaker's position on the program

• Invited one-hour lecturers * Special session speakers

Abeles, F. #78
Accola, R.D.M. #138
Alsina, C. #132
*Andersen, H. H. #61
Arkin, J. #12
*Ash, A. #99
Atalla, R. #126
Barrett, W. W. #8
Batra, H. S. #22
*Berglund, J. F. #80
Bojanic, R. #128
*Bramson, M. #53
*Byleen, K. #34
*Carruth, J. H. #83
Chidambaraswamy, J. #6
*Church, P. T. #150
*Clark, C. E. #82
Cohn, H. #3
Cooper, M. #145
Corduneanu, C. #23
*Crawley, W. #137
*DeSilva, C. N. #65
•Dudley, R. M. #111
•Dynkin, E. B. #112
Edrei, A. #106
*Eisenfeld, J. #31
*Ellis, R. S. #55
Erdelyi, I. #124
*Ethier, S. N. #113
Feinsilver, P. #75
*Ferry, S. C. #42
*Freyd, P. #40
*Frisch, U. #118
Fryant, A. J. #108
Gaglione, A. M. #2
Galambos, J. #73
*Gale, D. #50
*Geoghegan, R. #41
Giardina, C. R. #154
Gillet, H. A. #142
*Ginzburg, L. R. #30
*Graham, G. #79
*Gross, L. #56
*Gross, L. J. #32
Grünbaum, F. A. #158
•Gundy, R. #45
*Gurel, O. #62
Gustafson, R. F. #18
*Hallam, T. G. #33
Hartig, D. G. #19
•Hironaka, H. #46
Hoffman, J. #141
*Hofmann, K. H. #81
*Hollingsworth, J. #68
Jacobowitz, H. #105
Jain, R. K. #10
*Jardine, J. F. #71
*Junghenn, H. D. #84
Kafker, A. H. #14
*Kazarinoff, N. D. #64
Keigher, W. F. #5
•Kempf, G. #44
Kent, M. J. #144
Kim, J. B. #9
Kohlmayr, G. F. #160
Kramer, K. #140
*Krause, G. M. #136
*Lakshmikantham, V. #66
*Lang, W. E. #60
*Laufer, H. B. #102
*Lawler, G. F. #117
Layton, W. J. #25
Lepson, B. #127
*Lerner, B. T. #52
*Lewis, W. #147
*Lin, T. Y. #90
*Lomonaco, S. J., Jr. #69
*Luedeman, J. K. #51
*Magill, K. D. #38
Marcus, M. #7
*Margolis, S. W. #48
*Martin, J. #87
*McAuley, L. F. #86
*McCleary, J. #91
McCoy, P. A. #28
*McGibbon, C. A. #92
McOwen, R. C. #21
Meadows, D. S. #16
*Mihalik, M. #67
*Milnes, P. #135
*Miranda, R. #97
Morales, P. #120
*Mori, S. #58
Moulis, E. J., Jr. #104
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*Nashed, M. Z. #94
Neaderhouser, C. C. #155
*Neisendorfer, J. A. #93
*Newman, C. M. #54
*Nico, W. R. #36
Ogawa, H. #24
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*Papanicolaou, G. C. #57
*Pastijn, F. #35
*Persson, U. #98
Peters, J. V. #119
Prather, C. #110
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*Putcha, M. S. #37
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*Remage, R. #134
*Robinson, E. E. #148
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Roehrig, S. F. #129
*Rosen, R. #63
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Roxin, E. O. #153
Royster, D. C. #15
*Rushing, T. B. #43
Salzer, H. E. #157
Schmeelk, J. #125
Schneider, R. #107
Shantaram, R. #11
*Shatz, S. S. #100
Siddiqi, J. A. #131
Simoson, A. #123
*Starbird, M. #88
Stern, L. E. #152
Stiller, P. F. #143
*Straubing, H. #47
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*Taqqu, M. S. #114
Thrash, J. B. #151
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*Tuy, H. #96
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*Venema, G. A. #149
*Venkataraman, R. #133
*Wahl, J. M. #103
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Wenocur, R.D.S. #74
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*Wilson, D. C. #146
Wolfe, S. J. #72
*Wollkind, D. J. #95
*Woodruff, E. P. #85
Woyczynski, W. A. #76
*Yau, S.S.-T. #59
Yui, N. #139
*Zabell, S. #116
Zaidman, S. #121
*Zucker, S. #101

Iowa City, April 27–28, 1979, University of Iowa

Program for the 766th Meeting

The seven hundred sixty-sixth meeting of the American Mathematical Society will be held on Friday and Saturday, April 27-28, 1979 at the University of Iowa, Iowa City, Iowa. The sessions of the meeting will be held on the third floor of the Iowa Memorial Union, which will also be the hotel headquarters for the meeting.

By invitation of the Committee to Select Hour Speakers for Western Sectional Meetings, there will be four invited one-hour addresses. **Charles G. Conley** of the University of Wisconsin, Madison, will address the Society at 11:00 a.m. on Friday; his topic is "On the structure of the set of solutions of a differential equation." **Wolfgang R. G. Haken** of the University of Illinois, Urbana, will speak at 1:45 p.m. on Friday; the title of his talk is "On the homeomorphism problem of 3-manifolds." **Judith D. Sally** of Northwestern University will give an hour talk at 11:00 a.m. on Saturday on the subject "The Hilbert function of a local ring." **B. A. Taylor** of the University of Michigan, Ann Arbor, will speak at 1:45 p.m. on Saturday; his topic is "Algebras of entire functions. Some problems from harmonic analysis."

By invitation of the same committee, there will be seven special sessions of selected twenty-minute papers. **Daniel D. Anderson** of the University of Iowa has organized a special session on Commutative ring theory, to be held Friday; the speakers will be David F. Anderson, David E. Dobbs, Jonathan S. Golan, Sarah Glaz, Evan G. Houston, James A. Huckaba, Jacob R. Matijevic, and Ira J. Papick. **Kent R. Fuller** of the University of Iowa has organized a special session on Noncommutative ring theory, to be held Saturday; the speakers will be Goro Azumaya, John A. Beachy, Carl Faith, Joel K. Haack, Israel N. Herstein, Lawrence S. Levy, Richard D. Resco, and Robert B. Warfield, Jr. **William H. Jaco** of Institute for Advanced Study has organized a special session on Three-dimensional manifold theory, to be held both Friday and Saturday; the speakers will be Selman Y. Akbulut, Joan S. Birman, Benny D. Evans, Charles D. Fuestel, Deborah L. Goldsmith, Cameron McA. Gordon, John P. Hempel, Ronald J. Knill, S. J. Lomonaco, Jr., Herbert C. Lyon, Robert Myers, Frank A. Raymond, Peter B. Shalen, Jonathan K. Simon, Jeffery L. Tollefson, and Wilbur Whitten. **James D. Kuelbs** of the University of Wisconsin, Madison, and **Walter V. Philipp** of the University of Illinois, Urbana, have organized a special session on Probability on Banach spaces, to be held both Friday and Saturday; the speakers will be Alejandro de Acosta, M. B. Aleksandrowicz, A. Araujo, Alexandra Bellow, Chandrakant M. Deo, Evarist Giné, Marjorie G. Hahn, James D. Kuelbs, Hui-Hsiung Kuo, Vidyadhar S. Mandrekar, Michael B. Marcus, Gregory J. Morrow, Arnold L. Neidhardt, Walter V. Philipp, M. Ann Piech, Chi-Shang Soong, Louis Sucheston, J. Jerry Uhl, Jr., A. Weron, Wojbor A. Woyczynski, Sandy L. Zabell, and Joel Zinn. **Richard P. McGehee** of the University of Minnesota has organized a special session on Celestial mechanics, to be held Saturday; the speakers will be Edward A. Belbruno, Robert L. Devaney, Neal D. Hulkower, Martin P. Kummer, Ernesto A. Lacomba, James A. Murdock, Julian I. Palmore, Dieter S. Schmidt, Robert O. Shelton, and John B. Urenko. **Paul S. Muhly** of the University of Iowa has organized a special session on Operator theory, to be held Friday; the speakers will be Theagenis J. Abatzoglou, John W. Bunce, Lawrence A. Fialkow, Domingo A. Herrero, Alan Hopenwasser, Palle E. T. Jorgensen, David R. Larson, Richard I. Loebl, Jean N. Renault, Phillip M. Unell, and Warren R. Wogen. **John C. Polking** of Rice University has organized a special session on Several complex variables, to be held Saturday; the speakers will be Albert Boggess, Daniel M. Burns, Jr., John P. D'Angelo, Gregory A. Fredricks, Michael B. Freeman, Hugo Rossi, and David S. Tartakoff.

There will also be three sessions of contributed ten-minute papers.

REGISTRATION

The registration desk will be located on the third floor of the Iowa Memorial Union, and will be open from approximately 8:30 a.m. to 4:30 p.m. on Friday and from 8:00 a.m. to 3:00 p.m. on Saturday. The registration fee will be $5 for nonmembers, $3 for members, and $1 for students and unemployed mathematicians.

ACCOMMODATIONS

Sixty guest rooms will be available in the Iowa House, located in the western part of the Iowa Memorial Union. The present rates are $15.50 for single rooms and $20 for double rooms, plus a 3% tax. Requests for reservations should mention the AMS meeting and should be addressed to Center for Conferences and Institutes, Iowa Memorial Union, Iowa City, Iowa 52242; telephone (319) 353-5505.

Guest rooms will also be available at the Highlander Inn, Iowa City, Iowa 52240, on Interstate 80 at Iowa 1. The current rates are $21 for single rooms and $28 for double rooms, plus 3% tax.

FOOD SERVICE

The following eating establishments will be available in the Iowa Memorial Union: The River Room Cafeteria will be open from 7:00 a.m. to 7:00 p.m. on Friday and from 7:30 a.m. to 11:00 a.m. on Saturday. The Meal Mart snack bar will be open from 9:00 a.m. to 10:00 p.m. on Friday and from 11:00 a.m. to 10:00 p.m. on Saturday. The State Room provides table d'hôte dining on Friday from 11:30 a.m. to 1:15 p.m. Beer will be available in the Wheel Room of the Union.

PARKING

For those staying in Iowa House, free parking is available in the parking ramp east of the Union. Others attending the meeting may park there for a modest fee if space is available.

TRAVEL AND LOCAL INFORMATION

Iowa City is on Interstate 80 and is within 300 miles driving distance from such cities as Chicago, Kansas City, Milwaukee, Minneapolis, Omaha, and St. Louis. The University is near the center of Iowa City about three miles south of Exit 244 of Interstate 80. The Iowa Memorial Union is at the corner of Madison and Jefferson Streets, on the east bank of the Iowa River.

Although Iowa Airlines and Horizon Airways offer direct service to Iowa City from some Iowa cities (including Des Moines), Iowa City is not served directly by any major airline. Many of those attending the meeting will find it convenient to take either Ozark Air Lines or United Airlines to Cedar Rapids, 18 miles north of Iowa City, and take a limousine from there to Iowa City; limousine service is available after each flight.

Nearby points of interest, other than the University itself, include Plum Grove in Iowa City (the restored home of the first governor of the Iowa Territory), the Hoover Birthplace and Presidential Library (ten miles east of Iowa City in West Branch), and the Amana Colonies (twenty miles west of Iowa City).

PROGRAM OF THE SESSIONS

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

FRIDAY, 8:30 A.M.

Special Session on Operator Theory. I, Harvard Room

8:30- 8:50 (1) Smooth points and norm derivatives in c_p and B(H). Professor THEAGENIS ABATZOGLOU, Iowa State University (766-B7)

9:00- 9:20 (2) Derivations on a C*-algebra and its double dual. Professor JOHN W. BUNCE*, and Professor WILLIAM PASCHKE, University of Kansas (766-B5)

9:30- 9:50 (3) On the range of the operator $T(X) = AX - XB$. Preliminary report. Professor LAWRENCE FIALKOW, Western Michigan University (766-B10)

10:00-10:20 (4) Characterization of operators with local similarity cross sections. Preliminary report. Professor DOMINGO HERRERO, Instituto Venezolano de Investigaciones Cientificas, Venezuela (766-B12)

10:30-10:50 (5) The equation $Tx = y$ in a reflexive operator algebra. Professor ALAN HOPENWASSER, University of Alabama, University (766-B11)

FRIDAY, 8:30 A.M.

Special Session on Probability on Banach Spaces. I, Minnesota Room

8:30- 8:50 (6) Some recent results on the law of the iterated logarithm. Preliminary report. Professor J. KUELBS*, University of Wisconsin, Madison, and Professor J. ZINN, Michigan State University (766-F7)

9:00- 9:20 (7) The central limit theorem and the law of the iterated logarithm in Banach spaces. Professor J. KUELBS, University of Wisconsin, Madison, and Professor J. ZINN*, Michigan State University (766-F8)

9:30- 9:50 (8) Almost sure invariance principles for sums of B-valued random variables. Professor WALTER PHILIPP, University of Illinois, Urbana-Champaign (766-F2)

10:00-10:20 (9) Approximation of rectangular sums of B-valued random variables. Preliminary report. Mr. GREGORY J. MORROW, University of Illinois, Urbana-Champaign (766-F18)

10:30-10:50 (10) A strong convergence theorem for stationary Gaussian sequences in a Hilbert space. Professor C.M. DEO, University of Ottawa (766-F16) (Introduced by Professor Walter Philipp)

FRIDAY, 8:30 A.M.

Session on Algebra, Logic, Number Theory, and Geometry, Ohio State Room

8:30- 8:40 (11) Partial Henselizations. Dr. ROBERT W. SHEETS, Southeast Missouri State University (766-A19)

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

8:45- 8:55 (12) Baer rings and rings with a minimal direct summand containing the nilpotents. Dr. GARY F. BIRKENMEIER, Southeast Missouri State University (766-A5)

9:00- 9:10 (13) Finite length in torsion theories. Preliminary report. Ms. BARBARA ANN BENANDER, Kent State University (766-A17) (Introduced by Professor Kent R. Fuller)

9:15- 9:25 (14) On prime kernel functors. Preliminary report. Mr. ALAN BENANDER, Kent State University (766-A18) (Introduced by Professor Kent R. Fuller)

9:30- 9:40 (15) Polynomial rings and orders. Dr. POOBHALAN PILLAY, University of Durban-Westville, South Africa, and Rutgers University, New Brunswick (766-A23) (Introduced by Professor Carl Faith)

9:45- 9:55 (16) A characterization of rings which admit elimination of quantifiers. Preliminary report. Dr. BRUCE I. ROSE, University of Notre Dame (766-E1)

10:00-10:10 (17) Proof of a formula of Ramanujan concerning Bernoulli numbers. Preliminary report. Professor SAMUEL S. WAGSTAFF, Jr., Northern Illinois University (766-A14)

10:15-10:25 (18) Collineation groups acting irreducibly on lines of a translation plane. Professor M.J. KALLAHER* and Professor T.G. OSTROM, Washington State University (766-D1)

FRIDAY, 8:30 A.M.

Session on Topology, Northwestern Room

8:30- 8:40 (19) Spectral properties of the adjoint representation of a dynamical system. Preliminary report. Professor R.C. SWANSON, University of Missouri, Columbia (766-G4)

8:45- 8:55 (20) On orientable torus bundles over the circle which contain Klein bottles. Preliminary report. Professor PAIK K. KIM* and Professor DONALD SANDERSON, Iowa State University (766-G18)

FRIDAY, 9:00 A.M.

Special Session on Commutative Ring Theory. I, Illinois Room

9:00- 9:20 (21) Pierce sheaves and torsion-theoretic monopresheaves. Professor JONATHAN S. GOLAN, Indiana University, Bloomington (766-A2)

9:30- 9:50 (22) When coherent pairs are Noetherian pairs. Professor IRA J. PAPICK, University of Missouri, Columbia (766-A1)

10:00-10:20 (23) Annihilation of ideals in commutative rings. JAMES A. HUCKABA* and JAMES M. KELLER, University of Missouri, Columbia (766-A3)

10:30-10:50 (24) Valuations and semi-valuations of graded domains. Dr. DAVID F. ANDERSON*, University of Tennessee, Knoxville, and Dr. JACK OHM, Louisiana State University, Baton Rouge (766-A4)

FRIDAY, 9:00 A.M.

Special Session on Three-Dimensional Manifold Theory. I, Northwestern Room

9:00- 9:20 (25) Some observations on the Seifert conjecture. Preliminary report. Professor RONALD J. KNILL, Tulane University (766-G5)

9:30- 9:50 (26) On proper essential embeddings of planes in 3-manifolds. Professor E.M. BROWN, Dartmouth College, and Professor C.D. FEUSTEL*, Virginia Polytechnic Institute and State University (766-G14)

10:00-10:20 (27) Reducibility of Heegaard splittings. Preliminary report. Professor JOHN HEMPEL, Rice University (766-G12)

10:30-10:50 (28) On the classification of PL involutions of 3-manifolds. Professor JEFFREY L. TOLLEFSON, University of Connecticut, Storrs (766-G13)

FRIDAY, 11:00 A.M.

Invited Address, Illinois Room

(29) On the structure of the set of solutions of a differential equation. Professor CHARLES G. CONLEY, University of Wisconsin, Madison (766-B28)

FRIDAY, 1:45 P.M.

Invited Address, Illinois Room

(30) On the homeomorphism problem of 3-manifolds. Professor WOLFGANG R.G. HAKEN, University of Illinois, Urbana (766-G22)

FRIDAY, 3:00 P.M.

Special Session on Commutative Ring Theory. II, Illinois Room

3:00- 3:20 (31) Some remarks on *-operations. Preliminary report. Professor JOHN HEDSTROM and Professor EVAN HOUSTON*, University of North Carolina, Charlotte (766-A6)

3:30- 3:50 (32) Lying-over pairs of commutative rings. Preliminary report. Professor DAVID E. DOBBS, University of Tennessee, Knoxville (766-A7)

4:00- 4:20 (33) Matrix factorization and Towber rings. J.R. MATIJEVIC, University of Southern California (766-A20)

4:30- 4:50 (34) Uppers of 0 over coherent rings. Preliminary report. SARAH GLAZ*, Case Western Reserve University, and WOLMER V. VASCONCELOS, Rutgers University, New Brunswick (766-A8)

FRIDAY, 3:00 P.M.

Special Session on Operator Theory. II, Harvard Room

3:00- 3:20 (35) Discrete subgroups and invariant vector fields. Preliminary report. Professor PALLE E.T. JORGENSEN, Stanford University (766-B1)

3:30- 3:50 (36) Nest-subalgebras of von Neumann algebras. Professor FRANK GILFEATHER and Professor DAVID R. LARSON*, University of Nebraska, Lincoln (766-B23)

4:00- 4:20 (37) Group actions on C*-algebras. Professor RICHARD I. LOEBL, Wayne State University (766-B27)

4:30- 4:50 (38) On the structure of groupoid C*-algebras. Preliminary report. Dr. JEAN RENAULT, University of Iowa (766-B18)

5:00- 5:20 (39) Self-adjointness of an elliptic operator on a Riemannian manifold. Dr. PHILIP UNELL, Iowa State University (766-B3)

5:30- 5:50 (40) On direct sums of reflexive operators. Professor WARREN R. WOGEN, University of North Carolina, Chapel Hill (766-B16)

FRIDAY, 3:00 P.M.

Special Session on Three-Dimensional Manifold Theory. II, Northwestern Room

3:00- 3:20 (41) Some local aspects of the topology of real algebraic varieties. SELMAN AKBULUT, Rutgers University, New Brunswick (766-G19)

3:30- 3:50 (42) Incompressible surfaces in the boundary of a handlebody—an algorithm. Dean HERBERT C. LYON, Northland College (766-G2)

4:00- 4:20 (43) Automorphisms of Seifert manifolds. WALTER D. NEUMANN, University of Maryland, College Park, and FRANK RAYMOND*, University of Michigan, Ann Arbor (766-G16)

4:30- 4:50 (44) $PSL_2(\mathbf{C})$ and incompressible surfaces. Professor PETER B. SHALEN, Courant Institute of Mathematical Sciences, New York University (766-G15)

FRIDAY, 3:00 P.M.

Special Session on Probability on Banach Spaces. II, Minnesota Room

3:00- 3:20 (45) A characterization of almost sure convergence. Preliminary report. Professor ALEXANDRA BELLOW*, Northwestern University, and Professor ARYEH DVORETZKY, Hewbrew University (766-F19)

3:30- 3:50 (46) Essential convergence of L_1-bounded martingales does not imply the Vitali condition V. Miss ANNIE MILLET and Professor LOUIS SUCHESTON*, Ohio State University, Columbus (766-F1)

4:00- 4:20 (47) The continuum limit of the one-dimensional classical Heisenberg model. Preliminary report. Professor DAVID ISAACSON and Professor SANDY ZABELL*, Rutgers University, New Brunswick (766-F13)

4:30- 4:50 (48) Differentiability of measures associated with parabolic equations on infinite dimensional spaces. M. ANN PIECH, State University of New York, Buffalo (766-B14)

5:00- 5:20 (49) A central limit theorem for diffusions. Preliminary report. Dr. ARNOLD NEIDHARDT, Courant Institute of Mathematical Sciences, New York University (766-F17)

5:30- 5:50 (50) Some questions in probability on Banach space arising in economics. Professor A. ARAUJO, University of Chicago (766-F14) (Introduced by Professor James P. Kuelbs)

FRIDAY, 3:00 P.M.

Session on Classical Analysis, Ohio State Room

3:00- 3:10 (51) Stability and chaos in a discrete predator-prey model. Preliminary report. Professor WILLIAM O. RAY, Iowa State University and Professor STANLEY E. SELTZER*, Illinois State University (766-B31)

3:15- 3:25 (52) Central motions. Professor RONALD A. KNIGHT, Northeast Missouri State University (766-B26)

3:30- 3:40 (53) Noether's theorem and invariants of non-conservative differential systems of continuum mechanics. Professor VADIM KOMKOV, American Mathematical Society, Ann Arbor, Michigan (766-B8)

3:45- 3:55 (54) Indicators of products and surjective convolution maps of analytic functions. Preliminary report. Mr. MARK S. EPHRON, University of Michigan, Ann Arbor (766-B29)

SATURDAY, 8:00 A.M.

Special Session on Probability on Banach Spaces. III, Minnesota Room

8:00- 8:20 (55) Exchangeable sequences in Banach spaces. Dr. CHI-SHANG SOONG, Villanova University (766-F4)

8:30- 8:50 (56) The multidimensional central limit theorem for arrays normed by affine transformations and related asymptotic independence results. Professor MARJORIE G. HAHN*, Tufts University, and Professor MICHAEL J. KLASS, University of California, Berkeley (766-F3)

9:00- 9:20 (57) Weak convergence of the empirical characteristic function. Preliminary report. Professor MICHAEL MARCUS, Northwestern University (766-F20)

9:30- 9:50 (58) On sums of independent random variables with values in L_p $(2 \leq p < \infty)$. Dr. EVARIST GINE-M., Instituto Venezolano de Investigaciones Cientificas, Venezuela, and V. MANDREKAR* and Professor J. ZINN, Michigan State University (766-F11)

10:00-10:20 (59) Convergence of moments in the CLT in Banach spaces: applications. Dr. EVARIST GINE-M., Instituto Venezolano de Investigaciones Cientificas, Venezuela (766-F6)

10:30-10:50 (60) Integrability and uniform integrability of triangular arrays in Banach spaces. Professor ALEJANDRO de ACOSTA, Instituto Venezolano de Investigaciones Cientificas, Venezuela (766-F12) (Introduced by Professor James P. Kuelbs)

SATURDAY, 8:00 A.M.

Special Session on Celestial Mechanics. I, Ohio State Room

8:00- 8:20 (61) On the construction of the reduced phase space of a Hamiltonian System with Abelian symmetry group. Preliminary report. MARTIN KUMMER, University of Toledo (766-C4)

8:30- 8:50 (62) A mathematical approach to spin/orbit resonance. JAMES MURDOCK, Iowa State University (766-B20)

9:00- 9:20 (63) A canonical regularization of the three-dimensional restricted three-body problem and a class of periodic collision orbits. Preliminary report. Mr. EDWARD A. BELBRUNO, Courant Institute of Mathematical Sciences, New York University (766-B21)

9:30- 9:50 (64) Classifying homographic solutions of the n-body problem in E^4. Professor JULIAN I. PALMORE, University of Illinois, Urbana (766-G7)

10:00-10:20 (65) New notion of bifurcation sets in transitive mechanical systems. Preliminary report. Professor ERNESTO A. LACOMBA, Universidad Autonoma Metropolitana, Mexico (766-G8)

10:30-10:50 (66) Morse-Smale singularities in simple mechanical systems. ROBERT L. DEVANEY, Tufts University (766-G9)

SATURDAY, 8:00 A.M.

Session on Functional Analysis, Harvard Room

8:00- 8:10 (67) Asymptotic normal structure and fixed points of nonexpansive mappings. Professor RAINALD SCHÖNEBERG, University of Iowa (766-B2)

8:15- 8:25 (68) The fixed point property and unbounded sets in Hilbert space. Dr. WILLIAM O. RAY, Iowa State University (766-B6)

8:30- 8:40 (69) On asymptotic centers and fixed point theorems in conjugate Banach spaces. T.C. LIM, University of Chicago (766-B25)

SATURDAY, 8:30 A.M.

Special Session on Three-Dimensional Manifold Theory, III, Northwestern Room

8:30- 8:50 (70) Knot theory and three manifolds. Preliminary report. Professor DEBORAH GOLDSMITH, University of Michigan, Ann Arbor (766-G20)

9:00- 9:20 (71) Knots in the boundaries of contractible 4-manifolds. Professor C. McA. GORDON, University of California, Berkeley (766-G21)

9:30- 9:50 (72) A certain cell decomposition for 2-knot complements. Professor S.J. LOMONACO, Jr., State University of New York, Albany (766-G6)

10:00-10:20 (73) Wirtinger presentations and knot groups. Professor JONATHAN SIMON, University of Iowa (766-G10)

10:30-10:50 (74) Inverting double knots. Professor WILBUR WHITTEN, University of Southwestern Louisiana (766-G1)

SATURDAY 9:00 A.M.

Special Session on Noncommutative Ring Theory, I, Illinois Room

9:00- 9:20 (75) Exact rings. Preliminary report. Professor GORO AZUMAYA, Indiana University, Bloomington (766-A21)

9:30- 9:50 (76) Essentially Artinian modules. Preliminary report. Professor JOHN A. BEACHY, Northern Illinois University (766-A15)

10:00-10:20 (77) Injective quotient rings of commutative rings II. CARL FAITH, Rutgers University, New Brunswick (766-A10)

10:30-10:50 (78) On rings with self-duality. JOEL K. HAACK, University of Iowa (766-A22)

SATURDAY, 9:00 A.M.

Special Session on Several Complex Variables, I, Harvard Room

9:00- 9:20 (79) Kernels for the tangential Cauchy-Riemann equations in codimensions one and two. Preliminary report. Mr. AL BOGGESS, Rice University (766-B17) (Introduced by Professor John Polking)

9:30- 9:50 (80) Curvatures of foliations and Monge-Ampère equations. Preliminary report. Mr. DANIEL M. BURNS, Jr., University of Michigan, Ann Arbor (766-B30)

10:00-10:20 (81) Order of contact of real and complex varieties. Professor JOHN P. D'ANGELO, University of Illinois, Urbana (766-B9)

10:30-10:50 (82) Complexifications of C-R manifolds. Preliminary report. Dr. GREGORY A. FREDERICKS, Texas Tech University (766-B19)

SATURDAY, 11:00 A.M.

Invited Address, Illinois Room

(83) The Hilbert function of a local ring. Professor JUDITH D. SALLY, Northwestern University (766-A13)

SATURDAY, 1:45 P.M.

Invited Address, Illinois Room

(84) Algebras of entire functions. Some problems from harmonic analysis. Professor B.A. TAYLOR, University of Michigan, Ann Arbor (766-B4)

SATURDAY, 3:00 P.M.

Special Session on Noncommutative Ring Theory, II, Illinois Room

3:00- 3:20 (85) Center-like elements in prime rings. I.N. HERSTEIN, University of Chicago (766-A9)

3:30- 3:50 (86) Modules over pullbacks and subdirect sums. Professor LAWRENCE S. LEVY, University of Wisconsin, Madison (766-A12)

4:00- 4:20 (87) Primitive polynomial rings. Preliminary report. Dr. RICHARD RESCO, University of Southern California (766-A11)

4:30- 4:50 (88) The spectrum of a fully bounded Noetherian ring. Preliminary report. Professor ROBERT B. WARFIELD, University of Washington (766-A16)

SATURDAY, 3:00 P.M.

Special Session on Several Complex Variables, II, Harvard Room

3:00- 3:20 (89) Fully integrable Pfaffian systems. Preliminary report. Professor MICHAEL FREEMAN, University of Kentucky (766-B24)

3:30- 3:50 (90) Certain Sp(n,R)-homogeneous domains. Professor HUGO ROSSI, University of Utah (766-B13)

4:00- 4:20 (91) Analytic regularity of solutions to $\Box_b$ and the $\overline{\partial}$-Neumann problem near isolated degeneracies of the Levi form. Professor DAVID S. TARTAKOFF, University of Illinois, Chicago Circle (766-B22)

SATURDAY, 3:00 P.M.

Special Session on Three-Dimensional Manifold Theory, IV, Northwestern Room

3:00- 3:20 (92) Homeotopy groups of certain lens spaces. Professor JOAN S. BIRMAN*, Columbia University, and Professor J.H. RUBINSTEIN, University of Melbourne, Australia (766-G11)

3:30- 3:50 (93) Involutions on standard orbits of the three sphere. Preliminary report. BENNY D. EVANS, Oklahoma State University, Stillwater (766-G17)

4:00- 4:20 (94) Homology 3-spheres which admit no PL involutions. ROBERT MYERS, University of Texas, Austin (766-G3)

SATURDAY, 3:00 P.M.

Special Session on Probability on Banach Spaces, IV, Minnesota Room

3:00- 3:20 (95) Basically scattered vector measures. Professors N.J. KALTON, BARRY TURETT, and J.J. UHL, Jr.*, University of Illinois, Urbana (766-B15)

3:30- 3:50 (96) An example of quasi-invariant cylindrical measure. Professor HUI-HSIUNG KUO, Louisiana State University, Baton Rouge (766-F5)

4:00- 4:20 (97) Laws of large numbers and Beck convexity in metric linear spaces. Preliminary report. Professor K. SUNDARESAN and Professor W.A. WOYCZYINSKI*, Cleveland State University (766-F15)

4:30- 4:50 (98) Gaussian cylindrical processes in Banach spaces. Professor A. WERON, Southern Illinois University, Carbondale, and Wrocław Technical University Poland (766-F10) (Introduced by Professor James P. Kuelbs)

5:00- 5:20 (99) On some Banach spaces related to stable measures. Preliminary report. Mrs. M.B. ALEKSANDROWICZ* and Professor A. WERON, Southern Illinois University, Carbondale and Wrocław Technical University, Poland (766-F9)

SATURDAY, 3:00 P.M.

Special Session on Celestial Mechanics, II, Ohio State Room

3:00- 3:20 (100) Noncollision singularities in the four-body problem. Professor ROBERT O. SHELTON, University of Tennessee, Knoxville (766-C1) (Introduced by Professor Richard P. McGehee)

3:30- 3:50 (101) Improbability of collisions in Newtonian gravitational systems of specified angular momentum. Dr. JOHN B. URENKO, Pennsylvania State University, Schuylkill (766-C2)

4:00- 4:20 (102) Toward a proof of a conjecture of Wintner. Preliminary report. Dr. NEAL D. HULKOWER*, Jet Propulsion Laboratory, Pasadena, and Professor DONALD G. SAARI, Northwestern University (766-C3)

4:30- 4:50 (103) The lunar theory of Hill and Brown. Preliminary report. DIETER SCHMIDT, University of Cincinnati (766 -C5)

Urbana, Illinois

Paul T. Bateman
Associate Secretary

PRESENTERS OF PAPERS

Following each name is the number corresponding to the speaker's position on the program

• Invited one-hour lecturers * Special session speakers

*Abatzoglou, T. #1
*Akbulut, S. #41
*Aleksandrowicz, M. B. #99
*Anderson, D. F. #24
*Araujo, A. #50
*Azumaya, G. #75
*Beachy, J. A. #76
*Belbruno, E. A. #63
*Bellow, A. #45
Benander, A. #14
Benander, B. A. #13
Birkenmeier, G. F. #12
*Birman, J. S. #92
*Boggess, A. #79
*Bunce, J. W. #2
*Burns, D. M. #80
•Conley, C. G. #29
*D'Angelo, J. P. #81
*de Acosta, A. #60
*Deo, C. M. #10
*Devaney, R. L. #66
*Dobbs, D. E. #32
Ephron, M. S. #54
*Evans, B. D. #93
*Faith, C. #77
*Feustel, C. D. #26
*Fialkow, L. #3
*Fredricks, G. A. #82
*Freeman, M. #89
*Gine-M., E. #59
*Glaz, S. #34
*Golan, J. S. #21
*Goldsmith, D. #70
*Gordon, C. M. #71
*Haack, J. K. #78
*Hahn, M. G. #56
•Haken, W. R. G. #30
*Hempel, J. #27
*Herrero, D. #4
*Herstein, I. N. #85
*Hopenwasser, A. #5
*Houston, E. #31
*Huckaba, J. A. #23
*Hulkower, N. D. #102
*Jorgensen, P. E. T. #35
Kallaher, M. J. #18
Kim, P. K. #20
Knight, R. A. #52
*Knill, R. J. #25
Komkov, V. #53
*Kuelbs, J. #6
*Kummer, M. #61
*Kuo, H.-H. #96
*Lacomba, E. A. #65
*Larson, D. R. #36
*Levy, L. S. #86
Lim, T. C. #69
*Loebl, R. I. #37
*Lomonaco, S. J., Jr. #72
*Lyon, H. C. #42
*Mandrekar, V. #58
*Marcus, M. #57
*Matijevic, J. R. #33
*Morrow, G. J. #9
*Murdock, J. #62
*Myers, R. #94
*Neidhardt, A. #49
*Palmore, J. I. #64
*Papick, I. J. #22
*Philipp, W. #8
*Piech, M. A. #48
Pillay, P. #15
Ray, W. O. #68
*Raymond, F. #43
*Renault, J. #38
*Resco, R. #87
Rose, B. I. #16
*Rossi, H. #90
•Sally, J. D. #83
*Schmidt, D. #103
Schöneberg, R. #67
Seltzer, S. E. #51
*Shalen, P. B. #44
Sheets, R. W. #11
*Shelton, R. O. #100
*Simon, J. #73
*Soong, C.-S. #55
*Sucheston, L. #46
Swanson, R. C. #19
*Tartakoff, D. S. #91
•Taylor, B. A. #84
*Tollefson, J. L. #28
*Uhl, J. J., Jr. #95
*Unell, P. #39
*Urenko, J. B. #101
Wagstaff, S. S., Jr. #17
*Warfield, R. B. #88
*Weron, A. #98
*Whitten, W. #74
*Wogen, W. R. #40
*Woyczynski, W. A. #97
*Zabell, S. #47
*Zinn, J. #7

Vancouver, June 15–16, 1979, University of British Columbia

Second Announcement of the 767th Meeting

The seven hundred sixty-seventh meeting of the American Mathematical Society will be held at the University of British Columbia in Vancouver, Canada, on Friday and Saturday, June 15 and 16, 1979. The meeting will be held in conjunction with sectional meetings of the Mathematical Association of America (MAA) and the Society for Industrial and Applied Mathematics (SIAM).

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited one-hour addresses. **Theodore T. Frankel** of the University of California, San Diego, will lecture on "Some geometrical aspects of general relativity" at 1:30 p.m. on Saturday. **Oscar E. Lanford III** of the University of California, Berkeley, will speak at 11:00 a.m. on Saturday; the title of his talk is "One-dimensional transformations." Both lectures will be in Room 110 of the Henry Angus Building.

By invitation of the same committee, there will be three special sessions. The titles of the sessions and the names of the organizers are: Probability, **Priscilla E. Greenwood**; Representations and ring theory, **Stanley S. Page**; Mathematical physics, **Lon M. Rosen**. All of the organizers are at the University of British Columbia. Persons submitting abstracts for the meeting who feel their paper is suitable for one of these special sessions should indicate this clearly on the abstract, and mail it so as to reach the office of the American Mathematical Society in Providence by April 3, 1979.

There will also be sessions of contributed ten-minute papers. Abstracts should be sent to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940, so as to arrive by the deadline of April 24, 1979. Late papers will be accepted for presentation at the meeting but will not be listed in the printed program.

At a dinner on Friday evening, the guest speaker will be Constance Reid, author of Hilbert (Springer-Verlag, 1970) and Courant in Göttingen and New York (Springer-Verlag, 1976). Her talk, jointly sponsored by the AMS and MAA, will be of interest to nonmathematicians as well as mathematicians, and is titled "The answer to the question everyone asks." Dinner will be served in the Graduate Student Center on the university campus; the time and price of the dinner will be announced in the June issue of the NOTICES. Reservations may be necessary, and persons interested in attending the dinner should correspond directly with A. H. Cayford, Department of Mathematics, University of British Columbia, Vancouver, British Columbia (V6T 1W5), Canada.

The MAA program will include the following partial list of invited speakers: **Z. A. Melzak, H. J. Reed,** and **Kenneth J. Tiahrt.** The Open University of Britain has been invited to make a presentation on the teaching of calculus.

REGISTRATION

The registration area for the meeting will be on the main floor of the Henry Angus Building, in the lounge opposite lecture rooms 104 and 110. (The Henry Angus Building is a modern building on the main mall adjacent to the campus bookstore.) The registration desk will be open on Friday from 8:00 a.m. to noon and from 1:00 p.m. to 4:30 p.m., and on Saturday from 8:30 a.m. to noon and from 1:00 p.m. to 3:30 p.m. Registration fees will be $3 for members of AMS, MAA, or SIAM; $5 for nonmembers; and $1 for students and unemployed persons.

ACCOMMODATIONS

Both on-campus and off-campus accommodations are available. In all cases, the rates are given in Canadian dollars (worth about U.S. $0.84 in February) and are subject to 5 percent provincial hotel tax.

On-campus housing is available in the Walter Gage Residence. This facility offers primarily single accommodations, where six single bedrooms share a common washroom and lounge area. There are four apartments of this type on each floor of the three 17-story towers. For participants preferring twin accommodations, there are a limited number of suites consisting of a bedroom with two twin beds, a lounge with refrigerator and balcony, and a private washroom. The rate structure is: adult in single, $12; couple in adjacent single rooms, $21; children under 12, $6; International Student Card holder, $8.50; suite (single), $24; suite (double), $31. Participants should make room reservations by writing to UBC Conference Centre, University of British Columbia, Vancouver, B.C. (V6T 1W5), Canada. Deposits are not accepted; however, payment is requested upon check-in. Personal checks are accepted, but credit cards will not be honored. Canadian currency is requested, although the 24-hour reception desk service is prepared to make currency exchange. Participants are advised to use one of the two banks on campus to obtain the current exchange rate (Bank of Montreal and Canadian Imperial Bank of Commerce). Meals will be served on an individual cash basis in the Student Union Building directly across the street from the residence. There are also a few restaurants in the nearby shopping village, about a five minute walk away. Complimentary parking is available for registered guests; no permit is required.

There are no hotels within walking distance of the campus. The following may be reached from campus in approximately 20 minutes by car or 40 minutes by bus. Reservations should be made directly with the hotel or motel.

BAYSHORE INN
1601 W. Georgia Street
Telephone: (604) 682-3377

Single	$51 - $57
Deluxe single	55 - 61
Double	63 - 71
Deluxe double	67 - 73

BURRARD MOTOR INN
1100 Burrard Street
Telephone: (604) 681-2331

Single	$22
Double	25

CENTENNIAL LODGE APARTMENT MOTEL
1111 Burnaby Street
Telephone: (604) 684-8763

Single or double*	$24

(*Each apartment has an additional hide-a-bed and can accommodate an extra roll-away bed at an extra charge of $4 per person.)

HYATT REGENCY
655 Burrard Street
Telephone: (604) 687-6543

Single	$44 - $66
Double	56 - 78

SYLVIA HOTEL
1154 Gilford Street
Telephone: (604) 681-9321

Single	$24
Single with kitchenette	25
Double	27
Double with kitchenette	28

HOTEL VANCOUVER
900 W. Georgia Street
Telephone: (604) 684-3131

Single	$41 - $53
Double	53 - 65

TRAVEL

Vancouver is served by several major airlines. Taxi service from the airport to campus costs approximately $12. Travelers with a small amount of luggage may take the Airport Limo Service ($3 per person) to 41st Avenue and Granville and then take the 41st bus to the campus (50¢ per person in exact change).

Bus service from downtown runs every 15 minutes and takes about 40 minutes. Bus #10 (10th & UBC) goes directly to the campus; bus #14 (Hastings) returns with the same frequency to downtown.

Persons arriving in Vancouver by car via Highway 99 from the United States border should proceed over the Oak Street Bridge, continue down Oak Street and turn left at 49th Avenue; 49th Avenue merges with S.W. Marine Drive, which continues to the campus. Persons arriving in Vancouver via the Trans-Canada Highway should take the Grandview exit onto 12th Avenue, which eventually merges with 10th Avenue and leads directly to the campus.

Budget Rent-a-Car (8665 Barnard Street, telephone (604) 263-2431) will offer $1 off the regular daily rate to all participants of the mathematics meeting. Their current daily rate is $16.95, although this is subject to change prior to June 1. They have a service desk at the airport and reservations are recommended.

Kenneth A. Ross
Associate Secretary

Eugene, Oregon

Duluth, August 22–25, 1979, University of Minnesota

First Announcement of the 83rd Summer Meeting

The eighty-third summer meeting of the American Mathematical Society will be held at the University of Minnesota, Duluth, Minnesota from Wednesday, August 22, through Saturday, August 25. All sessions will take place on the campus of the university.

Participants who smoke should be aware that Minnesota has an Indoor Clean Air Act which states, essentially, that indoor smoking in public places is prohibited unless specifically posted "smoking permitted." This has been enforced, occasionally to the embarrassment of the smoker.

A set of Colloquium Lectures, consisting of four one-hour talks, will be presented by **George D. Mostow** of Yale University. The title of the series will be announced later. The first lecture will be given at 1:00 p.m. on Wednesday; the second at 8:30 a.m. on Thursday; the third at 8:30 a.m. on Friday; and the fourth at 8:30 a.m. on Saturday.

The 1979 Leroy P. Steele Prizes will be awarded at a session at 2:30 p.m. on Friday, August 24.

By invitation of the Society's Program Committee, there will be eight invited one-hour addresses. A partial list of speakers and titles is as follows: **Alan Hatcher**, Princeton University; **James I. Lepowsky**, Rutgers University, New Brunswick; **I. I. Piatetski-Shapiro**, Yale University, "Zeta-functions and representations"; **Herbert E. Scarf**, Yale University; **Jacques Tits**, Collège de France; **Eugene Trubowitz**, Massachusetts Institute of Technology; and **W. Stephen Wilson**, Institute for Advanced Study.

There will be eleven special sessions of selected twenty-minute papers. The titles of these special sessions and the names of the mathematicians arranging them are as follows: **Harold E. Benzinger**, University of Illinois, Urbana, Differential operators and diffusion processes; **Eugene B. Fabes**, University of Minnesota, Minneapolis, Singular integrals and harmonic analysis; **Paul O. Frederickson**, University of Maryland, College Park, and Lakehead University, Computational fluid dynamics; **David S. Griffeath**, University of Wisconsin, Madison, Percolation and interacting systems; **Julian I. Palmore**, University of Illinois, Urbana-Champaign, Topological methods in the study of dynamical systems; **John G. Ratcliffe**, Massachusetts Institute of Technology and University of Wisconsin, Madison, Homological and combinatorial methods in group theory; **J. Ian Richards**, University of Minnesota, Minneapolis, Analytic number theory; **Seymour Schuster**, Carleton College, Graph theory; **Joel H. Shapiro**, Michigan State University, Functional analysis in spaces of analytic functions; **Steven I. Sperber**, Institute for Advanced Study and University of Minnesota, Minneapolis, p-adic analysis in number theory and geometry; and **Franklin D. Tall**, University of Toronto, Applications of set theory to topology.

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 22, 1979, three weeks earlier than the normal deadline for contributed papers, in order that it may be considered for inclusion.

There will be sessions for contributed ten-minute papers on Wednesday afternoon, Thursday morning, Friday morning, Friday afternoon, Saturday morning, and Saturday 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 the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940, so as to arrive by the abstract deadline of June 12, 1979.

Members are reminded that a charge of $7 is imposed for retyping abstracts that are not in camera-ready form.

The Society's Committee on Employment and Educational Policy (CEEP) will sponsor a panel discussion at 7:30 p.m. on Tuesday, August 21, arranged by Alan C. Tucker, SUNY, Stony Brook. Lida K. Barrett of the University of Tennessee, Knoxville, and Peter J. Hilton of the Battelle Memorial Institute, Seattle, will be members of the panel. The title of the discussion is "Trends in curriculum and employment in the mathematical sciences."

COUNCIL AND BUSINESS MEETING

The Council of the Society will meet at 5:00 p.m. on Wednesday, August 22, in the Ballroom of Kirby Student Center. The Business Meeting of the Society will be held in the Marshall Performing Arts Center at 4:00 p.m. on Thursday, August 23. 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, refer to the box on page 168.

OTHER ORGANIZATIONS

The Mathematical Association of America (MAA) will hold its summer meeting on August 21-23, Tuesday-Thursday, in conjunction with this meeting of the Society. The Business Meeting of the Association will take place at 10:00 a.m. on Wednesday, August 22, at which the Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards will be presented. A more detailed listing of the program of the Association appears in the Summary of Activities, beginning on page 175.

Pi Mu Epsilon (ΠΜΕ) will hold its summer meeting on Wednesday and Thursday, August

American Mathematical Society Short Course Series

Operations Research: Mathematics and Models

August 19–20, 1979

The American Mathematical Society will present a one and one-half day short course entitled "Operations Research: Mathematics and Models," on Sunday and Monday, August 19 and 20, 1979, in Bohannan Hall 90 on the University of Minnesota, Duluth campus.

Operations Research can be defined as the application of scientific methods to decision problems. Various fields of the mathematical sciences have contributed to the successful resolution of a diverse set of decision problems. This short course will emphasize specific application areas and the mathematics used in modeling and solving the related problems.

The program is under the direction of Saul I. Gass, Chairman of the Faculty in Management Science and Statistics, College of Business and Management, University of Maryland, College Park, and Ralph Disney, Department of Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University. The short course was recommended by the Society's Committee on Employment and Educational Policy, whose members are Lida K. Barrett (chairman), Alan J. Goldman, Arthur P. Mattuck, Donald C. Rung, Robert J. Thompson, and William P. Ziemer. The short course series is under the direction of the CEEP Short Course Subcommittee, whose members are Alan J. Goldman (chairman), Ronald L. Graham, Cathleen S. Morawetz, and Barbara L. Osofsky.

The program will consist of six seventy-five minute lectures. Each lecture will be self-contained and be devoted to a different area of application: health care delivery systems (William Pierskalla, University of Pennsylvania); fire department allocation and deployment (Warren E. Walker, The Rand Corporation); queueing networks (Ralph L. Disney, Virginia Polytechnic Institute and State University); fishery management (Frederick C. Johnson, National Bureau of Standards); military (Seth Bonder, Vector Research and University of Michigan, Ann Arbor); and agriculture (Robert B. Rovinsky, U.S. Department of Agriculture).

Abstracts for the talks and accompanying reading lists are printed in this issue of the NOTICES, beginning on page A-362. A basic knowledge of undergraduate mathematics will be presumed. Persons unfamiliar with the concepts of mathematical modeling and/or operations research can get the most benefit by consulting the following references: "Mathematicians in the practice of operations research," G. Raisbeck, American Mathematical Monthly 83(1976), 681-701; "Mathematicians in Operations Research Consulting," D. H. Wagner, American Mathematical Monthly 82(1975), 895-905; Chapter 5 of Patterns of Problem Solving, M. Rubinstein, Prentice-Hall, 1975; Chapter 3 of Modeling of Complex Systems, V. Vemuri, Academic Press, 1978; the texts An Introduction to Mathematical Modeling, E. A. Bender, Wiley, 1978; Principles of Operations Research, H. M. Wagner, Prentice-Hall, 1975; Operations Research: An Introduction, H. A. Taha, Macmillan, 1971; Introduction to Operations Research, F. S. Hillier and G. J. Lieberman, Holden-Day, 1974; and Operations Research, D. T. Phillips, A. Ravindran and J. J. Solberg, Wiley, 1976.

The short course is open to all who wish to participate upon payment of the registration fee. There are reduced fees for students and unemployed individuals. Please refer to the section entitled MEETING PREREGISTRATION AND REGISTRATION for details.

22-23. The J. Sutherland Frame Lecture will be given by H. Jerome Keisler of the University of Wisconsin, Madison, at 8:30 p.m. on Wednesday. Professor Keisler's title is "Infinitesimals: Where they come from and what they can do."

The Association for Women in Mathematics (AWM) will sponsor a panel discussion at 4:00 p.m. on Thursday, August 23, on the topic "Mathematics education: A feminist perspective." Judith Roitman will moderate. An open meeting of the AWM Council will take place at 5:00 p.m. on Wednesday, August 22, and an invited address will be given at 1:00 p.m. on Friday, August 24; the name of the speaker and title of the talk will be announced in a later issue of the NOTICES.

The Mathematicians Action Group (MAG) will sponsor a panel discussion at 7:00 p.m. on Friday, August 24, and an open meeting of its Steering Committee will take place at 9:00 a.m. on Wednesday, August 22.

MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

The summer Employment Register at the Duluth meeting will operate on an informal basis. No interviews will be scheduled by the staff; instead, facilities will be provided for posting both applicant and employer résumés. The Employment Register staff will provide a message desk for individuals to leave messages for one another, requesting interviews. Actual arrangements for interviews will be the responsibility of the employer and applicant. A room will be set aside for the interviews.

Applicants should recognize that the purpose of the Register is solely to provide an opportunity for an initial contact between applicant and employer, but that no guarantee can be made that any employers will, in fact, attend the meetings or participate in the Employment Register.

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 Barbara L. Osofsky, David A. Sanchez, Michael Taylor, and Guido L. Weiss, with the secretary as chairman.

In order that a motion for the Business Meeting of August 23, 1979, receive the service to be offered by the committee in the most effective manner, it should be in the hands of the secretary by July 25, 1979.

Everett Pitcher, Secretary

At the suggestion of the AMS-MAA-SIAM Committee on Employment Opportunities, employers listing in the July and August issues of Employment Information in the Mathematical Sciences will be asked to signify in their listings their intention to participate in the Employment Register at the summer meeting. A mailing requesting this information will be sent in May.

Applicants who plan to participate in the summer Employment Register are urged to complete the special applicant form included in this issue on page A-362 and send it to Providence, together with the meeting preregistration form provided on page A-363. Please be sure to fill in the coded summary strip at the bottom of the applicant form. (See the news item "Summer Employment Register and 1979 Summer List of Applicants" on page 187). Applicants are not required to participate in the summer Employment Register or attend the summer meeting in order to have their names appear on the list. There is, however, no provision for posting of résumés for participants not attending the meeting.

Those who plan to participate in the summer Employment Register are required to register or preregister for the meeting. The deadline for preregistration for the meeting and Employment Register is July 27. Further information will appear in the June NOTICES and in the May issue of the publication Employment Information in the Mathematical Sciences.

EXHIBITS AND BOOK SALE

The book and educational media exhibits will be displayed in the Tweed Museum of Art (25 on the campus map on page 170) at the following times: Tuesday, August 21, 1:00 p.m. to 5:00 p.m.; Wednesday and Thursday, August 22-23, 8:30 a.m. to 4:30 p.m. All participants are encouraged to visit the exhibits sometime during the meeting.

Books published by the Society will be sold at prices somewhat below the usual mail order prices. The book sale will also be located in the Tweed Museum, and will be open at the following times: Tuesday, August 21, 8:00 a.m. to 4:30 p.m.; Wednesday and Thursday, August 22-23, 8:30 a.m. to 4:30 p.m.

MEETING PREREGISTRATION AND REGISTRATION

Participants who wish to preregister for the meetings should complete the preregistration form on page A-363 of this issue of the NOTICES. The deadline for receipt of preregistrations in Providence is July 27. Those who preregister will pay lower registration fees than those who register at the meeting, as indicated in the following schedule. Preregistrants will be able to pick up their badges and programs when they arrive at the meeting. Complete instructions on making hotel or residence hall reservations are given in the sections titled RESIDENCE HALL HOUSING and HOTEL ACCOMMODATIONS.

Meeting preregistration and registration fees partially cover expenses of holding the meetings. The preregistration fee does not represent an advance deposit for lodgings.

Please note that separate fees are required for the Short Course and the Joint Mathematics Meetings. These fees are as follows:

AMS Short Course
Operations Research: Mathematics and Models

	Preregistration	At Meeting
Student/Unemployed	$ 3	$ 5
All other Participants	18	20

Joint Mathematics Meetings

	Preregistration	At Meeting
Members of AMS, MAA, and IIME	$23	$25
Nonmembers	33	35
Student/Unemployed	2	3

Please also note that, commencing with this meeting, a $2 charge will be imposed for all invoices prepared when preregistration/housing forms are submitted without an accompanying check for the preregistration fee(s), or are accompanied by an amount insufficient to cover the total fee(s).

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

Students are considered to be only those currently working toward a degree, who do not receive compensation totaling more than $7,000 from employment, fellowships, and scholarships.

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 or retired from their latest position.

A fifty percent refund of the preregistration fee(s) will be made for all cancellations received in Providence no later than August 17. No refunds will be granted for cancellations received after that date, or to persons who do not attend the meetings.

Registration for the Short Course ONLY will begin on Sunday, August 19, at 11:00 a.m., outside Room 90 of Bohannan Hall (18 on the campus map). Participants who are not attending the Short Course are advised that no general meeting information or registration material will be available prior to the time listed below for the Joint Mathematics Meetings registration. The registration desk for the Joint Mathematics Meetings will be located in the Tweed Museum of Art. The desks will be open during the hours listed below:

AMS Short Course
Operations Research: Mathematics and Models

Outside Room 90, Bohannan Hall

Sunday, August 19	11:00 a.m. - 3:30 p.m.
Monday, August 20	8:00 a.m. - 2:00 p.m.

Joint Mathematics Meetings

Tweed Museum of Art

Monday, August 20	2:00 p.m. - 8:00 p.m.
Tuesday, August 21	8:00 a.m. - 4:30 p.m.
Wednesday, August 22 Thursday, August 23 Friday, August 24	8:30 a.m. - 4:30 p.m.
Saturday, August 25	8:30 a.m. - 1:30 p.m.

RESIDENCE HALL HOUSING

The University of Minnesota-Duluth is proud of its essentially barrier-free environment, and will assist with arrangements for those with special needs. Participants desiring assistance should accompany their preregistration/housing form with a short description of their particular situation.

Participants desiring confirmed reservations for on-campus housing must preregister prior to July 27. Rooms may be available for those who do not preregister, but this cannot be guaranteed. Early registration is particularly recommended for the apartment units described below, since the supply might not meet the demand. Advance payment for housing is not required; however, full payment for accommodations must be made at check-in time. Cash, personal checks, or travelers' checks will be accepted; credit cards will not be honored.

Please use the preregistration and residence hall housing request form provided on page A-363 of this issue of the NOTICES, and return it so as to arrive no later than July 27 to the Mathematics Meetings Housing Bureau, P.O. Box 6887, Providence, Rhode Island 02940, giving as complete information as possible in order that your residence hall assignment can be made correctly.

There will be two types of accommodations available for participants and their families:

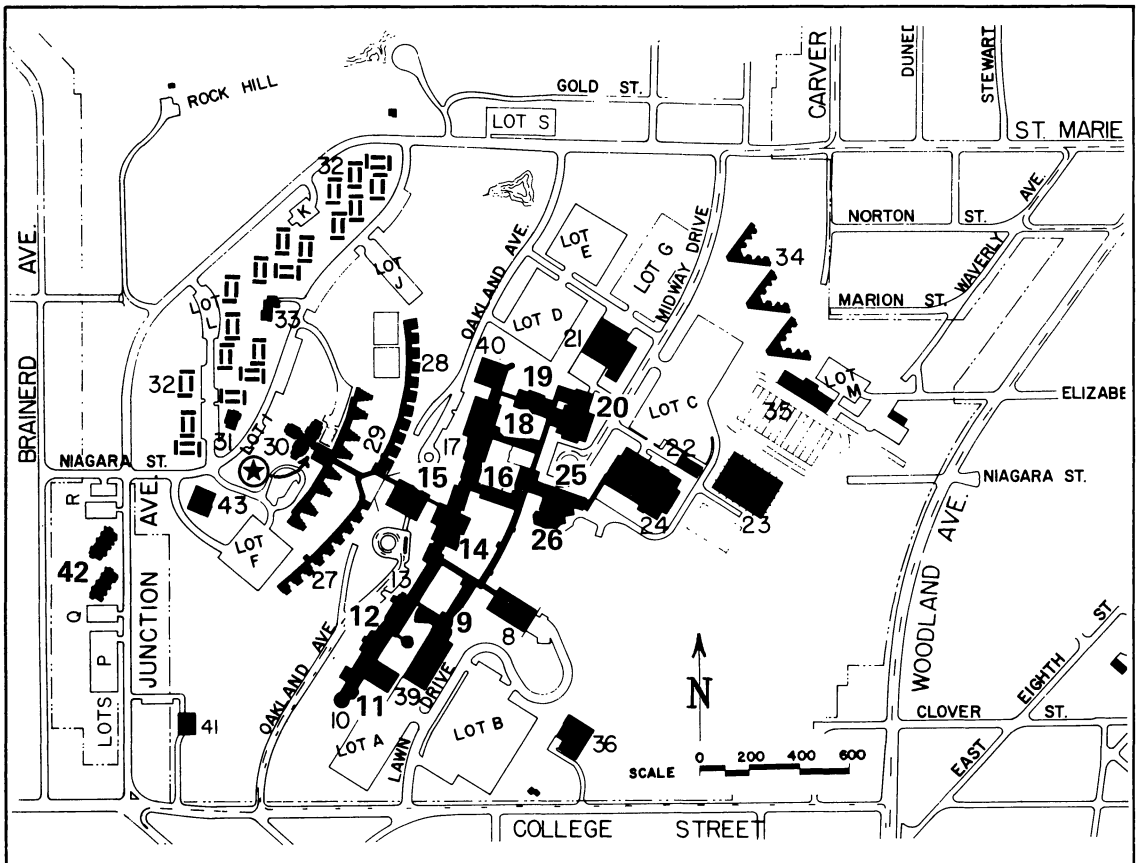
Residence Hall Rooms: The residence halls are located near the dining center, and within five to seven minutes walking time from the meeting rooms. They are not air-conditioned. Both single and double rooms are available. Each room has two twin beds, two desks, chairs, a bureau, and closet space. Cots are available without extra charge for use by children ten years of age or under, but not more than one cot may be used per double room and at least one parent or adult must occupy one of the beds in rooms where a child ten years of age or under occupies a cot. Cots may not be added for children over ten years of age, who must occupy a bed and pay the adult rate. A limited number of cribs for small children is available. Participants wishing to reserve a crib should check the appropriate box on the preregistration/housing form on page A-363. There will be a nominal rental charge for the cribs. Bed linens, towels, washcloths, soap, and drinking cups are provided. Maid service (making beds and tidying up) and fresh towels will be provided on a daily basis. No private baths are available. Generally speaking, there are two group bathrooms per floor, with individual shower stalls. There are no cooking facilities available in the residence halls.

The rates, including the 8 percent sales tax, are:

Single residence hall room	$8.64/night
Double residence hall room	7.02/night per person

Apartment Units: The apartment units are slightly farther from the center of campus than the residence halls, but are still within seven or eight minutes walking time of any place on campus. They are not air-conditioned. Each apartment unit consists of two bedrooms (each containing two single beds), a complete bath, living room, and kitchen, and is designed to accommodate four people. Again, cots are available without extra charge for children ten years of age or under; the same rules apply as for residence halls, except that in an apartment unit the use of two cots is permitted. The kitchens in the apartment units have a stove, refrigerator and sink, but cooking and eating utensils are not furnished. Other furnishings, maid service, and towels are the same as for residence hall rooms.

The rate, including the 8 percent sales tax, regardless of the number of occupants (up to a



UNIVERSITY OF MINNESOTA – DULUTH CAMPUS

– Legend –

★ **GRIGGS – LAKE SUPERIOR HALL** – *Check in here for Residence Hall assignment*

1 Old Main
2 Research Laboratory
3 Washburn Hall
4 Torrance Hall
5 Provost's Residence
6 Alworth Apartments
7 Alworth Residence
8 Administration
9 **CHEMISTRY**
10 Marshall W. Alworth Planetarium
11 **MARSHALL W. ALWORTH HALL**
12 **LIFE SCIENCE**
13 Mathematics – Geology
14 **KIRBY STUDENT CENTER**
15 **RESIDENCE HALL DINING CENTER**
16 **SOCIAL SCIENCES**
17 Library
18 **BOHANNON HALL**
19 **HOME ECONOMICS**
20 **MARSHALL PERFORMING ARTS CENTER**
21 Industrial Education
22 R. O. T. C.
23 Physical Education Field House
24 Physical Education
25 **HUMANITIES & TWEED MUSEUM OF ART**
26 **A. B. ANDERSON HALL**
27 Vermilion Hall
28 Burntside Hall
29 Griggs Hall
30 Lake Superior Hall
31 Health Service
32 The Village
33 Village Service Center
34 Stadium Apartments
35 Stadium & Griggs Field
36 Lund Plant Services
39 School of Medicine
40 Medical Science Library
41 Duluth Fire Station No. 4
42 **JUNCTION AVE. APARTMENTS**
43 Sax Brothers Memorial Communications Center (WDSE TV)

CITY BUS LINES – – – – – – – – – –
INTER CAMPUS BUS - - - - - - - - - - - - - -

maximum of four adults and two children ten years of age or under occupying cots), is $27 per night.

Pets are not allowed in on-campus living areas. Apart from applicable state laws (drinking age is 19), there are no restrictions on the use of alcoholic beverages in the residence halls. Free ice is available from an ice machine located at the Griggs-Lake Superior Hall Information Desk. Telephones in the rooms are disconnected during the summer months, but there are pay phones in the lounge areas of the residence halls and apartment buildings.

Participants are encouraged to use all of the facilities in the housing area; tennis, basketball, and volleyball courts are available. Some residence halls have saunas, weight training machines, pianos, and pinball machines. Use of any facility, other than coin-operated laundry machines, games, and vending machines, is free of charge to participants.

When arriving on campus participants should proceed to the Griggs-Lake Superior Hall Information Desk (⍟ on the campus map) to obtain their housing assignment. The desk will be open on a twenty-four hour basis, beginning at 8:00 a.m. on August 17. Residence hall rooms and apartment units may be occupied as early as August 17, or as late as August 29. Again, full payment for accommodations must be made at check-in time by way of cash, personal checks, or travelers' checks.

FOOD SERVICES

An air-conditioned dining center, located on the third floor of Kirby Student Center (14 on the campus map) will be serving complete meals during the week of the meetings. The dining hall will open at 10:00 a.m. on Sunday, August 19, and will close after lunch on Saturday, August 25. Apart from these two days, and the evening meal on Tuesday, the schedule will be:

Breakfast	7:00 a.m. - 9:30 a.m.
Lunch	11:00 a.m. - 1:30 p.m.
Dinner	5:00 p.m. - 6:30 p.m.

All meals are on an a la carte basis, and typically cost $3 for breakfast, $3.50 for lunch, and $4.50 for dinner. Weather permitting, on Tuesday, August 21, there will be a cookout and beer party on Kirby Terrace instead of cafeteria service. That evening, dinner will be served between 6:00 p.m. and 7:30 p.m.

Beverages, sandwiches, and snacks will also be available on campus in the VenDen, a vending machine area located in the basement of Bohannan Hall, and from vending machines located in the residence halls. The VenDen is open from 6:00 a.m. to 10:00 p.m. daily.

The areas immediately adjacent to the campus are primarily residential, but there are two restaurants and a doughnut shop near the corner of St. Marie Street and Woodland Avenue, about 12 minutes' walking distance. The nearest nationally-advertised, fast food chain restaurant would require the use of a car for all but the more determined hikers. Participants will receive a list of these and other Duluth restaurants with their registration materials.

HOTEL ACCOMMODATIONS

A block of rooms has been set aside for use by participants at the Radisson Duluth Hotel. Participants should make their own reservations early directly with the Radisson or other hotels listed below, and should identify themselves as participants in either the Short Course or Joint Mathematics Meetings. The rates listed are subject to change.

The following codes apply: FP = Free Parking; SP = Swimming Pool; AC = Air-Conditioned; TV = Television; CL = Cocktail Lounge; RT = Restaurant. The age limit for children under which there is no charge, providing a cot is not required and they are in the same room as a parent, is shown in parentheses on the same line as the charge for an extra person in the room. In all cases "Single" refers to one person in one bed; "Double" refers to two persons in one bed; and "Twin" refers to two persons in two beds. A rollaway cot for an extra person can be added to double or twin rooms only. Participants will be advised of deposit requirements by the hotels at time of confirmation. The actual mileage and approximate walking times from the hotel to the campus are given in the parentheses following the name of the hotel. All rates quoted are subject to the 8 percent sales tax.

RADISSON DULUTH HOTEL
(2.8 miles, 55 minute walk)*
505 W. Superior Street 55802
Telephone: (218) 727-8981
Single: $30.50
Twin Double: 39.50
Extra person in room $7 (18 years)
Code: FP, SP, AC, TV, RT, CL

HOTEL DULUTH
(2.5 miles, 45 minute walk)*
231 E. Superior Street 55802
Telephone: (218) 727-4577
Single: $20
Double/Twin: 25
Extra person in room $5 (12 years)
Code: FP, TV, RT, CL

NORMANDY INN
(2.7 miles, 50 minute walk)*
209 W. Superior Street 55802
Telephone: (218) 722-1202
Single: $30.50
Double/Twin: 34.50
Extra person in room $10 (18 years)
Code: SP, AC, TV, RT, CL

*Because of the distance of these hotels from campus, and the 400 foot change in elevation, participants wishing to stay in a hotel are advised to provide themselves with a rental car or other means of transportation, unless they are determined hikers.

ATHLETIC FACILITIES

All meeting participants and their families may use the outdoor tennis courts in the dormitory area, as well as the outdoor track and tennis courts near the field house. Indoor facilities include gymnasiums, a weight training room, a

track, and a swimming pool. Hours for indoor facilities will be posted. Participants should bring their own gear; towel service is provided for swimmers for a small fee. Details on public golf courses and other athletic facilities can be obtained at the Local Information Section of the Joint Mathematics Meetings registration desk.

BOOK STORES

The book stores on campus are open between 8:00 a.m. and 4:30 p.m. weekdays. Dalton's, located in the Normandy Court downtown, is open from 10:00 a.m. to 9:00 p.m. weekdays, from 11:00 a.m. to 5:30 p.m. on Saturday, and from noon to 5:00 p.m. on Sunday. The Walden Book Store, located in the Miller Hill Mall, is open Monday through Friday from 9:30 a.m. to 9:00 p.m., from 9:30 a.m. to 6:00 p.m. on Saturday, and from 11:00 a.m. to 5:00 p.m. on Sunday. The Book Post, located near the campus at 2311 Woodland Avenue, is open from 10:00 a.m. to 5:30 p.m. Monday through Saturday, and between 2:00 p.m. and 5:00 p.m. on Sunday.

CAMPING

Several camp sites have been set aside for participants at Spirit Mountain, approximately 15 miles from the university. These camp sites are equipped with electrical and water hookups, a fireplace and picnic table. Spirit Mountain is an all-season resort, offering skiing in the winter and other outdoor activities during the summer, such as swimming, tennis, hiking, and jogging. The Campground Control Building offers a camp store, laundry, and telephones. There are washrooms and showers, as well as a first aid station. There is also a restaurant and cocktail lounge. The rates for the camp sites are $3.50/day for tents, $5.50/day for a vehicle requiring electrical service only, and $6.50/day for a vehicle requiring electrical and water service. Interested participants should reserve these camp sites in advance by writing before July 20 to Spirit Mountain Campground, 9500 Spirit Mountain Place, Duluth, Minnesota 55810, and by identifying themselves as participants in the mathematics meetings.

CHILD CARE

A local nursery school has agreed to open its facilities for children up to eight years old, provided there is sufficient demand. This school is located at the edge of campus within easy walking distance of the residence halls. It is fully equipped and staffed by professionals who will plan appropriate activities, including field trips, for each age group. Cribs are available for infants. The charge will be $2 per hour for children under two-and-one-half years, $1.25 per hour for children two-and-one-half to eight years, with an additional charge for lunch. Interested parents should preregister with a deposit of $5, indicating dates and hours they wish to use this service, by writing Dr. S. S. Anderson, Department of Mathematical Sciences, University of Minnesota, Duluth, Minnesota 55812. A decision will be made on June 15 whether there is sufficient demand to merit opening the facility. The $5 deposit will be refunded only if the facility is not opened. Duluth does not have a professional babysitting organization, but a list of private babysitters will be available at the Local Information Section of the Joint Mathematics Meetings registration desk.

CRIB RENTAL

Cribs for small children and infants will be made available for use in the residence halls at a low cost to participants who check the appropriate box on the preregistration/housing form on page A-363. The exact rental fee will be given in the June issue of the NOTICES.

ENTERTAINMENT

The Local Arrangements Committee has planned a number of free or low-cost activities for participants and their families. Tickets for each of the following events, including transportation, will be available at the Local Information Section of the Joint Mathematics Meetings registration desk, unless otherwise specified.

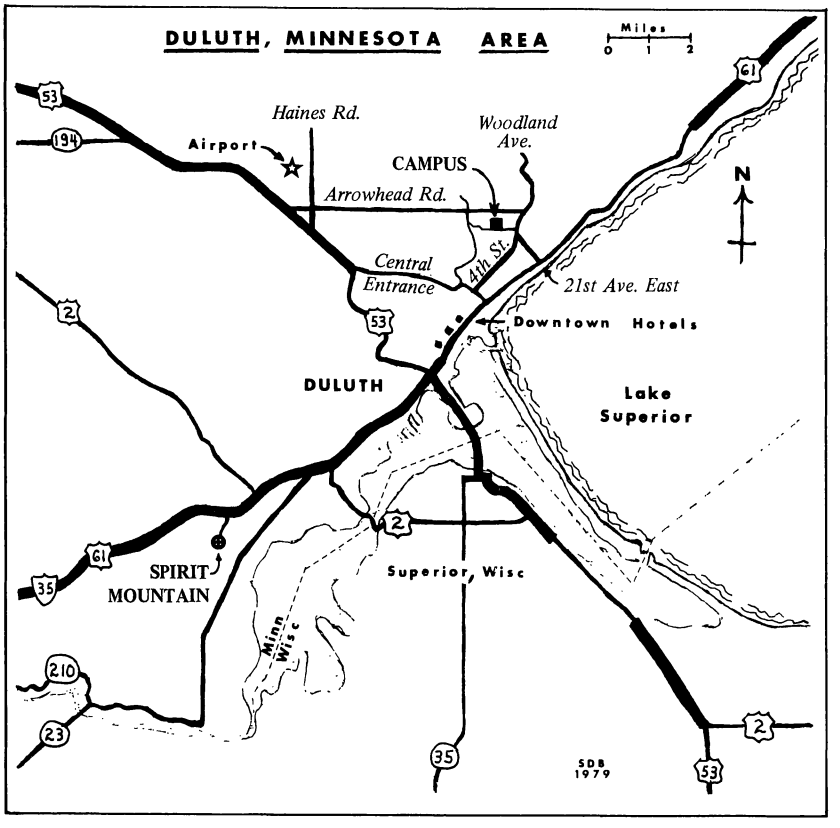
On Tuesday, August 21, and again on Friday, August 24, outings are planned on the Brule River in northern Wisconsin. An outfitter will supply canoes or kayaks and all necessary equipment, and participants will have a choice between a white water or a novice course.

Weather permitting there will be a cookout and beer party on Kirby Terrace on Tuesday, August 21, in lieu of normal cafeteria service that evening. Dinner will be served between 6:00 p.m. and 7:30 p.m., and tickets for the party may be obtained at the door.

On Wednesday, August 22, there will be a trip to Gooseberry Falls State Park. The tour bus will leave at 1:00 p.m. and return about 5:30 p.m., traveling to the park along a portion of Lake Superior's famous and scenic North Shore Drive, with a stop along the way to tour the French River Fish Hatchery.

Thursday evening, August 23, the traditional summer meeting picnic will be held at Spirit Mountain Resort (see area map on page 173). Spirit Mountain is a city-operated ski resort and recreational complex. In the summer it offers hiking, swimming, tennis, horseback riding, camping, and picnicking. The main lodge also contains an excellent restaurant and cocktail lounge. The menu for Thursday evening will include Walleye Pike (all you can eat), corn on the cob, potatoes, beans, salad, and beverage. Tickets will be on sale at the Thermofax Section of the Joint Mathematics Meetings registration desk until noon on Wednesday, August 22, but participants are urged to purchase their tickets in advance when preregistering for the meeting, using the space provided on the form on page A-363. The adult ticket price is $10.25, which includes bus transportation to and from Spirit Mountain, or $9 without the bus transportation. The ticket prices for children 12 years of age and under are $5.75 or $4.50 respectively.

Tour buses will depart from the campus at 1:45 p.m. and 4:15 p.m. Tuesday through Friday



to take visitors to the St. Louis County Heritage and Art Center (the Depot) and the harbor area near downtown Duluth. The Depot is a former railroad station that has been converted into a cultural center, and includes an excellent railroad museum, the Chisholm Museum, an art institute, and a county historical museum. The building itself is an interesting example of Normal Revival architecture. Those continuing on to the harbor area may purchase tickets for the two-hour harbor cruise aboard the Vista Queen or the Vista King.

LIBRARIES

The University Library (17 on the campus map) will be open from 8:00 a.m. to 9:00 p.m. Monday through Friday. The Duluth Public Library, located at 101 West 2nd Street, is open from 9:00 a.m. to 9:00 p.m. on Monday, Tuesday, and Wednesday, and from 9:00 a.m. to 5:30 p.m. Thursday and Friday.

MAIL AND TELEPHONE MESSAGES

All mail and telegrams for persons attending the meetings should be addressed to the participant in care of Joint Mathematics Meetings, Tweed Museum of Art, University of Minnesota, Duluth, Minnesota 55812. Mail and telegrams so addressed may be picked up at the Joint Mathematics Meetings registration desk, located in the Tweed Museum of Art, during the hours that desk is open.

A telephone message center will be located in the same area to receive incoming calls for participants during the hours the desk is open. Messages will be written down, and the name of the participant for whom a message has been received will be posted on a blackboard near the desk until the message is picked up. The telephone number of the message center will be published in the June issue of the NOTICES.

During those hours when the message center is not open, telephone messages for participants staying on campus may be relayed through the residence hall information desk attendant at (218) 726-7381.

MEDICAL SERVICES

The University Health Service Center (31 on the campus map) is open between 9:00 a.m. and 3:00 p.m. each weekday, with a doctor in attendance. Duluth is served by St. Mary's Hospital at 407 East 3rd Street (emergency telephone 727-4551, extension 291), and by St. Luke's Hospital at 915 East 1st Street (emergency telephone 727-6636, extension 600). Both hospitals maintain emergency service around the clock, and each has a dentist available on an on-call basis 24 hours a day, seven days a week. For police, fire, or ambulance service, dial 911.

PARKING

Participants may park without charge in all of the lots shown on the campus map except

for metered, reserved, and designated reserved spaces. In addition, visitor parking permits, which will permit courtesy parking in metered spaces in downtown Duluth, will be available at the Local Information Section of the Joint Mathematics Meetings registration desk.

TRAVEL AND LOCAL INFORMATION

Duluth, a city of 100,000, is located at the western tip of Lake Superior, approximately 150 air miles northeast of Minneapolis. It is served by North Central Airlines, by Greyhound and Wisconsin Northern bus lines, and by Amtrak, and it is a terminus of freeway I-35 and the focus of numerous other scenic highways.

The Duluth Airport is approximately 7 miles from campus. Car rentals are available at the airport from Avis, Hertz, National, and Budget. Ford and Sears also rent cars locally, but special arrangements will have to be made for pickup and delivery. Advance reservations are strongly recommended for all car rentals.

Citywide taxi service is available, as is limousine service between the airport and downtown hotels. The taxi ride from the airport to the university campus costs $5, and costs may be shared among two or more passengers. City buses do not stop at the airport, but they do connect the campus with the downtown area, about three miles away.

The host institution plans to supplement taxi service between the campus and airport with an informal free shuttle at the times of the most commonly used flights. Those arriving at the airport can obtain shuttle service information and other assistance at an information desk that will be set up near the baggage claim area and staffed at the times of more popular incoming flights. To facilitate the scheduling of the free shuttle, it is important that you supply flight information in the space provided on the preregistration and housing form on page A-363 of the NOTICES. Participants should be aware that if their flights are delayed, they should be prepared to rely on the taxi service, if necessary.

Information about points of interest in the Duluth area, such as the Duluth Zoo, Hawk Ridge Nature Reserve, Mesabi Iron Range, and the Forest Interpretive Center at Grand Rapids, will be available at the Local Information Section of the Joint Mathematics Meetings registration desk. Those passing through the Minneapolis-St. Paul area on the way to or from the meetings might wish to visit the Chanhassen Dinner Theatre, the Minnesota Zoological Gardens, the Guthrie Theatre, or the Minnesota State Fair (August 23 through September 2). Those who might wish to combine a vacation in Minnesota with their trip to the meetings may get further information from the Tourism Division, Minnesota Department of Economic Development, 480 Cedar Street, St. Paul, Minnesota 55101. Inquiries regarding Wisconsin should be directed to the Wisconsin Department of Business Development, Division of Tourism, P.O. Box 7606, Madison, Wisconsin 53707.

WEATHER

The weather in Duluth is notoriously unpredictable. Normal daytime highs in late August are 73°F and normal nighttime lows are 53°F, but wide variations from both figures are common. The maximum and minimum recorded temperatures for the dates of the meetings are 94°F and 39°F, respectively. Average precipitation for August is 3.79 inches, with between 20 percent and 30 percent chance of rain for a typical day. A raincoat or light jacket is practically a necessity, and it might even be prudent to keep an extra sweater handy, since the temperature can drop by as much as 40°F if cool breezes from Lake Superior suddenly replace warm westerly winds.

LOCAL ARRANGEMENTS COMMITTEE

Duane E. Anderson, Sabra S. Anderson, Paul T. Bateman (ex officio), Sylvan Burgstahler (cochairman), Francis G. Florey, Louis M. Friedler, Joseph A. Gallian, William J. LeVeque (ex officio), William R. McEwen, James L. Nelson (cochairman), and David P. Roselle (ex officio).

Urbana, Illinois

Paul T. Bateman
Associate Secretary

SUMMARY OF ACTIVITIES

The purpose of this summary 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
SUNDAY, August 19	OPERATIONS RESEARCH: MATHEMATICS AND MODELS
11:00 a.m. - 3:30 p.m.	REGISTRATION (Short Course Only)
2:00 p.m. - 3:15 p.m.	Mathematical modelling of military conflict situations Seth Bonder
3:30 p.m. - 4:45 p.m.	Fire department deployment analysis Warren E. Walker
MONDAY, August 20	
8:00 a.m. - 2:00 p.m.	REGISTRATION (Short Course Only)
9:00 a.m. - 10:15 a.m.	Mathematical modelling of health care delivery systems William Pierskalla
10:30 a.m. - 11:45 a.m.	Practical aspects of fishery management modeling Frederick C. Johnson
1:30 p.m. - 2:45 p.m.	Queueing networks: An overview Ralph L. Disney
3:00 p.m. - 4:15 p.m.	Operations research: Applications in agriculture Robert B. Rovinsky
4:30 p.m. - 5:00 p.m.	General discussion

	JOINT MATHEMATICS MEETINGS	
MONDAY, August 20	American Mathematical Society	Mathematical Association of America
9:00 a.m. - 4:00 p.m.		Board of Governors Meeting
2:00 p.m. - 8:00 p.m.	REGISTRATION	
TUESDAY, August 21	AMS	Other Organizations
8:00 a.m. - 4:30 p.m.	REGISTRATION	
8:00 a.m. - 4:30 p.m.	Book Sale	
9:00 a.m. - 10:00 a.m.		MAA - The Earle Raymond Hedrick Lectures Lecture I - Mary Ellen Rudin
morning		MAA - Sessions
1:00 p.m. - 5:00 p.m.	EXHIBITS	
1:00 p.m. - 2:00 p.m.		MAA - The Earle Raymond Hedrick Lectures Lecture II - Mary Ellen Rudin
afternoon		MAA - Sessions
7:00 p.m.		MAA - Film Program
7:00 p.m. - 9:00 p.m.		Pi Mu Epsilon - Reception
7:30 p.m. - 9:00 p.m.	Committee on Employment and Educational Policy - Panel Discussion	
evening	COOKOUT AND BEER PARTY	
WEDNESDAY, August 22	AMS	Other Organizations
8:30 a.m. - 4:30 p.m.	REGISTRATION	
8:30 a.m. - 4:30 p.m.	EXHIBITS	
8:30 a.m. - 4:30 p.m.	EMPLOYMENT REGISTER	
8:30 a.m. - 4:30 p.m.	Book Sale	
9:00 a.m. - 10:00 a.m.		Mathematicians Action Group Steering Committee - Open Meeting
9:00 a.m. - 10:00 a.m.		MAA - The Earle Raymond Hedrick Lectures Lecture III - Mary Ellen Rudin
morning		MAA - Sessions
10:00 a.m. - 11:00 a.m.		MAA - Business Meeting
noon - 1:00 p.m.		IIME - Council Luncheon

SUMMARY OF ACTIVITIES

WEDNESDAY, August 22	American Mathematical Society	Other Organizations
1:00 p.m. - 2:00 p.m.	Colloquium Lecture I George D. Mostow	
2:30 p.m. - 3:30 p.m.	Invited Address	
3:00 p.m. - 5:30 p.m.		IME - Contributed Paper Session
3:45 p.m. - 4:45 p.m.	Invited Address	
afternoon	Special Sessions Sessions for Contributed Papers	
5:00 p.m. - 10:00 p.m.	Council Meeting	
6:30 p.m. - 10:00 p.m.		MAA - Banquet for Thirty Year Members
7:00 p.m.		MAA - Film Program
7:00 p.m. - 8:15 p.m.		IME - Banquet
8:30 p.m. - 9:30 p.m.		IME - J. Sutherland Frame Lecture Infinitesimals: Where they come from and what they can do H. Jerome Keisler

THURSDAY, August 23	AMS	Other Organizations
8:00 a.m. - 9:00 a.m.		IME - Dutch Treat Breakfast
8:30 a.m. - 4:30 p.m.	REGISTRATION	
8:30 a.m. - 4:30 p.m.	EXHIBITS	
8:30 a.m. - 4:30 p.m.	EMPLOYMENT REGISTER	
8:30 a.m. - 4:30 p.m.	Book Sale	
8:30 a.m. - 9:30 a.m.	Colloquium Lecture II	
9:00 a.m. - 10:30 a.m.		IME - Contributed Paper Session
9:45 a.m. - 10:45 a.m.	Invited Address	
11:00 a.m. - noon	Invited Address	
morning	Special Sessions Sessions for Contributed Papers	
afternoon		MAA - Sessions
3:00 p.m. - 5:30 p.m.		IME - Contributed Paper Session
4:00 p.m. - 5:00 p.m.		Association for Women in Mathematics Panel Discussion - Mathematics education: A feminist perspective Judith Roitman (moderator)
5:00 p.m. - 6:00 p.m.		AWM - Open Council Meeting
6:00 p.m. - 10:00 p.m.	SPIRIT MOUNTAIN PICNIC	

FRIDAY, August 24	AMS	Other Organizations
8:30 a.m. - 4:30 p.m.	REGISTRATION	
8:30 a.m. - 4:30 p.m.	EMPLOYMENT REGISTER	
8:30 a.m. - 9:30 a.m.	Colloquium Lecture III	
9:45 a.m. - 10:45 a.m.	Invited Address	
11:00 a.m. - noon	Invited Address	
morning	Special Sessions Sessions for Contributed Papers	
1:00 p.m. - 2:00 p.m.		AWM - Invited Address
2:30 p.m. - 4:00 p.m.	Prize Session	
4:00 p.m. - 5:00 p.m.	Business Meeting	
afternoon	Special Sessions Sessions for Contributed Papers	
7:00 p.m. - 8:30 p.m.		MAG - Panel Discussion

SATURDAY, August 25	AMS	
8:30 a.m. - 1:30 p.m.	REGISTRATION	
8:30 a.m. - 9:30 a.m.	Colloquium Lecture IV	
9:45 a.m. - 10:45 a.m.	Invited Address	
11:00 a.m. - noon	Invited Address	
morning and afternoon	Special Sessions Sessions for Contributed Papers	

Organizers and Topics of Special Sessions

Names of the organizers of special sessions to be held at meetings of the Society are listed below, along with the topic of the session. Papers will be considered for inclusion in special sessions, if their abstracts are submitted to the Providence office by the deadlines given below. These deadlines are three weeks earlier than those for abstracts for regular sessions of ten-minute contributed papers. The most recent abstract form has a space for indicating that the abstract is for a special session. If you do not have a copy of this form, be sure your abstract is clearly marked "For consideration for special session (title of special session)." Papers not selected for special sessions will automatically be considered for regular sessions unless the author gives specific instructions to the contrary.

767th Meeting	Vancouver, Canada, June 1979	Deadline: April 3
Priscilla E. Greenwood	Probability	
Stanley S. Page	Representations and ring theory	
Lon M. Rosen	Mathematical physics	

768th Meeting	Duluth, Minnesota, August 1979	Deadline: May 22
Harold E. Benzinger	Differential operators and diffusion processes	
Eugene B. Fabes	Singular integrals and harmonic analysis	
Paul O. Frederickson	Computational fluid dynamics	
David S. Griffeath	Percolation and interacting systems	
Julian I. Palmore	Topological methods in the study of dynamical systems	
John G. Ratcliffe	Homological and combinatorial methods in group theory	
J. Ian Richards	Analytic number theory	
Seymour Schuster	Graph theory	
Joel H. Shapiro	Functional analysis in spaces of analytic functions	
Steven I. Sperber	p-adic analysis in number theory and geometry	
Franklin D. Tall	Applications of set theory to topology	

770th Meeting	Kent, Ohio, November 1979	Deadline: August 6
Chandler Davis	Spectral theory of Hilbert space	
Richard S. Varga	Approximation theory	

773rd Meeting	San Antonio, Texas, January 1980	Deadline: To be announced
Richard A. Askey	Orthogonal polynomials	
A. T. Bharucha-Reid and R. Kannan	Stochastic approximation	
James E. Humphreys and Brian J. Parshall	Cohomology and representations of algebraic groups	
Peter A. Loeb	Nonstandard analysis	
Donald L. Thomsen, Jr.	Societal mathematics	
	Boulder, Colorado, March 1980	Deadline: To be announced
Lawrence W. Baggett and Arlan B. Ramsay	Nonabelian harmonic analysis	
Alan Day and Walter F. Taylor	Lattice theory and general algebra	
Karl E. Gustafson	Topics in mathematical physics	

Invited Speakers at AMS Meetings

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

Vancouver, Canada, June 1979

Theodore T. Frankel	Oscar E. Lanford III

Duluth, Minnesota, August 1979

Alan Hatcher	Jacques Tits
James I. Lepowsky	Eugene Trubowitz
I. I. Piatetski-Shapiro	W. Stephen Wilson
Herbert E. Scarf	

Kent, Ohio, November 1979

Kyung W. Kwun	Albert Marden
Daniel R. Lewis	Paul H. Rabinowitz

San Antonio, Texas, January 1980

Enrico Bombieri	Jack C. Kiefer
Kenneth R. Goodearl	William P. Thurston
J. William Helton	Francois Treves
Peter G. Hinman	

Nominations for 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 1979. 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 25. Nominations by petition in the manner described below 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 below 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 its intent of nominating all persons on whose behalf there were valid petitions.

A petition in aid of a candidate for the position of vice-president or of member-at-large of the Council is valid if it conforms to several rules and operational considerations, as follows:

1. To be considered, petitions must be addressed to Everett Pitcher, Secretary, Box 6248, Providence, Rhode Island 02940, and must arrive by July 16, 1979.

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. At least fifty valid signatures are required for a petition to be considered further.

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 not in the CML or 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 current 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. His assent is the only other condition for presentation of the petition to the Council. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

NOMINATION PETITION FOR 1979 ELECTION

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

.....

as a candidate for the position of*

.....

of the American Mathematical Society for a term beginning January 1, 1980.

Name and Address (Printed or typed, or NOTICES mailing label)	Signature

*Specify "vice-president" or "member-at-large of the Council".

The Nominating Committee for 1980

The Council has approved the continuation of the procedure of filling places on the Nominating Committee by election. There will be four continuing members of the Nominating Committee, namely

Richard D. Anderson
Judy Green
Paul R. Halmos
Victor L. Klee

There will be four places filled by election 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 below, 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 a petition that conforms to several rules and operational considerations, as follows:

1. To be considered, petitions must be addressed to Everett Pitcher, Secretary, Box 6248, Providence, Rhode Island 02940, and must arrive by July 16, 1979.

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. At least 100 valid signatures are required for a petition to be considered further.

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 not in the CML or 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. His assent is the only other condition of placing it there. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

NOMINATION PETITION FOR 1979 ELECTION

(Nominating Committees of 1980, 1981)

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

.....

as a candidate for the position of Member of the Nominating Committee of the American Mathematical Society for the years 1980 and 1981.

Name and Address (Printed or typed, or NOTICES mailing label)	Signature

WARREN WEAVER

Warren Weaver of New Milford, Connecticut, died on November 24, 1978 at the age of 84. He was a member of the Society for 57 years.

The appreciation of his work in support of scientific research which follows was prepared by Professor Emeritus William L. Duren, Jr., of the University of Virginia, who, in the summer of 1927, was enrolled in a course on electromagnetic theory taught by Weaver at the University of Chicago. Their acquaintance continued over the years; they worked together during World War II, and both participated in the early years of the NSF (although Duren's term as Program Director for Mathematics preceded Weaver's term on the NSB).

Warren Weaver, Philanthrope

Warren Weaver's ideas about policy in foundation support of scientific work appeared to be contradictory. In his main service as a director in the Rockefeller Foundation, he developed such special applications of science as quantitative biology, better corn for Mexico, and better rice for India. In his membership on the Science Board of NSF he came down strong for support of fundamental research. As a director of the Alfred P. Sloan Foundation his policy was to support chosen men or women, neither with a particular mission in applied science nor with commitment to fundamental research, and he assisted in the support of an institute of applied mathematics at NYU. He did not try to resolve these apparent contradictions by any abstract principles, which he distrusted as being too inflexible. Instead, he believed that such diverse aims were not only tolerable but desirable. It only required that the one who made the choices in the foundation have a good mind and training and be willing to use them with the help of the best obtainable expert advice.

He practiced what he preached. Trained as a mathematician in electromagnetic field theory, he was asked suddenly in 1932 to undertake a director's job at the Rockefeller Foundation involving many sciences. At the start he feared his lack of competence, for he said, "I was convinced that the great wave of the future...was in the biological sciences." He studied intensely to be able to make sound judgments in his first programs in quantitative biology. He continued his study of science and communication throughout his life, not only to do well in his job as supporter of science but also to become a remarkable interpreter of science and mathematics to the public. He proved that, if a mathematician puts his mind to it, mathematics is a very good base–perhaps the best–from which to become broadly educated in science and the humanities. By the time he retired, Warren Weaver was as knowledgeable a scientific generalist as we had in this country, and as wise a director of philanthropic enterprises as we had.

Now here was a man heavily committed by training to applied mathematics and later to applications of physical science in biology, a man who had been involved in questions about the impact of the computer on our society and its proper uses. He became alarmed at demands from such national leaders as Lyndon Johnson, Hubert Humphrey, and Richard Nixon for practical results from federal funds spent on NSF, NIH, and other federal agencies. Weaver said in Science and Imagination:

> "Such demands would be unfortunate but excusable if they were motivated merely by an impatient desire to reduce illness and suffering. Such demands are frightening if and when they reflect a failure, at highest levels, to recognize the futility of overemphasis on the immediately practical.
>
> "This is in part a recurrence of the atomic bomb illusion–of false conviction that any problem can be solved in eighteen months by appropriating enough money. Adequate support of competence is of course necessary, and this support should be flexibly available wherever competence can be found. But able, trained persons and basic imaginative ideas are the first essential. These cannot be produced by pressure nor bought instantaneously for cash. The government cannot successfully order up cures, but the government can help to provide the circumstances under which progress is assured."

If these remarks had come from a pure mathematician or scientist, they might have been discounted as self-serving and ideological. But coming from Warren Weaver, they represent a depth of informed wisdom and experience that must be heeded.

The word philanthropic is another key to the qualities he thought were needed to guide the choice of men or projects to support. He called himself whimsically, a "philanthropoid." In a hard-headed, informed, and by no means sentimental way, he required that what he

asked his foundation to support should be for the good of mankind. On the flyleaf of his book U.S. Philanthropic Foundations, there is a quote from Herbert Hoover: "A voluntary deed by a man impressed with a sense of responsibility and brotherhood of man is infinitely more precious to our national ideals and national spirit than a thousandfold poured from the treasury of a government under the compulsion of law." That aptly describes the deeds of Warren Weaver.

William L. Duren, Jr.

Curriculum Vitae

Warren Weaver was born in Reedsburg, Wisconsin, July 17, 1894, and was awarded the following degrees by the University of Wisconsin: B.S. (1916), C.E. (1917), Ph.D. (1922), LL.D. (1948). The title of his Ph.D. thesis is "A summary of the analytic formulation of the theory of electrodynamics." He taught at the California Institute of Technology (and its predecessor, Throop College) between 1917 and 1920, and from 1920 to 1932 at the University of Wisconsin, where he was chairman of the department of mathematics from 1928 to 1932.

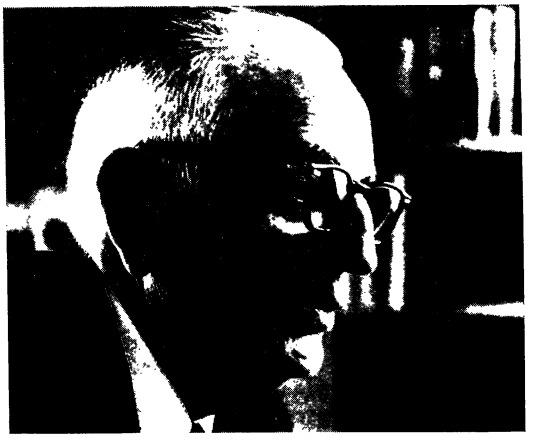
From 1932 to 1959 he worked for the Rockefeller Foundation, as Director of the Division of Natural Science (1932 to 1952), Director of the Division of Natural Science and Agriculture (1952 to 1955), and Vice President, Natural and Medical Sciences (1955 to 1959). At the Alfred P. Sloan Foundation, he served as Trustee (1956 to 1967), as Vice President (1959 to 1964), and, from 1965 until his death, as Special Advisor to the President of the Foundation.

In World War I he was a second lieutenant in the Air Service, working on aviation equipment. In World War II, as a civilian, he served with a series of government groups which dealt with such problems as Britain's anti-aircraft defenses and the development of the atomic bomb.

Weaver was active in the Society as a member-at-large of the Council (1937 to 1939) and a member of the Board of Trustees (1941 to 1947). He served as the Society's representative to the Division of Physical Sciences of the National Research Council (1944 to 1949) and on the following AMS committees: Executive Committee of Mathematical Reviews (1939), War Policy Committee (1943), Committee to Study Certain Problems in Connection with the Future of Mathematical Reviews (1944), Committee on Library and Housing (1947), Committee on Applied Mathematics (1947).

He served on many governing boards, including the National Science Board (1956 to 1960), the Sloan-Kettering Institute, the Salk Institute, the Governing Council of the Courant Institute, and many government panels and committees. He was Chief, Applied Mathematics Panel, National Defense Research Committee of the Office of Scientific Research and Development (1943 to 1946); Chairman, Naval Research Advisory Committee (1946 to 1947); Member, War Department Research Advisory Panel (1946 to 1947); and Chairman, Basic Research Group, Research & Development Board, Department of Defense (1952 to 1953).

He received many honors and awards. For his wartime service, he was awarded the United States Medal for Merit, the Medal for Service in the Cause of Freedom from Britain, and the Legion of Honor from France. Among his major scientific awards were the Public Welfare Medal of the National Academy of Sciences, in 1957; the Kalinga Prize, an international literary award sponsored by UNESCO, in 1965; and the Arches of Science Award of the Pacific Science Center, in 1965. He received honorary doctoral degrees from the Universities of São Paulo, Rochester, and Pittsburgh, from the Drexel Institute of Technology, Rensselaer Polytechnic Institute, and New York University, in addition to his alma mater. He was President of the American Association for the Advancement of Science in 1954 and Chairman of the Board in 1955.



Warren Weaver (c. 1967)
Photo courtesy of Sloan Foundation

His books include the third edition of Elementary Mathematical Analysis by Charles S. Slichter, McGraw-Hill, 1925; The Electromagnetic Field (with Max Mason), University of Chicago Press, 1929; The Mathematical Theory of Communication (with Claude E. Shannon), University of Illinois Press, 1949; The Scientists Speak (editor), Boni and Gaer, 1947; Lady Luck; The Theory of Probability, Anchor Books, 1963; Alice in Many Tongues, University of Wisconsin Press, 1964; U.S. Philanthropic Foundations, Their History, Structure, Management and Record, Harper and Row, 1967; Science and Imagination; Selected Papers, Basic Books, 1967; Scene of Change; A Lifetime in American Science, Scribner, 1970.

The building at New York University which since 1965 has been the home of the Courant Institute of Mathematical Sciences is named Warren Weaver Hall. It was constructed with funds supplied by the Sloan Foundation, the Ford Foundation, the National Science Foundation, and others.

LETTERS TO THE EDITOR

Role of the Society

At Biloxi, during an open meeting discussion, I presented viewpoints I have held for several years, which may interest a wider audience.

The AMS is effective in furthering the cultural aspects of mathematics. However, it has been little more than a bystander in its role as representative of its membership, in contrast with that of similar organizations–for instance, the American Physical Society, or the American Medical Association.

This country is confronted with the human problem of appalling waste of many highly talented Ph.D.'s in mathematics who either immediately, or eventually, are forced out of the field, a situation comparable to relegating a painstakingly artificed, delicate, precision instrument to a shelf, or to use as a hammer. Yet perhaps one of the most meaningful of Human Rights is the right to practice one's profession. However, it is not as an ethical obligation, nor as a charity that I see action as necessary, but because of the enormous gain attendant on utilizing this available pool of exceptionally trained individuals.

Thus far the prevailing impression of efforts to deal with this unemployment problem is one of navigating turbulent seas with no compass and with a handkerchief as sail. This is not to denigrate a variety of suggestions of which, perhaps, the most practical for successful intercession by the AMS relates to the spreading tendency to herd upwards of 100 auditors into mathematics courses. Several educators have criticized this practice, which minimizes active participation by the students; and on this issue of smaller classes, the AMS might vigorously press administrators and regents.

I suggest that an authoritative representative of the AMS, perhaps the Executive Director, be stationed in Washington. Inter alia he would present the case for mathematicians to foundations, to public and private fiscal agents, to the science advisors to the administration, and to funding committees of the Congress. It is quite probable that the indifference of many legislators amounts merely to ignorance of ongoing research in mathematics. As precedent for such an advocate's role, I mention the continued presence in Washington for several years in the early 60s of the President of the National Academy of Sciences, Fred Seitz, to argue for the support of science.

To contend that pure mathematics may yield conclusions far more practical for the next generation than direct engineering development is not easy, but examples abound in every branch of science. In particular, the observation that the whole course of evolution of our universe, and the continued existence of civilization pivots and totters on $E = mc^2$ may gain us sympathetic consideration. Moreover, it was acceptance of the importance of mathematicians by high government officials concerned with wresting space supremacy from the Russians after their Sputnik that led to the 4-fold increase in Ph.D. degrees.

The practice in the so-called Iron Curtain countries of funding many competent young mathematicians with no, or at least no permanent, university affiliations, in research activities ought, I think, be adopted by us also. Such a program would provide nonmilitary counterparts of the Institute for Defense Analysis, Rand, and the various Think Tanks. Moreover, our hobbling preoccupations with purely mathematical projects and solutions should be supplemented by aggressive programs possibly involving other Societies (and even Industry), and large scale support ought be solicited from a variety of agencies.

I suggest, therefore, that the AMS, in concert with other organizations, lead in initiating joint projects in a variety of fields. Again there are precedents. During World War II, for instance, with urgent need for sophisticated innovation, mathematicians, often with no background in Physics or Chemistry, were in the forefront of developments in Communications (particularly Radar) research at MIT; Meteorology at Cal. Tech. and later at Princeton; Ship Design at the Taylor Model Basin; Coding, Ballistics, and a wealth of other projects at university centers, industrial complexes, the Brooklyn Navy Yard and Annapolis, besides widespread individual and group consulting services. (Indeed the problems were so intriguing that a number of mathematicians elected to change fields after the war.)

The years since the war have seen new disciplines develop, many utilizing high speed computers, but today's problems demand comparable urgency of innovation. As an indication of the diversity of needed joint projects, I describe one as a sample: It is an elementary observation that economists are partitioned into cults, each with its own prophet. What one can hope for from a confrontation of mathematicians, physicists and economists are subtler and more powerful approaches to Economic Theory, particularly Economic Forecasting, as revolutionary and nonobvious as Phase Space in Dynamics, the Gibbs Ensemble in Statistical Mechanics, Game Theory in Economics, Information Theory in Transmission Problems, etc. It is not my point that Economics is too hard for the Economists and Econometricians, but that such large-scale joint work may provide new or more precisely defined models simulating various economic Universes, and so afford a deeper understanding of our system and repairs for its malfunctioning.

The problem of permanently absorbing productive young mathematicians concerns the national interest, and might well be publicly revealed in interviews and articles by spokesmen for the Society.

D. G. Bourgin
University of Houston

Photographs of Mathematicians

I have just read Bergman's letter about Konrad Jacobs' collection of photographs of mathematicians.

I have also a collection of black and white and of color photographs of many mathematicians I have photographed during talks given at meetings or at several Universities in Europe and the USA. I believe I have sent copies of their pictures to all these individuals. I would like to add my collection to Jacobs' and anyone who reads this column and does not want his/her picture in the collection please contact me. If you want to choose your own picture to be on display, please tell me the code number on the back: I sometimes have several from the same person.

I think the idea of having a collection of pictures of mathematicians is indeed a very good one.

J.M.S. Simões-Pereira
Hunter College

NEWS AND ANNOUNCEMENTS

SLOAN FELLOWSHIPS AWARDED

Sloan Fellowships for Basic Research have been awarded to seventy-eight outstanding scientists including sixteen mathematicians. The recipients were selected on the basis of their exceptional potential to make creative contributions to scientific knowledge.

The fellowships, granted by the Alfred P. Sloan Foundation, run for two years and are in the amount of $10,000 a year. Candidates for fellowships are nominated by senior scientists familiar with their talents. Fellows need not pursue a specified research project and are free to shift the direction of their research at any time.

Jürgen Moser, of the Courant Institute of Mathematical Sciences, is chairman of the selection committee. S. S. Chern of the University of California, Berkeley, is the other mathematician on the committee.

The mathematicians awarded Sloan Fellowships for 1979 with their affiliations are: Avner Ash (Columbia University), Eric D. Bedford (Princeton University), James O. Berger (Purdue University), Sun-Yung A. Chang (University of Maryland, College Park), Frederick R. Cohen (Temple University), Lawrence C. Evans (University of Kentucky), Cameron McAllan Gordon (University of Texas, Austin), Troels Jorgensen (University of Minnesota), Tai-Ping Liu (University of Maryland, College Park), Richard M. Schoen (Courant Institute of Mathematical Sciences, New York University), Andrew J. Sommese (Cornell University), Eugene B. Trubowitz (Massachusetts Institute of Technology), Lawrence C. Washington (University of Maryland, College Park), Sidney M. Webster (Princeton University), Robert J. Zimmer (University of Chicago), and Gregg J. Zuckerman (Yale University).

1980 MATHEMATICS SUBJECT CLASSIFICATION

A revision of the mathematics subject classification scheme used by the American Mathematical Society and other publishers has been published in the 1978 annual index of Mathematical Reviews. This scheme, called the "1980 Mathematics Subject Classification", will be used in 1979 issues of Current Mathematical Publications and in the 1980 issues of Mathematical Reviews.

The revision is a modest one, maintaining the general structure of the earlier scheme. Sections 02 and 50 have been completely rewritten and are now labeled "03 Mathematical logic and foundations" and "51 Geometry". Some of the major fields have been rearranged and the contents of letter sections in some cases have been considerably expanded and/or rewritten. The revision was carried out jointly by Mathematical Reviews and Zentralblatt für Mathematik/Mathematics Abstracts.

Authors of research papers being submitted to the Society for publication are requested to begin to use the 1980 scheme immediately; the subject classifications are printed as a footnote on the first page of all research papers. During the transition period it will be necessary for authors to indicate whether the classification they are using is the AMS(MOS) Classification 1970 or the 1980 Mathematics Subject Classification.

The 1980 Mathematics Subject Classification, which was published in the 1978 Annual Index of Mathematical Reviews, has been reprinted and is available by sending a check or money order for one dollar bearing the code "SUBJSCHEME" to the American Mathematical Society, P.O. Box 1571, Annex Station, Providence, Rhode Island 02901.

NSF ADVISORY COMMITTEE FOR INFORMATION SCIENCE AND TECHNOLOGY

Richard C. Atkinson, Director of the National Science Foundation, has announced the appointment of nine members of the newly formed Advisory Committee for Information Science and Technology. Three of the appointees are members of the Society. They are Elwyn R. Berlekamp (Professor of Electrical Engineering and Computer Science and Professor of Mathematics at the University of California, Berkeley), Ruth M. Davis (Deputy Undersecretary of Defense for Research and Advanced Technology), and Ben Russak (President, Crane, Russak and Company, Inc.).

Additional appointments are expected to be announced soon. During its first year the Advisory Committee will be concerned primarily with identifying core research problems for information science.

U.S.-U.S.S.R. NEWSLETTER

Copies are available of the second issue of the U.S.-U.S.S.R. Science and Technology Newsletter, published by the Joint Commission Support Staff of the Division of International Programs of the NSF. This issue discusses the cancellation of the sixth meeting of the U.S.-U.S.S.R. Commission in July and reports of Science and Technology working groups: computer applications, chemical catalysis, electrometallurgy and materials, forestry, metrology, microbiology, physics, science policy, scientific and technical information, and water resources. For additional information on the working groups, the Newsletter contains the name and address of each U.S. Chairman.

For a copy of the Newsletter, write or call Barbara Joyce, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550 (202-634-4344).

NSF Bulletin

AMS RESEARCH FELLOWSHIP FUND
Request for Contributions

The number of AMS Research Fellowships which can be granted each year is dependent upon the contributions the Society receives. The Society contributes a minimum of $9,000 to the AMS Research Fellowship Fund each year, matching one-half the funds in excess of $18,000 raised from other sources, up to a total contribution by the Society of $20,000. Every member of the Society is urged to contribute to the Fund.

Contributions to the AMS Research Fellowship Fund are tax deductible. Checks should be made payable to the American Mathematical Society, clearly marked "AMS Research Fellowship Fund," and sent to the American Mathematical Society, P.O. Box 1571, Annex Station, Providence, Rhode Island 02901.

NSF PROGRAM ASSOCIATES NEEDED FOR EAST ASIA, LATIN AMERICA

The National Science Foundation is considering Intergovernmental Personnel Act nominations from universities and state and local government for two program associates in the Division of International Programs. One is for assignment in the East Asia Programs; the other in the Latin America Programs. The assignments are from one to two years; starting time for each is summer, 1979. Applicants should have a Ph.D. in science and engineering. Familiarity with at least one of the languages, the culture, and the scientific infrastructure within the particular region would be advantageous. Assignments will include program development, participation in staff operations in proposal review and evaluation, and interaction with NSF's counterpart organizations in the participating countries. Individuals selected for assignment will remain employees of their institution which may be reimbursed by NSF for a portion of their salaries and other costs related to the assignment.

Nominations should be forwarded by the applicant's institution (not by the individual) to Dr. J. E. O'Connell, Latin America and Pacific Section, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550 (202-632-5806).

NSF Bulletin

WOMEN SCIENTISTS TO VISIT U.S. HIGH SCHOOLS

The Research Triangle Institute will conduct a Visiting Women Scientists program through May 1979, to encourage young women to consider careers in science and technology. Women scientists will visit approximately 135 junior and senior high schools in the following areas: Los Angeles, Philadelphia, and Minneapolis-St. Paul. In addition to improved techniques, a Manual on Program Operations will be prepared, as well as a Women Scientists Roster for use by other groups interested in conducting similar programs. (For more information about the Roster see the January 1979 NOTICES, p. 69.) The program is in need of women scientists of disadvantaged ethnic minority group backgrounds and women from industry or government in the specific geographic areas. Please write Ms. Carol Place, Project Director, Research Triangle Institute, Box 12194, Research Triangle Park, NC 27709, or phone 919-541-6318.

A 192-page Visiting Women Science Pilot Program 1978 Final Report on this program held during the academic year 1977-1978 is now available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161. Request number PB 286372. Price is $9 for paperback or $3 for microfiche. A 15-page 1978 Highlights Report on the same program is also available from NTIS. The order number is PB 286373. Price is $4 for paperback or $3 for microfiche.

NSF Bulletin

PROPOSALS SUBMITTED TO NSF

The National Science Foundation brochure "Grants for Scientific Research" provides guidelines on eligibility and proposal preparation for scientists wishing to submit proposals for NSF grants. The latest edition, (NSF Publication 78-41A) expands the description of the category of grant applicants who are not affiliated with an organization which can serve as a grantee institution. The new paragraph states:

"(6) Unaffiliated scientists in the United States: Scientists in the United States who have no affiliations with organizations that could act as grantee institutions may receive support for meritorious research if they have the capability and facilities needed to perform the work, agree to fiscal arrangements satisfactory to the NSF Grants Officer, and otherwise meet the conditions described in this brochure. Unaffiliated scientists should contact the appropriate program (see Appendix VII) before submitting a proposal."

Members of the Society will be interested to know that the mathematical sciences section has made some grants to individuals in the past several years.

SUMMER EMPLOYMENT REGISTER AND 1979 SUMMER LIST OF APPLICANTS

The AMS-MAA-SIAM Committee on Employment Opportunities, which is charged with operation of the Employment Registers at Annual and Summer Meetings and which oversees publication of EMPLOYMENT INFORMATION IN THE MATHEMATICAL SCIENCES, will publish a summer list of applicants prior to the Duluth meeting in August 1979.

Copies of the 1979 summer list will be available at the meeting and, following the meeting, they may be purchased from the AMS office upon payment of the costs of reproduction and distribution. The list should prove useful to employers who have last minute openings, late in the summer or in the fall.

To be included in the list, applicants should complete the Applicant Preregistration Form on page A-362, and mail it to the Providence office where it must be received by July 27. A coded strip at the bottom of the form summarizes the information contained on the form. Please be sure to complete the coded summary in addition to completing the regular form. These strips will be used in preparing the computer-printed lists of applicants which will be distributed at the meeting and to those who request the list by mail. Great care should be taken in preparing the coded strip as well as the résumé form in order to assure that the listings are readable. Please study the instructions carefully before filling out the form.

For information on the Employment Register at the Duluth meeting, see page 167.

AMS RECIPROCITY AGREEMENT WITH NEW ZEALAND SOCIETY

The American Mathematical Society has concluded a reciprocity agreement with the New Zealand Mathematical Society, effective January 1, 1979. AMS members may join the New Zealand Mathematical Society at a reduced rate. Information on this organization and a summary of the privileges available to AMS members who join it under the terms of the reciprocity agreement are given below. This list supplements a report on reciprocity agreements given in the August 1978 NOTICES (pages 315 ff.) and the supplementary list given in the November 1978 issue (page 514).

New Zealand

New Zealand Mathematical Society
Apply for membership to: Dr. I. L. Reilly, Treasurer, New Zealand Mathematical Society, Mathematics Department, University of Auckland, Private Bag, Auckland, New Zealand.
Dues: $3.50 NZ (approximately $4.00 US)
Pay dues to: New Zealand Mathematical Society
Privileges of membership: All those of ordinary members except the right to vote; free copy of the Newsletter of the NZMS (3 per year); subscription to MATHEMATICS CHRONICLE (University of Auckland) at reduced rate (currently $4.00 NZ).
Officers: G. C. Wake (President), J. C. Turner (Vice-President), I. L. Reilly (Treasurer), H. S. Roberts (Secretary).

In addition, updated information has been received from the Deutsche Mathematiker-Vereinigung e. V.: the dues have been increased to DM30 and the privileges of membership now include subscriptions to JAHRESBERICHT, which contains mathematical survey articles and book reviews, and to MITTEILUNGEN, which contains general information and personal news.

The AMS office has also received copies of membership application forms from several societies in addition to those listed in the November report. Application forms are now available from the Providence office for the following organizations:

Australian Mathematical Society
Sociedade Brasileira de Matematica
Gesellschaft fűr Angewandte Mathematik und Mechanik
Allahabad Mathematical Society
Calcutta Mathematical Society
Vijnana Parishad
Unione Matematica Italiana
Mathematical Society of Japan
Polskie Towarzystwo Matematyczne
Deutsche Mathematiker-Vereinigung e.V.
Malaysian Mathematical Society

Application forms for AMS membership have been sent to each society with which the AMS has a reciprocity agreement.

NSF SEED PROGRAM

The Scientists and Engineers in Economic Development (SEED) Program of the National Science Foundation provides support for qualified U.S. scientists and engineers to apply their experience to specific problems in nearly fifty developing countries. Both Research/Teaching Grants and International Travel Awards are made. Research/Teaching grants for from one semester to a year are used to support specific development projects designed by U.S. scientists in collaboration with their foreign counterparts. Proposals for joint projects should be developed directly by the cooperating scientists and submitted to NSF through the U.S. scientist's home institution.

International Travel Awards are given for travel involved in participating in projects which require only a limited amount of time, or to support visits which will improve the planning and quality of a Research/Teaching project.

Applicants must be qualified scientists and engineers from U.S. academic institutions who will return to their institutions on completion of the project. Applications for travel support may be submitted at any time. The closing dates for submission of Research/Teaching proposals are June 1 and December 1. For guidelines for the preparation of proposals, write or call the Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550 (202-634-7930).

CASE STUDIES

For several years the Society's Committee on Employment and Educational Policy (CEEP) has collected "case studies" prepared by mathematicians with nonacademic or nontraditional employment. Previous studies were published in the November 1974, the February, June, August and November 1975, and the February 1978 issues of the NOTICES.

An article by Wendell H. Fleming, based on the results of the 22nd Annual AMS Survey (February 1979 NOTICES, pages 106-113), reports a recent significant increase in the number of Ph.D. mathematicians entering nonacademic employment. The Employment Concerns Subcommittee of CEEP, whose members are Hugo Rossi (chairman), Audrey Terras, Robert J. Thompson, Barnet Weinstock and William P. Ziemer, feels that the case studies can prove helpful to mathematicians seeking nontraditional positions, and it intends to continue the series. Mathematicians interested in participating in this project, either by preparing their own case studies or proposing others as candidates for case studies, are encouraged to write to Professor Audrey A. Terras (Department of Mathematics, University of California, La Jolla, California 92093), or to Professor Barnet M. Weinstock (Department of Mathematics, University of North Carolina, Charlotte, North Carolina 28223).

OTA CONGRESSIONAL FELLOWSHIPS

The Office of Technology Assessment (OTA) is seeking candidates for its Congressional Fellowship Program for 1979-1980. The program provides an opportunity for individuals who have demonstrated outstanding ability in management or research to gain a better understanding of science and technology issues facing the Congress and the way in which the Congress establishes national policy related to these issues. The OTA's basic function is to help legislative policymakers anticipate and plan for the consequences of technological changes and to examine the many ways, expected and unexpected, in which technology affects people's lives. OTA provides Congress with independent and timely information about the potential effects of technological applications.

Six Fellows are to be selected for the fellowship period of one year which begins in September 1979. The fellowship program will emphasize interdisciplinary, holistic approaches to public policy concerns, and is open to all disciplines of science and technology and related policy or research activities.

Applicants must have completed research and training at the doctoral level, or have equivalent experience (as judged by the Selection Committee). They will be considered on the basis of their records of achievement, their potential for contributing to OTA's congressional work, and their potential for professional growth.

To apply for the fellowships, applicants must submit the following:

(1) a detailed résumé, including area(s) of special interest, education and experience, publications, and names of three character references;

(2) three letters of reference from individuals who know the applicant well enough professionally to write about his or her capability and ability to work creatively as a member of an interdisciplinary research team (sent directly to the address below).

(3) a statement of approximately 1,000 words addressing the applicant's interest in the fellowship program and his or her career goals.

Applications and letters of reference must be postmarked by May 1, 1979, and should be sent to: Congressional Fellowships, Office of Technology Assessment, Congress of the United States, Washington, D.C. 20510.

ERDŐS PROBLEMS

A collection of problems which Paul Erdős has assigned to others is to be assembled. Mathematicians interested in cooperating in this project may submit copies of the correspondence containing the problem and supplement it with the following information: date problem given, monetary value (if any), source of problem (from Erdős alone, with someone else, or relayed by Erdős), comments on notation or other matters useful for the general reader. Material should be sent to Pat Faudree, 2983 Elgin, Memphis, TN 38118.

VISITING FULBRIGHT LECTURERS

A supplement has been published to the Directory of Visiting Fulbright Lecturers and Researchers in the U.S. 1978-1979 by the Council for International Exchange of Scholars. Three of the mathematicians listed have not been included in earlier lists of visiting mathematicians (see the October and November 1978, and January and February 1979 NOTICES). They are:

Aleksandar Jovanovic (Yugoslavia) who is conducting research in model and set theories at the Department of Mathematics, Pennsylvania State University, from April 1979 to August 1979;

Erich P. Klement (Austria) who is doing research on measure theory for fuzzy sets at the Department of Electrical Engineering and Computer Science, University of California, Berkeley, from February 1979 to June 1979; and

Ian Hugh Sloan (Australia) who is lecturing and doing research on numerical analysis of integrals at the Department of Physics and Astronomy at the University of Maryland from December 1978 to December 1979.

FULBRIGHT OPPORTUNITIES ABROAD 1980-1981

A leaflet describing in detail the Fulbright opportunities for 1980-1981 will become available in March. Members are reminded that application deadlines for these awards are June 1 for the American Republics, Australia and New Zealand, and July 1 for Africa, Asia and Europe. To receive a copy of the announcement, write to the Council for International Exchange of Scholars, Suite 300, Eleven Dupont Circle, Washington, D.C. 20036.

COOPERATIVE RESEARCH WITH LATIN AMERICA

The U.S.-Latin American Cooperative Science Program of the NSF seeks to promote beneficial cooperation in scientific research between scientists of the U.S.-Latin America and the independent nations of the Caribbean. U.S. investigators may request supplemental funding to extend on-going research into cooperative efforts with qualified Latin American scientists. Workshops and short-term scientific visits to carry out or complete the planning of cooperative research projects are also supported. Cooperating foreign scientists must obtain support from other sources and submit a matching proposal to their own national science council. Proposals should be prepared according to standard NSF guidelines and describe in detail the cooperative aspects of the workplan and the mutual benefits to be obtained. Deadlines are June 1 and December 1. For further information, contact the appropriate program managers at the National Science Foundation (202-632-5811): Mack Gilkeson (Argentina, Brazil, Mexico); Christine French (all other countries); and Eduardo Feller (all countries).

NSF Bulletin

MATHEMATICS HISTORIAN SOUGHT FOR ORAL HISTORY PROJECT

The American Mathematical Society's Committee to Monitor Problems in Communication has been considering ways in which the immediate past history of mathematical developments, other than the published technical literature, can be preserved. The Committee's attention has focused on an oral history program, in which archival transcripts would be made of extensive interviews with mathematicians who have played key roles in the development of institutions, organizations, research programs or national efforts involving mathematics. Management of this kind of program would require the serious professional commitment of a person trained in both mathematics and some aspects of history. If such a person were available and interested, it is anticipated that funding could be obtained, from government agencies or private foundations, for the support of the work.

Qualified persons who might be interested in making a substantial commitment to a program of this sort are invited to write to Professor George Seligman, Department of Mathematics, Yale University, New Haven, Connecticut 06520, including with the letter a curriculum vitae and whatever other evidence of competence for this kind of work the writer might consider relevant. Writers are encouraged to describe, in whatever detail they can, particular projects or subjects they would be interested in studying from the present point of view.

ADVANCED RESEARCH FELLOWSHIPS IN INDIA, 1980-1981

Twelve long-term (six to ten months) and nine short-term (two to three months) research awards, without restriction as to field, are offered for 1980-1981 by the Indo-U.S. Subcommission on Education and Culture. Applicants must be U.S. citizens at the postdoctoral or equivalent professional level. The fellowship program seeks to open new channels of communication between academic and professional groups in the United Stated and India and to encourage a wider range of research activity between the two countries than has previously existed. Therefore, scholars and professionals who have limited or no experience in India are especially encouraged to apply.

Fellowship terms include: $1,000-$1,500 per month, depending on academic/professional achievement and seniority, $350 per month payable in dollars and the balance in rupees; an allowance for books and study/travel in India; and international travel for the grantee. In addition, long-term fellows receive international travel for dependents; a dependent allowance of $100-$250 per month in rupees; and a supplementary research allowance up to 34,000 rupees.

The application deadline is July 1, 1979. Application forms and further information are available from the Council for International Exchange of Scholars, Attention: Indo-American Fellowship Program, Eleven Dupont Circle, Washington, D.C. 20036 (telephone: 202-833-4980).

NSF STARTS EXPERIMENT TO CUT RED TAPE, PAPERWORK IN ADMINISTRATION OF GRANTS

The National Science Foundation (NSF) has started an experimental program to improve the management of research projects supported by NSF and to simplify administration of research grants.

Dr. Richard C. Atkinson, NSF Director, said the experiment will demonstrate that better accountability is not synonymous with more paperwork.

"If successful," Dr. Atkinson said, "this experiment will show that the nation's universities, working in partnership with the Federal government, can give the American taxpayer more research value for each dollar spent and with a good deal less frustration over red tape."

The two elements of the experiment are a master grant concept and an expanded "Organizational Prior Approval System" (OPAS).

In the master grant concept, research projects approved by NSF in a single fiscal year at an institution are treated as parts of a single grant rather than as individual units. This permits simplified accounting methods and makes it easier for investigators to share resources among research projects.

The specially designed OPAS allows the university to make many of the decisions now normally made by the NSF, except for changes in such matters as the level of effort or scope of work. In return, the university agrees to certain safeguards to ensure that valid decisions are made.

The experimental program does not affect the NSF's peer review system used to evaluate proposals for scientific research programs.

The experimental program will run for one year in the Chemistry Departments of the University of Florida, the University of California, Los Angeles, the University of California, San Diego, and the University of Illinois at Urbana-Champaign. Several other universities also have expressed interest in participating. During the trial period NSF will collect data to determine the advantages and disadvantages of the new procedure. The evaluation will include an audit of accounting transactions to ensure that the system provides appropriate accountability over grant expenditures.

The Association of American Universities helped initiate the new experiment by soliciting suggestions from universities and other interested groups, arranging for discussions of possible techniques, and providing advice.

For further information on the experiment, call George Pilarinos, NSF Deputy Assistant Director, Directorate for Administration at (202) 632-5766.

NSF Press Release

COLLOQUIUM LECTURE NOTES

A set of Colloquium Lectures was presented by Phillip A. Griffiths at the annual meeting in Biloxi, Mississippi, in January 1979. Copies of the lecture notes, entitled "Complex analysis and algebraic geometry" (67 pages), are still available.

Requests should be accompanied by a check or money order for one dollar 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 Biloxi, 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.

QUERIES

Edited by Hans Samelson

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

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

176. **V. Ja. Kreĭnovič** (Pulkovo Special Astrophysical Observatory, 196140 Leningrad 140, U. S. S. R.). Is black-body 3^0K radiation really of cosmological origin or it is a mixture of radiation of many bodies as some physicists admit? Of course, nowadays when only the approximative spectral law is known—we cannot answer for sure. But in case we know precisely that the spectrum follows the Planck law, will it mean that the second case is disproved? In mathematical terms:

(1) if $\forall\omega > 0$ $(\omega^3(e^{\beta_0\omega} - 1)^{-1} = \int_0^\infty A(\beta)\omega^3(e^{\beta\omega} - 1)^{-1}\, d\beta)$ and $A(\beta) \geqslant 0$, is then $A(\beta)$ equal to $\delta(\beta - \beta_0)$?

The positive answer to this question will follow, if one can prove that

(2) if $\forall\omega > 0$ $(\int A(\beta)(e^{\beta\omega} - 1)^{-1}\, d\beta = 0)$ then $A(\beta) \equiv 0$.

Denoting $B = \ln\beta$, $W = \ln\omega$ and turning to Fourier transforms, I can reduce this to the question:

(3) Is Fourier transform of $[\exp(\exp z) - 1]^{-1}$ everywhere different from 0?

Who can prove or disprove any of (1)–(3)?

177. **V. Ja. Kreĭnovič** (Pulkovo Special Astrophysical Observatory, 196140 Leningrad 140, U. S. S. R.). Is there any method (not to use the word "algorithm") to find asymptotics for algebraic integrals $\int_{F_2^1(b)}^{F_1^1(b)} G(x, b)\, dx$, where G and F_i are arbitrary algebraic functions, when $b \longrightarrow \infty$? Any such integral can be reduced (by means of a linear change of variable) to $\int_0^1 G'(x, b)\, dx$ (G' algebraic). It seems true that for any given x, $G'(x, b)$ is asymptotically equal to $b^\nu \cdot a(x)$ for some rational ν and algebraic a, so if $\int_0^1 a(x)\, dx < \infty$ the answer is easy, but if $\int_0^1 a(x)\, dx = \infty$ what to do? E.g. $G'(x, b) = (1 - z)\{(1 + (bz)^2)\}^{-17/12}$? I've found the answer for that G', but by means of a special trick. Who knows what to do in a general case?

178. **William R. Allaway** (Department of Mathematical Sciences, Lakehead University, Thunder Bay, Ontario, Canada P7B 5E1). On a number of occasions members of the Department of Mathematical Sciences here at Lakehead University are asked to give talks to local high school students.

I am wondering if any of the readers of the Queries section of the *Notices of the AMS* could supply appropriate reference material for designing such talks.

179. **Ray E. Artz** (Department of Mathematical Sciences, Northern Illinois University, DeKalb, Illinois 60115). Let $f: \mathbf{R}^2 \longrightarrow \mathbf{R}$ be a C^∞ function, which, together with its derivatives of all orders, decreases rapidly as either argument tends to infinity. Let $\check{f}$ be the inverse Fourier transform on the second argument of f. In view of Bochner's Theorem, f is positive if and only if the mapping

$$(x, y) \longmapsto \check{f}(a, x - y)$$

is the kernel of a positive-definite operator for every $a \in \mathbf{R}$. Is there a known simple property of f which is equivalent to the mapping

$$(x, y) \longmapsto \check{f}\left(\frac{x + y}{2}, x - y\right)$$

being the kernel of a positive-definite operator? Has this question been studied?

180. **Albert A. Mullin** (475-B Cooke Drive, Redstone Arsenal, Alabama 35808). Suppose four lattice points define a rhombus with some interior angle $A \neq \pi/2$. It can be shown that π/A is transcendental for some (allowable) angle A. I would appreciate information which settles either of the following two problems of the geometric theory of transcendental numbers. (1) Can π/A ever be an *algebraic* irrationality? Clearly, π/A can *never* be rational. E.g., it is impossible that $A \in \{\pi/3, \pi/4, \pi/5, \cdots, \pi/n, \cdots\}$.

Analogously, suppose B is an acute interior angle of a right triangle with all sides of integer lengths. (2) Can π/B ever be an *algebraic* irrationality? Surely, π/B is transcendental for some (allowable) angle B. On the other hand, π/B is *never* rational.

RESPONSES

The replies below have been received to queries published in recent issues of the NOTICES. The editor would like to thank all who reply.

167. (vol. 26, p. 54, January 1979, Salzer). No reference was received, but a proof has been given by David Kelly, and is available from the A. M. S. Editorial Department at the following address: Queries Editor, American Mathematical Society, P. O. Box 6248, Providence, RI 02940.

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), deadline dates 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 are the same as the deadlines for abstracts. They are listed on the inside front cover of each issue.

1979-1980. **Academic Year devoted to Algebraic Geometry and Operator Theory,** The Mittag-Leffler Institute, Djursholm, Sweden. (February 1979, p. 123)

1978-1979. **Special Year in Harmonic Analysis,** University of Maryland. (April 1978, p. 192; see also February 1978, p. A-339)

January 1-December 22, 1979. **Mathematisches Forschungsinstitut Oberwolfach** (Weekly Conferences), Federal Republic of Germany. (November 1978, p. 503)

APRIL 1979

2-6. **Tenth Southeastern Conference on Combinatorics, Graph Theory and Computing,** Florida Atlantic University, Boca Raton, Florida. (January 1979, p. 72)

3-5. **1979 ACM SIGNUM Meeting on Numerical Ordinary Differential Equations,** Department of Computer Science, University of Illinois at Urbana-Champaign, Urbana, Illinois. (October 1978, p. 440)

3-5. **IEEE Specifications of Reliable Software Conference,** Cambridge, Massachusetts. (October 1978, p. 441)

3-7. **Thirty-first British Mathematical Colloquium,** University College, London, England. (February 1979, p. 124)

5. **Edinburgh Mathematical Society Meeting,** Stirling, Great Britain. (February 1979, p. 124)

7. **Twenty-first Algebra Day,** Carleton University, Ottawa, Canada. (February 1979, p. 124)

9-11. **The Mathematics of Road Traffic and Land Transport Planning,** University of Surrey, England. (February 1979, p. 124)

16-20. **Conference on Several Complex Variables,** Princeton University, Princeton, New Jersey. (January 1979, p. 72)

19-20. **Regional Combinatorics Minisymposium,** Pocatello, Idaho. (February 1979, p. 124)

20-21. **Triangle Area Topology Conference,** Duke University, Durham, North Carolina.
Invited Speakers: Charles Giffen, John Morgan, Harsh Pittie, Frank Quinn, James Stasheff.
Information: David Kraines, Department of Mathematics, Duke University, Durham, North Carolina 27706.

23-25. **American Nuclear Society Conference on Computational Methods in Nuclear Engineering,** Williamsburg, Virginia. (February 1979, p. 124)

30-May 2. **Eleventh Annual ACM Symposium on Theory of Computing,** Century Center Hotel, Atlanta, Georgia. (November 1978, p. 505)
Program: Thirty-eight talks in areas such as analysis of algorithms, computational complexity, formal languages and automata, theory of computation, and theory of programming.

MAY 1979

1-July 31. **Warwick Symposium on Diffeomorphisms with Application to Foliations,** Mathematics Institute, University of Warwick, Coventry, England. (February 1979, p. 124)

4. **Edinburgh Mathematical Society Meeting,** Stirling, Great Britain.
Information: Department of Mathematics, James C. Maxwell Building, The King's Buildings, Edinburgh, EH9 3JZ, Great Britain.

4-5. **Conference on the Scottish Book,** North Texas State University, Denton, Texas. (February 1979, p. 124)

4-6. **Conference in Analysis,** Purdue University, West Lafayette, Indiana 47907. (January 1979, p. 72)

7-8. **Symposium on Analysis and Computation of Fixed Points,** University of Wisconsin, Madison, Wisconsin. (February 1979, p. 124)

14-18. **Danish-French Colloquium on Potential Theory,** Copenhagen, Denmark. (February 1979, p. 124)

14-18. **1979 Australian Mathematical Society Annual Meeting,** Australian National University, Canberra, Australia.
Invited Speakers: K. Gruenberg, M. Kac, B. B. Mandelbrot, R. B. Potts, M. J. D. Powell, and J. W. Tukey.
Information: E. Seneta, Department of Statistics, Australian National University, Box 4, P. O. Canberra ACT 2600, Australia.

14-31. **First Franco-Southeast Asian Mathematical Conference,** Nanyang University, Singapore. (February 1979, p. 124)

16-18. **Symposium on Applied Mathematics,** Aarhus, Denmark. (February 1979, p. 124)

17-19. **Conference on Integration, Geometry, and Topology in Linear Spaces,** University of North Carolina, Chapel Hill, North Carolina. (February 1979, p. 124)

19-26. **International Conference on Functional-Differential Systems and Related Topics,** Błażejewko, Poland. (November 1978, p. 505)

21-25. **Coxeter Symposium,** Toronto, Canada. (January 1979, p. 72)

23-25. **Optimization Days 1979,** McGill University, Montreal, Canada. (November 1978, p. 505)

24-25. **Symposium on Mathematical Programming with Data Perturbations,** George Washington University, Washington, D. C. (January 1979, p. 72)

26-28. **Canadian Mathematical Society 1979 Summer Meeting,** University of Saskatchewan, Canada. (February 1979, p. 125)

28-30. **Statistical Society of Canada Annual Meeting,** University of Saskatchewan, Saskatoon, Canada. (February 1979, p. 125)

28-30. **Colloquium on Analysis on Varieties,** Metz, France.
Topics: Geometry and topology of varieties, Lie algebras and partial differential equations.
Invited Speakers: M. F. Atiyah, T. Aubin, R. Barre, M. Berger, J. P. Bourguignon, E. Combet, N. Desolneux-Moulis, S. Gallot, F. Hirzebruch, J. P. Jouanolou, A. Lichnerowicz, R. Moussu, J. P. Penot, V. Poenaru, R. Roussarie, T. J. Wilmore.
Information: A. Roux, Département de Mathématiques, Université de Metz, Ile du Saulcy, 57000 Metz, France.

31-June 6. **Seventh Conference of Analytic Functions,** Wisła (Carpathian Mountains, Province Bielsko-Biała), Poland. (October 1978, p. 441)

JUNE 1979

4-8. **Catastrophe Theory and Its Applications,** Salisbury State College, Salisbury, Maryland. (February 1979, p. 125)

5-8. **International Conference on Fundamentals of Numerical Computation,** Technical University of Berlin, Germany. (February 1979, p. 125)

6-13. **Mathematische Arbeitstagung,** Bonn, Federal Republic of Germany.
Information: F. Hirzebruch, Mathematics Institute, University of Bonn, 10 Wegelerstrasse, D-53 Bonn, Federal Republic of Germany.

9-23. **NATO Advanced Study Institute on Mathematical Modelling of Energy Systems,** Boğaziçi University, Istanbul, Turkey.
Invited Speakers: G. B. Dantzig (Stanford); R. J. Deam (London); J. Debanne (Ottawa); L. Ervik (Michelsen Research Institute); D. Finon (Grenoble); W. Haefele (Austria); I. Kavrak (Boğaziçi); W. Nordhaus (Washington, D.C.), A. J. Surrey (Sussex); A. Voss (Federal Republic of Germany).
Information: I. Kavrak, Director, Boğaziçi University, P. K./2 Bebek-Istanbul, Turkey.

11-13. **SIAM 1979 National Meeting,** Royal York Hotel, Toronto, Canada. (February 1979, p. 125)

11-15. **Mathematics and the Microcomputer,** Salisbury State College, Salisbury, Maryland. (February 1979, p. 125)

11-15. **NSF-CBMS Regional Research Conference on Finite Elasticity,** University of Tennessee, Knoxville, Tennessee.
Principal Lecturer: Morton E. Gurtin, Carnegie-Mellon University.
Program: The main purpose of this course will be to acquaint mathematicians and engineers with the main open problems of finite elasticity. The course will be completely self-contained.
Support: Available for twenty-five participants, pending final approval by NSF.
Information and Applications: Applications for participation and possible support should be made as soon as possible. Include a brief vita, a list of any related publications, and an indication of research interests. Applications and information may be obtained from Scott J. Spector, Mathematics Department, University of Tennessee, Knoxville, Tennessee 37916.

11-15. **Gordon Research Conference: Theoretical Biology and Biomathematics,** Tilton School, Tilton, New Hampshire.
Cochairmen: Charles DeLisi, Lee Segel.
Program: Session topics include: Molecular recognition and signal transduction at the single cell level; Information processing and behavioral control by systems of cells; Groups: ecology and epidemiology. There will be several papers presented in each session. The complete program for the Gordon Conferences is published in *Science*, March 9, 1979.
Application: Applications must be submitted in duplicate on the standard application form which may be obtained from the office of the Director. Attendance at each Conference is limited to approximately 100 conferees.
Information: Applications and further information on the Gordon Conferences may be obtained from Alexander M. Cruickshank, Director, Gordon Research Conferences, Pastore Chemical Laboratory, University of Rhode Island, Kingston, Rhode Island 02881.

11-16. **Joint Canada-France Combinatorial Colloquium,** Université de Montréal, Montréal, Canada. (February 1979, p. 125)
Invited Speakers: B. Alspach, A. Astié-Vidal, C. Berge, C. Benzaken, J.-C. Bermond, J. A. Bondy, P. Camion, V. Chvatal, L. Comtet, M. Deza, J. Edmonds, P. Erdös, P. Hell, A. Kotzig, M. Las Vergnas, L. Lovasz, R. C. Mullin, U. S. R. Murty, I. Rival, I. G. Rosenberg, P. Rosenstiehl, G. Sabidussi, R. G. Stanton, W. T. Tutte.

11-July 6. **Eighteenth Session of the Séminaire de Mathématiques Supérieures,** Université de Montréal, Canada.
Program: Abelian groups, modules and related topics.
Invited Speakers: K. Benabdallah, Université de Montréal; V. Dlab, Carleton University; P. C. Eklof, University of California, Irvine; L. Fuchs, Tulane University; C. Peskine, Université de Strasbourg; P. Roberts, University of Utah; K. W. Roggenkamp, University of Stuttgart.
Sponsors: The Ministry of Education of Québec, the National Sciences and Engineering Research Council Canada and the Université de Montréal.
Information: Aubert Daigneault, Département de Mathématiques et de Statistique, Université de Montréal, C.P. 6128, Montréal, Québec, Canada H3C 3J7.

12-15. **MAA Ohio Section Short Course on the Theory of Computing,** University of Akron, Akron, Ohio. (February 1979, p. 125)

12-17. **Colloque International sur les Fibres Vectoriels et Equations Differentielles,** Nice, France.
Participants: W. Barth (Université d'Erlangen); H. Grauert (Université de Göttingen); R. Hartshorne (Université de Californie, Berkeley); M. Schneider (Université de Göttingen); J. L. Verdier (Université Paris-Sud).
Information: H. Laurin, Département de Mathématiques, Parc Valrose, 06034 Nice Cedex, France.

14-19. **Siegen Topology Symposium,** Gesamthochschule Siegen, Federal Republic of Germany.
Speakers: (Tentative). J. F. Adams, M. G. Barratt, W. Browder, E. Brown, J. Cerf, T. tom Dieck, R. Edwards, S. Gitler, D. Gottlieb, W. Hsiang, W. Jaco, I. Madsen, M. Mahowald, R. J. Milgram, R. Oliver, T. Petrie, L. Siebenmann, L. Smith, Ch. Thomas, and many others.
Call for Papers: Contributed papers are solicited in algebraic, differential and geometric topology. Please submit short abstracts before May 31.
Organizing Committee: Ulrich Koschorke and Walter Neumann.
Information: Mathematik V, GH Siegen, Hölderlinstr. 3, 59 Siegen 21, Federal Republic of Germany.

17-23. **Second International Conference on Finite Groups and Geometries,** Han-sur-Lesse, Belgium. (February 1979, p. 126)

18-20. **Functional Differential and Integral Equations Conference,** West Virginia University, Morgantown, West Virginia. (February 1979, p. 126)

18-22. **International Conference on the Global Theory of Dynamical Systems,** Northwestern University, Evanston, Illinois. (January 1979, p. 72)

18-22. **MAA Summer Workshop on Applications of Mathematics in Medicine and Biology,** University of Maine, Orono, Maine.
Topics: Discrete population dynamics, harvesting problems in discrete population models, deterministic models for communicable diseases, Monte Carlo models for common source epidemics.
Principal Lecturer: Maynard Thompson, Indiana University. Other lectures on special topics will be arranged.
Information: P. Locke, Department of Mathematics, University of Maine, Orono, Maine 04469.

20-22. **1979 International Symposium on Fault-Tolerant Computing,** Madison, Wisconsin. (October 1978, p. 441)

20-22. **Third IMACS International Symposium on Computer Methods for Partial Differential Equations,** Lehigh University, Bethlehem, Pennsylvania. (October 1978, p. 441)

25-29. **1979 International Symposium on Information Theory,** Grignano, Italy. (October 1978, p. 441)

25-29. **International Symposium in Differential Geometry in Honor of S. S. Chern,** University of California, Berkeley, California. (February 1979, pp. 126, A-264)

26-29. **Dundee Biennial Conference on Numerical Analysis,** Dundee, Scotland. (February 1979, p. 126)

27-29. **Conference on the Numerical Analysis of Semiconductor Devices,** University of Dublin, Ireland. (February 1979, p. 126)

27-29. **LARS/IEEE Symposium on Machine Processing of Remotely Sensed Data,** Purdue University, West Lafayette, Indiana. (February 1979, p. 126)

JULY 1979

1-20. **London Mathematical Society Conference on Aspects of Contemporary Complex Analysis,** Collingwood College, Durham University, England. (January 1979, p. 73)

2-6. **Conference on Low Dimensional Topology,** University College of North Wales, Bangor, United Kingdom. (February 1979, p. 126)

2-6. **Workshop on Current Problems in General Relativity,** Dublin Institute for Advanced Studies, Dublin, Ireland.
Program: The emphasis of the workshop will be on equations of motion and related topics. Invited participants will include J. L. Anderson (New Jersey); W. G. Dixon (Cambridge); J. Ehlers (Munich); R. A. Matzner (Texas); R. F. O'Connell (Louisiana); I. Robinson (Texas).
Information: Director, School of Theoretical Physics (Working Seminar 1979), Dublin Institute for Advanced Studies, 10 Burlington Road, Dublin 4, Ireland.

2-7. **An International Symposium on Functional Differential Equations and Bifurcation,** Universidade de São Paulo, Brazil.
Program: The Symposium will be devoted to general lectures and communications on the basic fields of the subject: qualitative theory, stability and asymptotic behavior and applications of bifurcation theory related to ordinary, partial and functional differential equations.
Invited Lecturers: (Partial list). J. Carr (Heriot-Watt Univ.); S. N. Chow (Michigan State Univ.); J. K. Hale (Brown Univ.); J. Kato (Tohoko Univ.); R. Magnus (Iceland Univ.); J. Mallet-Paret (Brown Univ.); J. E. Marsden (Univ. of California-Berkeley); D. G. De Figueiredo (Univ. de Brasília); W. M. Oliva (Univ. de São Paulo); C. S. Hönig (Univ. de São Paulo); J. Palis Jr. (IMPA-Brasil); J. S. Tello (IMPA/Brasil).
Chairman: A. F. Izé.
Information: Instituto de Ciências Mathemáticas de São Carlos, Universidade de São Paulo, Caixa Postal 668, 13.560-São Carlos, São Paulo, Brasil.

2-8. **Conference in Algebraic Geometry: Varieties of Low Dimension,** Université d'Angers, Angers, France. (February 1979, p. 126)

2-20. **Recent Developments in Number Theory,** Queen's University, Kingston, Ontario, Canada. (February 1979, p. 126)

3-5. **Symposium on Fixed Point Algorithms and Complementarity,** University of Southampton, Southampton, England. (February 1979, p. 126)

10-21. **Geometry and Physics,** Durham, Great Britain.
Information: Department of Mathematics, University of Durham, Durham, DH1 3LE, Great Britain.

16-20. **Sixth International Colloquium on Automata, Languages and Programming,** Graz, Austria. (January 1979, p. 73; February 1979, p. 126)

22-August 1. **Conference on Noetherian Rings and Rings with Polynomial Identity,** Durham, Great Britain. (February 1979, p. 126)

22-August 1. **Progress in Analytic Number Theory,** Grey College, Durham, Great Britain. (February 1979, p. 126)

22-August 12. **Canadian Mathematical Society Annual Seminar,** University of Toronto, Toronto, Canada (February 1979, p. 144)

AUGUST 1979

5-14. **Logic Colloquium 1979,** University of Leeds, Great Britain.
Information: F. R. Drake, Logic Colloquium 1979, Department of Pure Mathematics, The University, Leeds LS2 9JT, Great Britain.

6-10. **Ninth Conference on Stochastic Processes and their Applications,** Northwestern University, Evanston, Illinois. (February 1979, p. 127)

6-10. **International Seminar on Functional Analysis, Holomorphy and Approximation Theory,** Universidade Federal do Rio de Janeiro, Brazil. (February 1979, p. 127)

6-10. **Second Symposium on Algebraic and Differential Topology,** Pontifica Universidade Catolica Rio de Janeiro.
Program: Invited and contributed lectures. For contributed papers, send manuscript or abstract by June 30, 1979.
Main Participants: S. Gitler, P. Hilton (tentative), I. M. James.
Information: Joao Pitombeira de Carvalho, Departamento de Matematica PUC/RJ, 22453 Rio de Janeiro, RJ, Brazil.

6-16. **International Conference in Banach Spaces,** Kent State University, Kent, Ohio. (February 1979, p. 127)

11-16. **Fourth International Congress on Mathematics Education,** Berkeley, California.
Information: J. K. Goldhaber, National Research Council/Mathematics, 2101 Constitution Avenue N.W., Washington, D.C. 20418.

13-18. **Workshop on the Present Trends in Representation Theory,** Carleton University, Ottawa, Canada.
Program: There will be four series of lectures: Block Theory (J. Alperin, Chicago); Highest Weight Modules for Semisimple Lie Algebras (J. E. Humphreys, Amherst); Trends in Representation Theory (P. Gabriel, Zurich); Algorithms for Solving Vector Space Problems (C. M. Ringel, Bielefeld). Additional series of lectures as well as seminars and discussions will be organized. The workshop precedes the Second International Conference on Representations of Algebras, to be held August 20-25.
Information: V. Dlab, Department of Mathematics, Carleton University, Ottawa, Canada K1S 5B6.

15-22. **Second International Symposium in West Africa on Functional Analysis and Its Applications,** University of Science and Technology, Kumasi, Ghana. (February 1979, p. 127)

16-18. **Symposium in Real Analysis,** University of Wisconsin, Milwaukee, Wisconsin.

Program: A. Bruckner will present a series of five lectures dealing with current developments in differentiation theory. In addition, it is expected that there will be sessions of contributed papers in related areas. Those interested in presenting such papers should submit abstracts by June 15, 1979.

Sponsor: College of Letters and Science and the Graduate School, University of Wisconsin, Milwaukee.

Support: Some limited support for food and lodging will be available on a selected basis.

Information: R. J. O'Malley or C. M. Lee, Department of Mathematical Sciences, University of Wisconsin, Milwaukee, Wisconsin 53201.

20-25. **Second International Conference on Representations of Algebras,** Carleton University, Ottawa, Canada.

Organizing Committee: J. Alperin (Chicago), M. Auslander (Brandeis), V. Dlab (Carleton), P. Gabriel (Zurich), I. Reiner (Illinois), C. M. Ringel (Bielefeld), A. V. Rojter (Kiev), H. Tachikawa (Tsukuba).

Information: V. Dlab, Department of Mathematics, Carleton University, Ottawa, Canada K1S 5B6.

22-29. **The Sixth International Congress of Logic, Methodology and Philosophy of Science,** Hannover, Federal Republic of Germany. (February 1979, p. 127)

23-September 8. **IXème Ecole D'Eté de Calcul des Probabilités de Saint-Flour,** Université de Clermont, France. (January 1979, p. 52)

26-September 1. **Canadian Mathematical Society Summer Research Institute on Mathematical Methods in Continuum Mechanics,** Quebec, Canada. (February 1979, p. 127)

26-September 1. **Second Australian Number Theory Conference,** Macquarie University, Sydney, Australia. (February 1979, p. 127)

27-31. **Tenth International Symposium on Mathematical Programming,** Montreal, Canada. (January 1979, p. 52)

27-31. **Colloquium on Finite Algebra and Multiple-valued Logic,** József Attila University, Szeged, Hungary. (February 1979, p. 127)

SEPTEMBER 1979

3-7. **Twelfth European Meeting of Statisticians,** Varna, Bulgaria. (February 1979, p. 127)

4-9. **Ninth IFIP Conference on Optimization Techniques,** Warsaw, Poland. (November 1978, p. 505)

9-13. **Symposium on Trends in Applications of Pure Mathematics to Mechanics,** Heriot-Watt University, Edinburgh, Scotland.

Sponsor: The International Society for the Interaction of Mechanics and Mathematics.

Program: The meeting will be devoted to problems related to nonlinear differential equations. Lectures will be of one-hour duration and primarily by invitation. Prospective participants are asked to inform the organizing committee well in advance of their intention to attend.

Information: R. J. Knops, Mathematics Department, Heriot-Watt University, Riccarton, Currie, Edinburgh EH14 4AS, Scotland.

16-21. **Lambda-Calculus Conference,** University College of Swansea, Swansea, Wales. (February 1979, p. 127)

19-21. **Sixteenth Midwestern Mechanics Conference,** Kansas State University, Manhattan, Kansas. (November 1978, p. 506)

OCTOBER 1979

8-10. **Session on Physical Systems Science,** Denver, Colorado. (February 1979, p. 127)

29-31. **Twentieth IEEE Symposium on Foundations of Computer Science,** San Juan, Puerto Rico. (February 1979, p. 127)

LATE ENTRIES

May 10–12. **John H. Barrett Memorial Lectures,** University of Tennessee, Knoxville, Tennessee. (See February 1979, p. 122)

June 3-5. **The Impact of Mini and Micro Computers on Bibliographic Data Bases,** Ottawa, Canada.

Information: Association for Information and Dissemination Centers, P. O. Box 8105, Athens, Georgia 30603.

July 16-20. **Computational Probability Lecture Series,** Johns Hopkins University, Baltimore, Maryland.

Program: The principal speaker will be M. F. Neuts of the University of Delaware. There will also be contributed talks.

Information: Alan F. Karr, Department of Mathematical Sciences, Johns Hopkins University, Baltimore, Maryland 21218.

August 6–10. **NSF-CBMS Regional Conference on Analytic Methods in Commutative Algebra,** George Mason University, Fairfax, Virginia.

Principal Speaker: Melvin Hochster (University of Michigan).

Program: Professor Hochster will deliver a series of ten lectures. In addition there will be opportunity for presentations by other participants.

Support: Financial support (subject to final approval of NSF) for travel, meals, and lodging will be available for twenty-five invited participants. A limited number of additional participants will be invited to attend at their own expense.

Information: Persons interested in participating should enclose a brief vita and indication of research interests and write directly to: Richard N. Draper, Conference Director, or M. R. Gabel, Assistant Conference Director, Department of Mathematics, 4400 University Drive, Fairfax, Virginia 22030.

September 16–18. **Non-Bibliographic Data Bases,** Boston, Massachusetts.

Host: New England Research Application Center.

Information: Association for Information and Dissemination Centers, P. O. Box 8105, Athens, Georgia 30603.

NEW AMS PUBLICATIONS

PROCEEDINGS OF THE STEKLOV INSTITUTE
(ISSN 0081-5438)

THEORY AND APPLICATIONS OF DIFFERENTIABLE FUNCTIONS OF SEVERAL VARIABLES. VI
edited by S. M. Nikol'skiĭ

In the papers of this collection, imbedding and extension theorems in the norms of weighted spaces are established for classes of differentiable functions. Generalizations of the Littlewood-Paley theorem and a theorem on multipliers are presented, as well as multiplicative estimates of derivatives and interpolation theorems. Multiplicative estimates of moduli of smoothness are obtained, and questions of extending functions in Sobolev spaces are studied in addition to questions of pasting functions together. Conditions for the existence of seminorms of the Sobolev operator are found, along with conditions for the solvability of some singular equations. The questions of comparative strength and hypoellipticity are investigated for general differential operators. An addendum to the Radon-Nikodým theorem is given. Difference methods are proposed and studied for Laplace's equation on polygonal domains and for nonlinear problems for ordinary differential equations.

Parts I through V of this series on differentiable functions were published as Volumes 77 (1965), 89 (1967), 105 (1969), 117 (1972), and 131 (1974) of the Proceedings of the Steklov Institute and were included in this series of translations of those Proceedings.

Number 140 (1976)
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PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS
(ISSN 0082-0717)

RELATIONS BETWEEN COMBINATORICS AND OTHER PARTS OF MATHEMATICS
edited by Dijen K. Ray-Chaudhuri

This volume contains lectures given at the Symposium on Relations between Combinatorics and Other Parts of Mathematics held at the March 1978 meeting of the Society at Ohio State University in Columbus, Ohio. Invited speakers focused on interconnections between combinatorics and geometry, group theory, number theory, special functions, lattice packings, logic, topological embeddings, games, experimental designs, and sociological and biological applications.

The table of contents is as follows:

George E. Andrews, *Connection coefficient problems and partitions*
David W. Barnette, *Path problems and extremal problems for convex polytopes*
James E. Baumgartner, *Independence proofs and combinatorics*
Raj C. Bose, *Combinatorial problems of experimental design. I: Incomplete block designs*
Francis Buekenhout, *The geometry of diagrams*
Peter J. Cameron, *A combinatorial toolkit for permutation groups*
Joel E. Cohen, János Komlós, and Thomas Mueller, *The probability of an interval graph, and why it matters*
H. S. M. Coxeter, *On R. M. Foster's regular maps with large faces*
Charles F. Dunkl, *Orthogonal functions on some permutation groups*
Paul Erdös, *Combinatorial problems in geometry and number theory*
Dominique Foata and Adriano M. Garsia, *A combinatorial approach to the Mehler formulas for Hermite polynomials*
A. M. Garsia and J. Remmel, *On the raising operators of Alfred Young*
Branko Grünbaum and G. C. Shephard, *Incidence symbols and their applications*
A. J. Hoffman, *Linear programming and combinatorics*
J. M. Goethals and J. J. Seidel, *Spherical designs*
Neil J. A. Sloane, *Self dual codes and lattices*
Louis Solomon, *Partially ordered sets with colors*
Alan P. Sprague, *Incidence structures with specified planes*
Richard P. Stanley, *Combinatorics and invariant theory*
John Philip Huneke, *On the genus of a graph*
Richard M. Karp, *Probabilistic analysis of a canonical numbering algorithm for graphs*

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MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY
(ISSN 0065-9266)

ORTHOGONAL POLYNOMIALS
by Paul G. Nevai

The purpose of the paper is to improve some results of R. Askey, P. Erdös, G. Freud, L. Ya. Geronimus, U. Grenander, G. Szegö and P. Turan on orthogonal polynomials, Christoffel functions, orthogonal Fourier series, eigenvalues of Toeplitz matrices and Lagrange interpolation. In particular, Turan's problem is answered: is there any weight w with compact support such that for each $p > 2$ the Lagrange interpolating polynomials corresponding to w diverge in L^p_w for some continuous function f? Most of the paper deals with Christoffel functions and their applications. Many asymptotics and limit relations are found for orthogonal polynomials on the assumption that the coefficients in the recursion formula behave in a prescribed way.

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IDEALS OVER UNCOUNTABLE SETS: APPLICATION OF ALMOST DISJOINT FUNCTIONS AND GENERIC ULTRAPOWERS
by Thomas Jech and Karel Prikry

This work is a systematic study of ideals over uncountable sets. The role of various properties of ideals in arithmetic of cardinal numbers is investigated. It is shown that there is a deep relationship between saturation of ideals and cardinal exponentiation. Precipitous ideals are introduced and used in connection with the singular cardinals problem.

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NATURALLY REDUCTIVE METRICS AND EINSTEIN METRICS ON COMPACT LIE GROUPS

by J. E. D'Atri and W. Ziller

The first part of this paper constructs a class of naturally reductive metrics on compact Lie groups and shows that all naturally reductive left invariant metrics are of this type if the group is simple. Results are also obtained concerning the isometry group, geodesics, sectional curvatures, and the question of holonomy irreducibility for such a metric. The second part analyzes the question of when these metrics are Einstein. Many new examples are given and a complete classification is given in certain cases. In doing this, certain facts are established about the ratios of the Killing forms of a Lie algebra and a subalgebra. Finally, some results are given for noncompact groups and for more general compact homogeneous spaces.

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MISCELLANEOUS

Nonacademic Employers of Ph. D. Mathematicians

The Employment Concerns Subcommittee of the Society's Committee on Employment and Educational Policy (CEEP) felt that graduate students in mathematics and their advisors would find useful a list of organizations where Ph.D. mathematicians have found nonacademic employment. The list below contains the names of organizations that have employed Ph.D. mathematicians; it is not a directory of employers seeking mathematicians, and should not be used as such. (Those seeking nonacademic or academic employment should consult Employment Information in the Mathematical Sciences, which is published jointly by the AMS and the MAA six times each year.)

In October 1977 CEEP conducted a survey of salaries paid Ph.D. mathematicians with full-time nonacademic employment in the United States. The results of that survey were published in the August 1978 NOTICES, pages 307-310, and the following list was derived from its responses.

The list on nonacademic employers below contains, with few exceptions, those organizations which were mentioned as the employer of at least two people who responded to the salary survey. This list does not include the names of a substantial number of organizations which were mentioned as being employers of one of the respondents to the survey; among these organizations are insurance companies, state, county and city governments, medical centers, and small consulting firms. Anyone considering nonacademic employment should be aware that others have found jobs in such places.

BUSINESS AND INDUSTRY

Aerospace Corp. - El Segundo, CA
Amoco Production Co. - Tulsa, OK
ARINC Research Corp. - Annapolis, MD
Argonne National Laboratory - Argonne, IL

Babcock and Willcox - Barberton, OH; Lynchburg, VA
Battelle Memorial Institute - Columbus, OH; Richland, WA
BDM Corp. - Las Vegas, NV; McLean, VA
Bell Laboratories - Holmdel, Murray Hill, Piscataway, Whippany, NJ
Boeing - Seattle, WA
Brookhaven National Laboratory - Upton, NY

Center for Naval Analyses - Arlington, VA
Chevron Research Co. - Richmond, CA
Chrysler Corp. - Detroit, MI
Computer Science Corp. - San Diego, CA; Silver Spring, MD; Arlington, VA
Control Data Corp. - St. Paul, MN

Draper Laboratory - Cambridge, MA
Digital Equipment Corp. - Maynard, MA
Dresser Industries - Pittsburg, PA; Olean, NY

EG&G Idaho, Inc. - Idaho Falls, ID
EPL Analysis - Olney, MD
ESL, Inc. - Sunnyvale, CA
Eastman Kodak Co. - Rochester, NY
EXXON Production Research Co. - Houston, TX

General Electric Co. - Schenectady, NY; Cincinnati, OH
General Research Corp. - Santa Barbara, CA
Grumann Aerospace Corp. - Bethpage, NY

Honeywell, Inc. - Minneapolis, MN
Hudson Institute - Cornwall-on-Hudson, NY
Hughes Aircraft - Culver City, Fullerton, CA

Institute for Defense Analyses - Princeton, NJ
IBM Corp. - Los Angeles, San Jose, CA; Armonk, Poughkeepsie, Yorktown Heights, NY

Jet Propulsion Laboratory - Pasadena, CA
Johns Hopkins University, Applied Physics Laboratory - Laurel, MD

Lawrence Livermore Laboratory - Livermore, CA
Lockheed - Sunnyvale, CA
Los Alamos Scientific Laboratory - Los Alamos, NM

Mathematica, Inc. - Princeton, NJ
McDonnell-Douglas - St. Louis, MO; Houston, TX
Mitre Corp. - McLean, VA
Mobile Oil Co. - New York, NY

Parke Mathematical Laboratories, Inc. - Carlisle, MA
Pratt and Whitney Aircraft Div. - East Hartford, CT

RCA Corp. - Princeton, NJ
Rand Corp. - Santa Monica, CA
Raytheon Co. - Wayland, MA
Rockland Research Institute - Orangeburg, NY

System Development Corp. - Santa Monica, CA
Sandia Laboratories - Livermore, CA; Albuquerque, NM
Science Applications, Inc. - McLean, VA
Stanford Research Institute - Menlo Park, CA
Sun Oil - Dallas, TX

Texaco, Inc. - Houston, TX
Texas Instruments, Inc. - Dallas, TX
TRW - Huntsville, AL; Redondo Beach, CA

Union Carbide Corp. - Oak Ridge, TN

Vought Corp. - Dallas, TX

Daniel H. Wagner Associates - Paoli, PA
Westinghouse - Pittsburgh, PA

Xerox - Palo Alto, CA

GOVERNMENT

Bureau of Census

Central Intelligence Agency

Department of Agriculture
Department of Commerce
Department of Defense
Department of Energy
Department of Health, Education & Welfare

Food and Drug Administration

ICASE (NASA)
Internal Revenue Service

National Center for Atmospheric Research
National Security Agency
National Aeronautics & Space Administration
National Bureau of Standards
National Institutes of Health
National Oceanographic & Atmospheric Administration
National Science Foundation

Office of Naval Research

Pension Benefit Guaranty Corp.

Social Security Administration

Tennessee Valley Authority

U. S. Air Force
U. S. Army
U. S. Navy

Personal Items

JANOS GALAMBOS of Temple University, Philadelphia, has been elected to membership in the International Statistical Institute.

JOSEPH B. KELLER of Courant Institute of Mathematical Sciences, was awarded the degree of Doctor Technices Honoris Causa on the occasion of the 150th anniversary of the Technical University of Denmark. The award was made in recognition of his significant achievements in a number of fields within applied mathematics and mathematical physics and for the associated contribution to engineering science.

JONATHAN D. SONDOW of Rice University has been appointed a visiting scholar at Columbia University.

PROMOTIONS

To Senior Associate. Daniel H. Wagner, Associates: WILLIAM J. BROWNING, BRUCE E. SCRANTON.

Deaths

Dean Emeritus RODNEY W. BABCOCK of Kansas State University College of Arts and Sciences died on January 10, 1979 at the age of 89. He was a member of the Society for 57 years.

Dr. WALTER H. GAGE of the University of British Columbia died on October 3, 1978 at the age of 73. He was a member of the Society for 51 years.

Professor Emeritus MILDRED E. TAYLOR of Mary Baldwin College died on November 3, 1978 at the age of 80. She was a member of the Society for 51 years.

Dr. ROGER N. VAN NORTON of Advanced Computer Techniques Corporation died on November 19, 1978 at the age of 49. He was a member of the Society for 25 years.

WARREN WEAVER, see page 182.

AMS REPORTS AND COMMUNICATIONS

Recent Appointments

Committee members' terms of office expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

Felix Browder (1980) and Ronald G. Douglas (1980) were elected to the Executive Committee of the Council by the Council members. The other members of the Executive Committee are R. H. Bing (1979 ex officio), Peter D. Lax (1981 ex officio), Everett Pitcher (1980 ex officio), Linda Preiss Rothschild (1979), and Stephen S. Shatz (1979).

Members of the Committee on Committees have been appointed by President Peter D. Lax to serve during his term as President (1979, 1980). They are: James A. Donaldson, Ronald G. Douglas, Ronald L. Graham, Wendell H. Fleming, Linda Preiss Rothschild, and Hans F. Weinberger (chairman). Everett Pitcher is a member ex officio.

An ad hoc Committee on Modes of Support of Research was authorized by the Council of January 23, 1979. The members, appointed by President Peter D. Lax are Herbert B. Keller, Calvin C. Moore, George D. Mostow (chairman), Ralph S. Phillips, James D. Stasheff, Elias M. Stein, and Hans F. Weinberger. The charge of the committee is twofold: (1) to collect, examine, formulate and circulate proposals from the mathematical community for mechanisms to foster progress in research in mathematics, and (2) to make recommendations for appropriate action to the Council at its April meeting.

Frank C. Hoppensteadt (1982) and Donald A. Ludwig (1982) were appointed to the joint Committee on Mathematics in the Life Sciences by President Werner C. Rheinboldt of SIAM and President R. H. Bing of the AMS. Continuing members of the Committee are Hans J. Bremermann (1979), Jack D. Cowan (1980), Murray Gerstenhaber (1979), Stuart Kauffman (1979), Simon Levin (1979), Robert M. May (1981), George F. Oster (1980) (chairman), and Sol I. Rubinow (1981).

Report on Yeshiva University

In June of 1977 the administration of Yeshiva University decided to close the Belfer Graduate School of Science. The school had originally been established, under an agreement with the Belfer family, who contributed substantial funds, for the perpetual purpose of providing "graduate programs in the fields of mathematics, science and education,...and to promote and develop research by advanced graduate students and faculty members." During the preceding fifteen years the Belfer School had developed into a major research institution in mathematics and physics.

Because of the calibre of the program, the paucity of faculty involvement in the decision-making process, the lack of appropriate concern for the fate of graduate students and the threat of termination of faculty members' appointments, the American Mathematical Society became involved in the issues surrounding the closing of the school.

In August, 1977, President Bing appointed a committee to represent the Society's interests in the affair. The committee consisted of Kenneth Hoffman, Chair of the Mathematics Department at MIT, G. D. Mostow, Professor of Mathematics and former Chair of the Department at Yale, and Shlomo Sternberg, then Chair of the Department at Harvard, acting as Chair. Also, Professor Murray Gerstenhaber of Penn acted as advisor to this committee and as an ex officio member. On 1 November, Professor Sternberg met with Mr. Belfer, the original donor. Mr. Belfer is a member of the Board of Trustees of Yeshiva University, but the decision about the School was made at a Trustees' meeting from which he was absent. The Belfer family appeared concerned by the closing of the School, but despite an indication of willingness to help in efforts to sustain the School, apparently there has as yet been no action in that direction by the Belfer family.

The AMS committee arranged a meeting on 21 March, 1978, with President Lamm and members of the Yeshiva Administration. At that meeting the committee recommended a number of steps which would reorganize the Belfer School so as to maintain its viability as a research center, without necessarily continuing the graduate program if the need for graduate study no longer existed. The committee also indicated possible sources of funding for these projects. At the same time, the committee indicated to the Administration that it expected a clear statement of their policy toward tenured academic personnel. The Administration was not responsive.

On 29 August, 1978, Professors Charles Patt and Norman Rosenfeld were given letters terminating their tenure appointments and giving them each a year's leave with pay. Professor Rosenfeld had been an associate professor since 1968; Professor Patt had taught at Yeshiva since 1965 and had been an associate professor since 1976. Professor Patt had throughout his career at Yeshiva been primarily concerned with undergraduate education, as had Professor Rosenfeld since 1975. The reason given for the terminations was that the "reorganization" eliminated the need for several full-time positions. Apparently, the Administration plan was to move those faculty who had been primarily concerned with research and graduate education into the undergraduate school and dismiss on a reverse seniority-by-rank basis tenured professors in the pool thus formed, even though those thereby selected had formerly been associated exclusively with undergraduate teaching. In addition, the Administration apparently persuaded two distinguished senior researchers to reject other offers and to remain at Yeshiva and refused to allow others to take scheduled sabbaticals. Moreover, adjunct part-time faculty were hired to meet the teaching needs resulting from the reduction in full-time staff; indeed both terminated faculty were hired on that basis.

Professor Rosenfeld received a letter of reinstatement on 20 November, 1978, which apparently leaves him in the same precarious position as other Yeshiva faculty with respect to his continued tenure; a provision of their regulations allows the administration to eliminate positions through "reorganization." Professor Patt has not, as of the time of writing this report, been reinstated and has experienced considerable difficulty in collecting his severance pay, his salary for the last few months of the 1977-1978 academic year, and his pay for teaching courses on a part-time basis this past fall.

Since there appear to be substantial questions as to whether normal academic practices were followed by the Yeshiva administration, the report of the AMS special committee was referred to the Society's Committee on Academic Freedom, Tenure and Employment Security (CAFTES) in December 1978. Realizing that the situation is still in flux, but alarmed by the serious nature of the situation, CAFTES recommended to the January AMS Council meeting

(1) that the matter be placed on the agenda of the April Council meeting and that representatives of the Yeshiva administration be invited to present their views; meanwhile CAFTES should monitor the situation closely and also keep in touch with AAUP;

(2) that the issue of closing graduate programs be referred to the AMS Committee on Employment and Educational Policy (Lida Barrett, chair) for consideration of such matters as the rights of students, the right of graduate faculty to move into undergraduate programs, the appropriate mechanisms and standards for deciding when to close graduate programs;

(3) that the possibility of the AMS' serving as an institutional affiliation for Yeshiva faculty applying for NSF contracts be explored with the NSF and the AMS trustees;

(4) that Professors Sternberg, Gerstenhaber and Mary Gray (chair of CAFTES) prepare a report for publication in the NOTICES.

The Council did approve the third and fourth recommendations and the Committee on Employment and Educational Policy has agreed to study the question of closing graduate programs.

Mary W. Gray
Murray Gerstenhaber
Shlomo Sternberg

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SIAM-AMS PROCEEDINGS

COMPUTATIONAL FLUID DYNAMICS

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This volume is based on lecutres given at the Symposium on Computational Fluid Dynamics which was held April 14–15, 1977 in New York City. The symposium consisted of three sessions with the following topics. In the area of applications, an area of particular current activity, meterological computations, were presented along with open numerical problems. Another section was devoted to computational methods for the Navier-Stokes equations. Finally, some special methods for nonlinear waves and transonic flows were included. Authors and their lectures in the Table of Contents are:

Bengt Fornberg, *Pseudospectral calculations on 2-D turbulence and nonlinear waves*

Alexandre J. Chorin, *Random vortices and random vortex sheets*

Carl W. Kreitzberg, *Progress and problems in regional numerical weather prediction*

Harold D. Orville, *The numerical simulation of severe convective storms*

R. F. Warming and Richard M. Beam, *On the construction and application of implicit factored schemes for conservation laws*

Robert W. MacCormack, *An efficient explicit-implicit-characteristic method for solving the compressible Navier-Stokes equations*

S. C. R. Dennis, *The computation of two-dimensional asymmetrical flows past cylinders*

Some knowledge of numerical analysis is required.

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NONLINEAR PROGRAMMING

edited by R. N. Cottle and C. E. Lemke

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M. J. D. Powell
R. T. Rockafellar

These Proceedings are based on lectures delivered at the Symposium on Nonlinear Programming held March 23 and 24, 1975, as part of the American Mathematical Society's annual New York meeting. This event was the ninth in a series of Symposia in Applied Mathematics jointly sponsored by the Society for Industrial and Applied Mathematics and the American Mathematical Society with financial support from the Energy Research and Development Agency (formerly the Atomic Energy Commission) and the National Science Foundation.

The organizing committee for the Symposium consisted of R. W. Cottle (Chairman), C. E. Lemke, S. M. Robinson, and J. B. Rosen. The committee's avowed intent was to help bring to the attention of a larger mathematical audience some of the history, theory, applications and vigorous research activity of the Nonlinear Programming field. The program was largely tutorial, although excellent talks on new results were purposely included and the speakers were encouraged to identify promising regions for further exploration.

1976, 200 pages; list $15.60; institutional member $11.70;
individual member $7.50. Code: SIAMS/9

COMPLEXITY OF COMPUTATION

edited by Richard M. Karp

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M. O. Rabin
M. H. Schultz
J. F. Traub

During the last decade computational complexity has become one of the most active research areas within the mathematical theory of computation. Workers in computational complexity seek to derive efficient algorithms for computational problems of practical interest, to prove the optimality of particular algorithms relative to well-defined measures of computational efficiency, and to derive general lower bounds on the time or space intrinsically necessary for the performance of computational tasks. The specific problems considered are drawn from diverse areas, including numerical computation, symbolic algebraic computation, combinatorics, computational logic and the manipulation of data structures. The mathematical tools called upon range from algebraic geometry to computability theory.

1974, 166 pages; list $18.40; institutional member $13.80;
individual member $9.20. Code: SIAMS/7

COMPUTERS IN ALGEBRA AND NUMBER THEORY

edited by G. Birkhoff and M. Hall, Jr.

This volume contains the written versions of talks delivered at the Symposium on Computers in Algebra and Number Theory on March 25 and 26, 1970.

Applications of algebraic ideas to computing are first considered by Garrett Birkhoff and Shmuel Winograd. Their papers devote especial attention to problems of optimizing computer algorithms.

The next five articles are devoted to number theory and combinatorial theory. Those by H. P. F. Swinnerton-Dyer and Bryan Birch are pure number theory, that by Leonard Baumert purely combinatorial. Hans Zassenhaus considers the problem of finding the Galois group of a field extension. J. H. van Lint studies perfect error-correcting codes and applies the effective methods of Alan Baker to related Diophantine problems.

The final section deals with the application of computers to finite groups. Problems on the construction and uniqueness of the new sporadic simple groups have involved heavy use of computers, and in several instances the existence of the groups has not been proved in any other way. The article by Marshall Hall is concerned with problems of existence and construction. The paper by M. D. Hestenes and D. G. Higman is concerned with relations between graphs and permutation groups. The articles by John Conway, John McKay, John Cannon, and Charles Sims deal with problems on the structure and subgroups of groups already known. Joachim Neubüser is concerned with algorithms for detailed analysis of a known group.

1971, 200 pages; list $16.80; institutional member $12.60;
individual member $8.40. Code: SIAMS/4

PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS

MATHEMATICAL ASPECTS OF COMPUTER SCIENCE

edited by J. T. Schwartz

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J. Hartmanis, *Context-free languages and Turing machine computations*

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Volume 19

1967, 266 pages

List price $12.80; institutional member $9.60;
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Code: PSAPM/19

THE INFLUENCE OF COMPUTING ON MATHEMATICAL RESEARCH AND EDUCATION

edited by Joseph P. LaSalle

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This volume contains seven of the invited addresses and fourteen of the contributed papers that were presented at the joint American Mathematical Society and the Mathematical Association of America Conference on the Influence of Computing on Mathematical Research and Education held at the University of Montana, August 13–24, 1973.

The invited addresses were directed primarily to the influence of the computer on mathematical research and the application of mathematics and secondarily on what this means for the teaching of mathematics and the education of mathematicians. The contributed papers describe more specifically some experiments in developing courses in mathematics with computing and algorithmic orientations and a few reports on computer influenced research.

1974, 205 pages; list $21.20; institutional member $15.90; individual member $10.60. Code: PSAPM/20

PROCEEDINGS OF THE STEKLOV INSTITUTE

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N. I. Černyh, *Approximation of analytic functions by trigonometric polynomials on a segment smaller than the period*

1974, 133 pages; list $22.80; institutional member $17.10; individual member $11.40. Code: STEKLO/109

MATHEMATICS OF COMPUTATION

MATHEMATICS OF COMPUTATION (formerly Mathematical Tables and Other Aids to Computation) is published quarterly by the American Mathematical Society. The journal is devoted to papers on advances in numerical analysis, the application of computational methods, mathematical tables, high-speed calculators, and other aids to computation. There is a section for reviews and description of tables and books, and a section for table errata. Various issues also contain a microfiche supplement. This journal is published quarterly in January, April, July, and October; index appears in October issue. Volume 33 begins with the January 1979 issue. (ISSN 0025-5718). 1979 subscription prices; member of CBMS Organizations*, $29.00; institutional member $39.00; list $55.00; individual member $20.00.

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Abstracts of Papers Presented to the Society

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Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

79T-A80 V. R. CHANDRAN, The Ramanujan Institute for Advanced Study in Mathematics, Chepauk, Madras-5, India. On δ-rings.

By a δ-ring we mean a ring R with a finite subset of R such that for every x in R, there is a polynomial $p_x(t)$ with integer coefficients depending on x such that $x-x^2p_x(x)$ is in S. M. S. Putcha and Adilyaqub (refer Math. Japon. 22(1977), 13-20) have proved that every Jacobson semisimple δ-ring is a subdirect sum of a finite ring and a commutative ring and have posed as an open problem whether every δ-ring can be written like that. In this paper we construct an infinite, noncommutative, subdirectly irreducible δ-ring which solves the problem posed by the authors in the negative. (Received November 3, 1978.) (Author introduced by Dr. D. Sundararaman).

79T-A81 E.Z. CHEIN, The Pennsylvania State University, University Park, Pennsylvania 16802. Remark on a conjecture of R.L. Graham I. Preliminary report.

Let $a_1 < a_2 < \ldots < a_n$ be a finite sequence of natural numbers. R.L. Graham has conjectured that $\max_{i,j} \{a_i/(a_i,a_j)\} \geq n$. As far as we know, this conjecture has been verified in the following special cases: (a) a_i is square-free for all i, (b) n or $n-1$ is prime, (c) $n^{1/2}$, $n-2$ or $n-3$ is prime, (d) a_k is a prime for some k. The purpose of this remark is to show that if a_k is a square of a prime number for some k, then $\max_{i,j} \{a_i/(a_i,a_j)\} \geq n$. (Received November 20, 1978.) (Author introduced by Professor Raymond G. Ayoub).

79T-A82 T.D.PARSONS, Pennsylvania State University, University Park, Pennsylvania 16802. Permutation action graphs. Preliminary report.

Let X be a nonempty set and F a multiset of permutations chosen from the symmetric group S_X on X. The permutation action graph (p.a.g.) G = (X,F) has vertex set V(G) = X and arcs the ordered pairs (x,xf) for f in F. It is a directed pseudograph (loops and multiple arcs may occur). When F is a set

we say G is proper. Every Cayley graph is a proper p.a.g., and every Schreier coset graph is a p.a.g. If $F = F^{-1}$, we may regard G as a pseudograph with undirected edges $\{x,xf\}$, $f \in F$. It is easy to see which F result in no loops or multiple arcs. Graph-theoretic properties are reflected in group-theoretic properties, much as in the case of Cayley graphs (of which p.a.g.'s are an obvious generalization). Of course, p.a.g.'s need not be point-symmetric, but it is easy to construct many which are (in addition to the Cayley graphs). Indeed, the elements t of the automorphism group Aut G may be characterized by a simple condition on the sets $ft^{-1}F^{-1}t$, $f \in F$. To each graph H we may associate the p.a.g. (V(H),Aut H). Therefore the problem of characterizing those permutation groups which are the automorphism groups of graphs can be regarded as the problem of characterizing a certain family of p.a.g.'s. (Received January 26, 1979.)

79T-A83 BRIAN J. DAY, Department of Pure Mathematics, University of Sydney, N.S.W. 2006, Australia
On duality in a closed category.

With each sufficiently complete symmetric monoidal closed category $V = (V,\otimes,I,[-,-],\ldots)$ and "dualising" object $D \in V$ we associate a full V-reflective subcategory V'' of V which is symmetric monoidal closed relative to V and has the property that an object $A \in V''$ is D-reflexive (in the sense that $A \tilde{=} [[A,D],D]$ via the canonical map) iff $[A,D]$ is D-reflexive. The category V'' is simply the epireflective V-hull of D in V' where V' is the epireflective V-hull of D in V. This leads to a Pontryagin-type duality $R^{op} \simeq R$ for all the D-reflexive objects of the original closed category V. Some applications are discussed. (Received January 29, 1979.)

*79T-A84 YEHIEL ILAMED, Soreq Nuclear Research Centre, Yavne, Israel. On central polynomials and algebraic algebras, II . Preliminary report.

Let $p^{h,s,t}(u;v) = \Sigma(m_\sigma n_\tau)u_{\sigma 1}v_{\tau 1}u_{\sigma 2}v_{\tau 2} \cdots u_{\sigma h}v_{\tau h}$ where the summation is taken over σ and τ, all the permutations on $\{1,\ldots,h\}$ and where $s = \{m_\sigma\}$ and $t = \{n_\tau\}$ are $h!$-lists of integers defining the symmetry shape of p ; $u_1,\ldots,u_h$, $v_1,\ldots,v_h$ are noncommutative indeterminates. Theorem 1. Let us assume: i) $p^{h,s,t}(u;v)$ is a central polynomial for a ring R, and ii) there are $a_1,\ldots,a_h,b_1,\ldots,b_h \in R$ so that $p^{h,s,t}(a;b)$ is not a zero divisor. Then R, as an algebra over its center Z(R), is algebraic. Let $(j*x)p^{h,s,t}(u;v) = \Sigma p^{h,s,t}(u_1,\ldots,u_{i1-1},xu_{i1},u_{i1+1},\ldots,u_{ij-1},xu_{ij},u_{ij+1},\ldots,u_h;v)$ where the summation is taken over the j-lists $(i1,i2,\ldots,ij)$ so that $1 \leqslant i1 < i2 < \ldots < ij \leqslant h$.
Theorem 2. Let R be a ring and $r \in R$. Let us assume: i) there are $a_1,\ldots,a_h,b_1,\ldots,b_h \in R$ so that $p^{h,s,t}(a;b) \in Z(R)$ is not a zero divisor, and ii) $(j*r)p^{h,s,t}(a;b) \in Z(R)$ for $j=1,\ldots,h$. Then r is algebraic of degree h . Remarks. i) Theorem 1 is a corollary of theorem 2 ; R, in theorem 1 , is algebraic of degree h , ii) Theorems 1 and 2 are independent of the symmetry shape of p .
(Received January 24, 1979.)

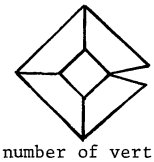
*79T-A85 JEAN-MARIE LABORDE, C.N.R.S., I.M.A.G., B.P. 53 X, 338041 Grenoble Cédex, France. A local characterization of the graph of hypercubes.

A simple graph is a finite hypercube iff

1 it doesn't contain a triangle,

2 each pair of vertices at distance 2 is joined by exactly two paths of length two,

3 the graph doesn't contain the following configuration as a (generated) subgraph:



4 $\exists n \in \mathbb{N}$ so that the number of vertices is 2^n and the number of edges is $n2^{n-1}$.

Whether conditions 1, 2 and 4 imply or not 3 is not clear. (Received January 24, 1979.)
(Author introduced by S. Foldes).

*79T-A86 U. M. SWAMY, G. C. RAO, and P. MANIKYAMBA, Andhra University, Waltair 530003, India. Prime ideal characterization of chain based lattices.

Epstein and Horn in their paper Chain based lattices (Pacific J. Math. 55(1975), 65-84), characterized P_1-lattices and P_2-lattices in terms of their prime ideals. But no such prime ideal characterization for P_0-lattices was given. The main aim in this paper is to characterize P_0-lattices in terms of its prime ideals. We also give a necessary and sufficient condition for a P-algebra to be a P_0-lattice (and hence a P_2-lattice). (Received February 2, 1979.) (Authors introduced by J. G. Krishna).

*79T-A87 JIM A. FLANIGAN, University of California, Los Angeles, California 90024. Continued conjunctive sums of loopy partizan graph games. Preliminary report.

In Chapter 14 of On Numbers and Games (Academic Press, 1976), J. H. Conway provides a theory for the continued conjunctive sum of impartial games whose graphs are rooted directed trees with finitely many vertices. He invents and employs the suspense function to carry out his analysis. To play optimally, a player should move to win slowly in each component game in which he can force a win, and to lose quickly in each component in which he cannot force a win. We extend the theory to continued conjunctive sums of unimpartial (or partizan) graph games whose graphs may contain circuits and loops and whose vertices may be any set. Infinite plays are declared as draws. Here, in the more general case, it is sometimes better for a player to play for a draw in a component in which he can force a win. Also it is sometimes better for a player to lose quickly in a component in which he could force a draw. The theory utilizes the onside of conjunctive sums. (In the onside, infinite plays are declared wins for Left instead of draws.) To carry out the analysis for the onside, we define and employ the left and right loopy onside suspense functions. We also provide the analysis for misère play. (Received February 5, 1979.)

79T-A88 WITHDRAWN

*79T-A89 ROBERT J. BOND, Boston College, Chestnut Hill, Mass. 02167. Some Results on the Capitulation Problem. Preliminary report.

Let K be an unramified abelian extension of a number field F with Galois group G, $|G|=n$. By class field theory, K corresponds to a subgroup H of the ideal class group $C\ell_F$ of F. Let J be the ideals of H which become trivial in K. Theorem 1. There is an epimorphism $\lambda: H^{-1}(G,C\ell_K) \to J$ whose kernel is image $(H^{-1}(G,C_K) \to H^{-1}(G,C\ell_K))$, C_K the idele class group. If G is cyclic, λ is an isomorphism. Theorem 2. Let K', F' be the Hilbert class fields of K and F resp., $m=[F':K]$, $r=[K':F']$. If $(n,r)=1$, $J=H_n=\{x \in H \mid x^n=1\}$ and $J \cong (C\ell_K)_n$. Theorem 3. Assume G cyclic of prime order p. Let S_K, S_F be p-Sylow subgroups of $C\ell_K$, $C\ell_F$ resp. Suppose S_F is of type (p,p) and $|S_K|=p^t$; $2 \leq t < p$. Then S_K is either elementary, in which case $J=H_p$, or of type $(p^2,p,\ldots,p)$, in which case $J=(1)$. (Received February 6, 1979.)

*79T-A90 V. O. McBRIEN, Harvard University, Cambridge, Massachusetts 02138. A class of real surfaces. Preliminary report.

The ancients were familiar with a long canonical method for "rationalizing" any surface of the form $x^q + y^q + z^q = 0$, $q \in \mathbb{Q}$. A simple case is $x^{1/3} + y^{1/3} + z^{1/3} = 0$ which has the hypersurface equation $(x + y + z)^3 + 27xyz = 0$. The topological nature of such Brieskorn type varieties has been studied in recent times with the help of the sometimes abused Milnor fibration. By using a suggestion of Pedoe, C. Benoit simplified the computation of the hypersurface equation of $x^{2/3} + y^{2/3} + z^{2/3} = 1$, a natural generalization of the astroid curve. Considered over $\mathbb{C}$ such surfaces lead to the conjecture that the Whitney stratification does not best suit the Milnor fibration for this class. (Received February 6, 1979.)

*79T-A91 ALBERT A. MULLIN, 475-B Cooke Dr., Redstone Arsenal, AL 35808. On consecutive composite numbers.

Let S_n be the finite set of all primes in the mosaic [Amer. Math. Monthly 74 (1967), 1100-1102] of natural number $n>1$. Lemma. $S_n=S_{n+m}$ only if $m|n$. Indeed, e.g., $S_n=S_{n+2}$ iff $n \in \{2, 6\}$; $S_n=S_{n+3}$ iff $n \in \{6,9\}$; $S_n=S_{n+4}$ iff $n \in \{8\}$. On the other hand, consider the Problem. Show that card $\{ m: S_m=S_{2m} \}$ is infinite. Note 1. In the present context, one can strengthen classical results concerning arbitrarily long finite sequences of consecutive composite numbers. Thus, for each natural number $n>1$ and prime number p there exist n consecutive sets of primes of the sequence $S_{(.)}$ whose intersection is the singleton $\{p\}$. E.g., choose $n=11$ and $p=2$. Then $S_{72470} \cap \cdots \cap S_{72480}= \{2\}$. Note 2. These results have several analogies with results for Catalan's conjecture. (Received February 1, 1979.)

79T-A92 Jonathan Samit, University of Massachusetts, Amherst, Massachusetts 01003. Quasi-regularity in subdirect sums.

Theorem. Let A be the subdirect sum of finitely generated polynomial identity algebras A_j over a field F such that all of the A_j have Krull dimension in the sense of Gordon. Then the intersection of all the powers of the quasi-regular radical of A is zero. Conjecture. The words "polynomial identity" can be replaced by the words "fully bounded" in the above theorem and the result will still be true. (Received February 1, 1979.)

*79T-A93 Victor Ya. Pan, IBM T. J. Watson Research Center, P. O. Box 218, Yorktown Heights, New York 10598. An improved algorithm for matrix multiplication

For any even n two $n \times n$ matrices can be multiplied involving $\frac{n^3-n}{3} + 4.5\, n^2$ scalar multiplications which gives the algorithm $O(N^p)$ total number of arithmetic operations for $N \times N$ matrix multiplications where $p \approx 2.7801$. The algorithm is based on the present author's previous construction. (Received January 12, 1979.) (Author introduced by Dr. Shmuel Winograd).

*79T-A94 Helaman Ferguson and Rodney Forcade, Brigham Young University, Provo, Utah 84602. Z-linear dependence algorithms, Part III.

Algorithm A_n solves an old problem in elementary constructive number theory, that of generalizing Euclid's algorithm or continued fractions to a terminating iterative algorithm for arbitrary finite dimensions. Algorithm A_n characterizes the Z-linear dependence of n real numbers, $x_1, \ldots, x_n$, $n \geq 2$. Let nonzero $x=(x_1, \ldots, x_n)$ be in R^n, also $R^n=xR+x^{\perp}$, $x^{\perp}$ the hyperplane orthogonal to the line xR. A (extended) hyperplane matrix for x with rows $r_1, \ldots, r_n$ is a matrix whose columns transposed form an R-basis (R-generating set) for the hyperplane $x^{\perp}$. Let $|B|$ be the parallelotope on the columns $b_1, \ldots, b_n$ of the matrix B, the n-cell of points $\sum t_i b_i$, $-1 \leq t_i \leq 1 \leq i \leq n$. The height of a matrix B, height(B), is the maximum of the absolute values of its entries. Algorithm A_n develops at the k^{th} iteration matrices $M_k=P_k^{-1}$ in GL(n, Z) (Z-integral matrices of determinant ± 1). The description of an iteration of the algorithm involves the crucial step of constructing special injection maps $j: GL(r, Z) \rightarrow GL(r+1, Z)$, $2 \leq r < n$. Algorithm A_n. (descent) Fix n, b, $1/n<1/2<b<1$. We describe one iteration. Let Q be a hyperplane matrix for x with r_j a row of minimum height, x^* be x without x_j, Q^* a hyperplane matrix for x^*. Initialize $x_c=x^*$, $Q_c=Q^*$. Apply Algorithm A_{n-1} to x_c and Q_c giving new $x_c=x^*M_c$, $Q_c=P_cQ^*$, $P_c=M_c^{-1}$ in GL(n-1, Z). If the height of any of the first n-1 rows of $j(P_c)Q$ divided by the height of r_j is $>b$, apply Algorithm A_{n-1} again, otherwise set $P=j(P_c)=M^{-1}$ for the last P_c. The iteration is $x \rightarrow xM$, $Q \rightarrow PQ$. Algorithm A_2. (essentially classical) If x_1 and x_2 have the same (opposite) sign, subtract (add) the one of smaller absolute value from (to) the other and replace the other by the result. This translates to GL(2, Z) matrices. (Received February 12, 1979.)

*79T-A95 T.N.E.GREVILLE, Mathematics Research Center, University of Wisconsin, Madison, Wisconsin 53706 and W.F.TRENCH, Drexel University, Philadelphia, Pennsylvania 19104. Band Matrices with Toeplitz inverses.

A square matrix $H = (h_{ij})_{i,j=0}^{m}$ is strictly banded if there are nonnegative integers r and s such that $r + s \leq m$ and $h_{ij} = 0$ if $j - i > r$ or $i - j > s$. A square matrix $T = (t_{ij})_{i,j=0}^{m}$ is a Toeplitz matrix if there is a sequence $\{\phi_\nu\}_{-m}^{m}$ such that $t_{ij} = \phi_{j-i}$ for $0 \leq i,j \leq m$.

The following theorem characterizes strictly banded matrices with Toeplitz inverses. Such matrices have been encountered by the first author in extending moving weighted average smoothing to the extremities of the data and by the second author in prediction of stationary time series.

Theorem. Let the matrix $H = (h_{ij})_{i,j=0}^{m}$ over a field F be strictly banded as defined above. Then H is the inverse of a Toeplitz matrix if and only if

$$(A)\quad \sum_{j=0}^{m} h_{ij}x^{j} = \begin{cases} x^{i}A(x)\sum_{p=0}^{i} b_{p}x^{-p}, & 0 \le i \le s-1, \\ x^{i}A(x)\,B(x), & s \le i \le m-r, \\ x^{i}B(1/x)\sum_{q=0}^{m-i} a_{q}x^{q}, & m-r+1 \le i \le m, \end{cases}$$

where $a_0 b_0 \neq 0$, $A(x) = \sum_{p=0}^{r} a_p x^p$, $B(x) = \sum_{q=0}^{\quad} b_q x^q$, and A(x) and $x^s B(1/x)$ are relatively prime.

(Received February 14, 1979.)

*79T-A96 S. KANEMITSU, Kyushu University, Fukuoka, Japan and R. SITA RAMA CHANDRA RAO, Andhra University, Waltair, India. On a conjecture of S. Chowla and of S. Chowla and H. Walum concerning the divisor problem.

Writing $G_{a,r}(x) = \sum_{n \le \sqrt{x}} n^{a} P_r(\{x/n\})$ for $a \ge 0$, $r \ge 1$ (P_r : Periodic Bernoulli function of order r), S. Chowla (The Riemann Hypothesis and Hilbert's Tenth Problem, Gordon and Breach, New York, 1965, 90-91) conjectured that $G_{0,2}(x) = O(x^{1/4+\epsilon})\ \forall \epsilon > 0$ which itself is a special case of S. Chowla and H. Walum's conjecture that $G_{a,r}(x) = O(x^{a/2+1/4+\epsilon})\ \forall \epsilon > 0$ (On the divisor problem, Proc. Sympos. Pure Math. 8(1965), Amer. Math. Soc., Providence, Rhode Island, 138-143). In this paper we prove (i) $G_{0,2}(x) = (\pi^{1/4}/\sqrt{2}\pi^{2}) \sum_{n=1}^{\infty} (\sigma(n)/n^{1/4}) \cos(4\pi\sqrt{nx} + \pi/4) + O(x^{1/4})$, $\sigma(n) = \sum_{d|n} d$ and (ii) $G_{a,r}(x) = O(x^{a/2+1/4})$ for $a > 1/2$, $r \ge 2$. Our result (i) together with the results of K. Chandrasekharan and Raghavan Narasimhan and Bruce C. Berndt suggests that Chowla's conjecture is as deep as the Dirichlet divisors problem. (Received February 15, 1979.) (Author introduced by Professor Don Redmond).

*79T-A97 James A. Huckaba, University of Missouri, Columbia, Missouri 65211 and Ira J. Papick, University of Missouri, Columbia, Missouri 65211, A Localization of R[x] .

Throughout, R will be a commutative integral domain with identity and x will be an indeterminate. If $f \in R[x]$, let c(f) denote the ideal of R generated by the coefficients of f. Define $S = \{f \in R[x]: c(f) = R\}$ and $U = \{f \in R[x]: c(f)^{-1} = R\}$. It is known that S and U are multiplicatively closed subsets of R[x] and that $S \subseteq U$. The ring $R[x]_S$ is usually denoted by R(x).

We determine conditions on the ring R so that $R(x) = R[x]_U$. A complete characterization of this property is given for Noetherian domains. In particular, we prove that if R is a Noetherian domain, then $R[x]_U = R(x)$ if and only if depth(R) ≤ 1. Some sufficient conditions for $R(x) = R[x]_U$ are that R is treed or that $\mathcal{P}(R)$ (the set of prime ideals of R that are minimal over conductors of the form (a:b)) is finite.

Our main theorem is that if R is either a GCD-domain, an integrally closed coherent domain, or a Krull domain, then $R[x]_U$ is a Bezout domain. We then apply our main result to give new characterizations of Prüfer domains, Bezout domains, and Dedekind domains. (Received February 15, 1979.)

79T-A98 David Ford & John McKay, Rm963-6, Concordia University, 1455 Maisonneuve.W, Montreal, Canada H3G 1M8. Finite groups & singularities. Preliminary report.

To each extended Dynkin diagram containing only single bonds there is a Killing form (which is positive semi-definite) represented by the Cartan matrix. Each such diagram is related to a singularity (see Steinberg, Conjugacy classes in algebraic groups, Springer Yellow series, No.366 p156) and its desingularisation.

The eigenvectors of the Cartan matrices form the character tables of the group of the desingularisation; in particular the null-space is the vector of irreducible degrees. (Received February 16, 1979.) (Author introduced by Dr. S.Klasa).

79T-A99 DAVID ZEITLIN, 1650 Vincent Avenue North, Minneapolis, Minnesota, 55411. Two new identities for integer sequences.

THEOREM. Let $W_{n+2} = PW_{n+1} + BW_n$, $n=0,1,\ldots$, where P, B, W_0, W_1 are integers. If $W_0 = 0$, $W_1 = 1$, set $W_n \equiv U_n$; if $W_0 = 2$, $W_1 = P$, set $W_n \equiv V_n$. Then, for $p = 1,2,\ldots$, and $n = 1,2,\ldots$, we have the identities

$$(1)\quad U_{2np} = V_p \sum_{k=0}^{n-1} (-B)^{p(n-1-k)} \binom{n+k}{2k+1} (P^2 + 4B)^k U_p^{2k+1}, \qquad \text{(note that } U_{2n} = U_n V_n\text{)}$$

$$(2)\quad U_{(2n-1)p} = (2n-1) \sum_{k=0}^{n-1} \left((-B)^{p(n-1-k)} \binom{n+k}{2k+1} (P^2 + 4B)^k U_p^{2k+1}\right)/(n+k) .$$

REMARKS. Identities for W_{2np} and $W_{(2n-1)p}$ follow from (1) and (2) by using the identity $U_p \cdot W_{np} = (W_p - V_p W_0) U_{np} + W_0 U_{(n+1)p}$. (1) and (2) give the special case $P=B=1$, which appears as a conjecture with $p = 12$ on p.405 in the paper by Robert C. Good, Jr., Fibonacci Quarterly, Vol.9, No.4, October, 1971. Proof of our (1) and (2) uses identities (1) and (2), p.300, in the paper by H.W.Gould, Fibonacci Quarterly, Vol.12, No.3, October, 1974. Additional formulas can be obtained from our (1) and (2) by inversion. (Received February 16, 1979.)

*79T-A100 Alexander ABIAN, Department of Mathematics, Iowa State University, Ames, Iowa 50011

The number of prime ideals of a p-ring

It is known that an infinite Boolean ring has at least as many prime ideals as it has elements. The relative size of the set of all prime ideals of a p-ring (i.e., a necessarily commutative ring in which $x^p = x$ and $px = 0$ for some prime $p > 0$) was an open question for some time (since the lattice-theoretical techniques applicable to Boolean rings do not readily apply to p-rings). In this paper, first, two compactness theorems are proved for p-rings and then based on these theorems it is shown that an infinite p-ring also has at least as many prime ideals as it has elements. In this connection we note that there are infinite p-rings which have as many prime ideals as they have elements, on the other hand, there are also infinite p-rings which have (cardinalitywise) more prime ideals than they have elements (a finite p-ring has p^n elements and n prime ideals for some positive integer n). (Received February 19, 1979.)

79T-A101 James Nechvatal, University of Southern California, Los Angeles, California 90007. Enumeration of Latin Rectangles. Preliminary Report.

Let L(k,n) denote the number of k by n Latin Rectangles, and let U(k,n) denote the number of k+1 by n Latin rectangles having first k lines 1,2,...n;2,3,...n,1;...;k,k+1,...k-1. Various formulas have been given previously for L(3,n) and U(3,n). Explicit formulas are given here for L(4,n) and U(4,n). Limited asymptotic information is derived for L(4,n), and an asymptotic series is given for U(4,n). Partial results are obtained for U(5,n). New asymptotic results are derived for L(3,n) and U(3,n). (Received February 19, 1979.)

Analysis (26, 28, 30–35, 39–47, 49)

79T-B62 S. ZAIDMAN, Département de Mathématiques, Université de Montréal, Montréal, Canada. Partial-differential equations with almost periodic right-hand side.

Consider the equation: $u_t(x,t) = -\sum_{l,k=1}^{n} a_{lk} u_{x_l x_k} + \sum_{l=1}^{n} a_l u_{x_l} + f(x,t)$ where $x = (x_1 \ldots x_n) \in R^n$, $-\infty < t < +\infty$; a_l are real constant coefficients; a_{lk} are complex constant coefficients such that: $\operatorname{Re} \sum_{l,k=1}^{n} a_{lk} s_l s_k \geq C_0 \sum_{l=1}^{n} s_l^2$, $C_0 > 0$, $s \in R^n$; $f(x,t)$ is an almost-periodic function, $-\infty < t < +\infty \to L^2(R^n)$, in Bochner's sense. For a class of continuous weak solutions $u(x,t)$, $-\infty < t < +\infty \to L^2(R^n)$, we prove that $L^2(R^n)$-boundedness is equivalent to $L^2(R^n)$-almost-periodicity, using the method of "concrete" orthogonal projections as in some previous work of the author (Rend. Accad. Naz. Lincei 32(1962), 30-37). (Received August 15, 1978.)

79T-B63 MOSTAFA A. ABDELKADER, 25 Sh. Champollion, Alexandria, Egypt. Exact solutions for the prompt-jump model of nuclear reactors.

In the prompt-jump model of a lumped-parameter nuclear reactor with one group of delayed neutrons, no external source of neutrons, and assuming Newton cooling, one is led to the nonlinear differential equation : (1) $(d + aT)(kn - km - cT)(dn/dT) + an(kn - km + (b - c)T) = 0$, where n denotes the neutron density, T the incremental temperature, and a, b, c, d, k, m are parameters; see D. L. Hetrick's "Dynamics of Nuclear Reactors", U. Chicago P., 1971, p. 366. When the parameters are interrelated, we obtain several exact solutions of (1). E.g., for $cd = 4akm$ and $2b = 3c$, the general solution is given by

$2m + cd(M - 3N)W = C(2m + cd(M - N)W)^3$, where $mM = 1$, $nN = 1$,

$(2/\ ) + cd(M - 2N)(M - N) + 2acTN^2 = 0$, and C is a constant of integration. Other solutions involve Bessel and hypergeometric functions, and some transcendental integrals. Eq. (1) is derived assuming reactivity $r = -aT$. For $r = -aT + hT^2$, where h is positive or negative, we get :

$$(d + aT - hT^2)(kn - km - cT)(dn/dT) =$$

$n(bhT^2 - abT + (2hT - a)(kn - km - cT))$, for which (because of the additional h) a larger number of exact solutions are obtained.(Received January 8, 1979.)

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ALESSANDRO FIGA'-TALAMANCA, University of Rome, 00100 Rome, Italy .
Positive definite functions on the free group .

A class of positive definite functions with preassigned values on the set of generators of a discrete free group G is defined. These functions resemble, in many respects,the Fourier-Stieltjes transforms of the Riesz products,and include, as a special case, those defined by U. Haagerup, as $e^{-t|x|}$ where $|x|$ denotes the length of the ward x (An example of non nuclear C^*-Algebra ,which has the metric approximation property, preprint) . The positive definite functions, which we construct, are used to give answers to a number of questions concerning the Fourier-Stieltjes algebra $B(G)$, and its relationship to its ideals $B_0(G) = B(G) \cap C_0(G)$, $A(G)$ the Fourier algebra and $B_\lambda(G)$ (λ is the regular representation of G) . In particular we exhibit functions $u \in B_0$ such that for every positive integer n, u^n is in the orthogonal complement of B_λ . This result is obtained via a general theorem which may be considered an analogue, in some sense, of the Zygmund's theorem on the singularity of a measure defined by Riesz products . (Received January 30, 1979.)

79T-B65 HSUAN-PEI LEE, Brown University, Providence, Rhode Island 02912. Orthogonal measures for subsets of the boundary of the ball in $\mathbb{C}^2$. Preliminary report.

Let B be the unit ball $\{|z_1|^2 + |z_2|^2 < 1\}$ in $\mathbb{C}^2$ and ∂B its boundary. For any compact set Y in $\mathbb{C}^n$, $R(Y)$ denotes the uniform closure of rational functions on Y . Basener has constructed a compact set Y on ∂B such that $R(Y) \neq C(Y)$ and Y is rationally convex. Using Henkin's solution of the $\bar{\partial}_b$-equation on ∂B , we prove the following theorem.

Theorem: Let X be a compact subset of ∂B with $R(X) \neq C(X)$ and X rationally convex. Let μ be a measure on X orthogonal to $R(X)$. Then there is a function K summable on ∂B which extends analytically to B from $\partial B \setminus X$, such that the following holds: Let X^+ be any smoothly bounded neighborhood of X on ∂B . Then for all $\phi \in C_0^\infty(\mathbb{C}^2)$,

$$\int_X \varphi \, d\mu = \frac{1}{4\pi^2} \int_{X^+} \bar{\partial}\varphi \wedge K \, d\zeta_1 \wedge d\zeta_2 - \frac{1}{4\pi^2} \int_{\partial X^+} \varphi K \, d\zeta_1 \wedge d\zeta_2$$

(Received February 2, 1979.)

*79T-B66 Otomar Hajek, Case Western Reserve University, Cleveland, Ohio 44106. The best uniform approximation problem is not well posed. Preliminary report

Let V be an n-dimensional subspace of $C[0,1]$ which satifies the Haar condition (only $v \equiv 0$ has n district zero points; coefficients are real). For x in $C[0,1]$ let Bx be the element $v \in V$ closest to x, in the uniform norm. THEOREM: For $n \geq 2$, the mapping $B : C[0,1] \to V$ is not uniformly continous in any neighborhood of any $v \in V$. (For $n = 1$, B satisfies a global Lipschitz condition.) (Received February 2, 1979.)

*79T-B67 JAMES V. PETERS, State University of New York at Purchase, Purchase, New York 10577. The Radon Transform: An Application to Probability.

As an application of the Radon transform to probability theory, we prove the law of large numbers for a certain class of integrable density functions. The proofs of both the weak and strong laws are stated in terms of general weighted averages for the mean. Using the Gaussian distribution, we give an example of a weighted average for which only the weak law is valid. (Received February 5, 1979.)

*79T-B68 Athanassios G. Kartsatos, University of South Florida, Tampa, Florida 33620. Mapping theorems for accretive operators in Banach spaces.

Denote by $B_r(0)$ the open ball with center at 0 and radius r. Theorem 1. Let X, X* be uniformly convex. Let T be an m-accretive operator with D(T) containing zero. Moreover, let D(T) be a dense subset of a closed, convex set $D_1 \subset X$ and $\|T(0)\| < r \leq \liminf_{\substack{x \in D(T) \\ \|x\| \to \infty}} \|Tx\|$, where r is a positive constant. Then $B_r(0) \subset R(T)$. Corollary. Assume that T satisfies the hypotheses of Theorem 1. Furthermore, let $\lim_{\substack{x \in D(T) \\ \|x\| \to \infty}} \|Tx\| = +\infty$. Then R(T) = X. Theorem 2. Let X, X^* be uniformly convex. Let T be m-accretive with D(T) = X. Suppose further the existence of positive constants r, s such that $\|T(0)\| < r/2 \leq \|Tx\|/2$ for every $x \in X$ with $\|x\| = s$. Then $B_t(0) \subset R(T)$, where $t = (2/3)(r/2 - \|T(0)\|)$. Several other theorems are given concerning the ranges of accretive operators. Recent results of Browder, Kirk and Schöneberg, Deimling are extended. Some results related to Theorem 1 were recently obtained by the author in [Nonlinear Equations in Abstract Spaces, Academic Press, New York, 1978]. In those results X was supposed to have a weakly continuous duality map. (Received February 5, 1979.) (Author introduced by M. N. Manougian).

*79T-B69 Jorge Toro González, Instituto Politecnico Nacional, Mexico City, Mexico D.F. Passivity for nonlinear evolution equations in Banach spaces.

Let X be a real Banach space with uniformly convex dual X^*. Consider the nonlinear evolution equation (*) $x' + A(t)x = f(t)$, where $A(t): D \subset X \to X$ is at least m-accretive for each t in an infinite interval J, and f is at least locally L^1 in the sense of Bochner. Passivity and α-passivity properties of (*) are studied for two types of solutions: solutions in the sense of Kato [J. Math. Soc. Japan, 19 (1967), 503-520] and solutions in the sense of Benilan [C. R. Acad. Sci. Paris, Sér. A, 274 (1972), 47-50]. Recent results of Wexler [J. Diff. Equations, 23 (1977), 414-435]concerning certain types of solutions of (*) in the case of a Hilbert space X are extended to the present setting. The material of this paper is taken from the author's doctoral dissertation written under the direction of Prof. A. G. Kartsatos at the University of South Florida. (Received February 5, 1979.) (Author introduced by M. N.Manougian).

*79T-B70 Mahmoud HAIFAWI, Middle East Technical University, Ankara, Turkey, On Realizable Banach Spaces, Preliminary Report.

Let E be a non- archimedean Banach Space over nontrivially valuated field K. Let $\mathcal{G}$ ($\neq \emptyset$) be the collection of all subspaces of E of countable type. Let ${}^*\mathcal{G}$ be its enlargement in ${}^*E$ which is an enlargement of E in the non-archimedean mathematical model. Each element of ${}^*\mathcal{G}$ is of *- countable type in ${}^*E/{}^*K$. A subspace A of ${}^*\widetilde{E}$ is said to be realizable if $\exists$ a set $B \subset {}^*E_{fin}$ s.t. $A = \pi(B)$ and a * - countable subset B' of ${}^*E_{fin}$ s.t. $B \subseteq B'$. It is shown: Theorem 1. If E is realizable, then ${}^*\widetilde{E}$ has the complementation property. Theorem 2. If ${}^*E = {}^*\widetilde{\mathcal{G}}$, then ${}^*\widetilde{E}$ is realizable. Theorem 3. E has the complementation property iff it is realizable. This extends the results of earlier abstract. (Received February 6, 1979.)

*79T-B71 Darrell Schmidt, Marshall University, Huntington, West Virginia, 25701. Nonuniqueness of alternation sets. Preliminary report.

For $f \in C[-1,1]$, let $T_n(f)$ be the best uniform approximation to f by polynomials of degree n or less and let $E_n(f) = \{x \in [-1,1]: |f(x) - T_n(f)(x)| = \|f - T_n(f)\|\}$. The alternation theorem implies that $E_n(f)$ contains at least $n + 2$ points. It is shown that there exists an $f \in C[-1,1]$ such that $E_n(f)$ contains more that $n + 2$ points for all $n = 0, 1, 2, \ldots$. (Received January 25, 1979.)

79T-B72 ERWIN O. KREYSZIG, University of Windsor, Windsor, Ontario, Canada. On a class of linear integral operators for partial differential equations

The operators to be considered are Bergman integral operators for $Lu = u_{zz*} + bu_{z*} + cu = 0$, $b, c \in C^{\omega}(\Omega)$, $(0, 0) \in \Omega$, defined by $(Tf)(z, z^*) = \int_C g(z, z^*, t)f(h)H\,dt$, $h = z\tau/2$, $H = \tau^{-1/2}$, $\tau = 1 - t^2$. The kernel satisfies $Mg = \tau g_{z*t} - t^{-1}g_{z*} + 2ztLg = 0$. Bergman's method of obtaining solutions g is a method of undetermined coefficient functions and yields operators T which generate local solutions u, in general. Call g a closed-form kernel if T generates global solutions. These operators include operators of exponential type, that is, with kernels of the form $g = e^q$, $q(z, z^*, t) = \sum_{s=0}^{m} q_s(z, z^*)t^s$, $q_m \neq 0$. Let $L \in E_0$ mean that b and c in $Lu = 0$ are such that there exists an operator of exponential type with even m. Using a suitable transformation of $Mg = 0$, one obtains necessary and sufficient conditions for $L \in E_0$ in a rather simple fashion. This criterion can also be used to prove the following theorem. If $L \in E_0$, then there exists a kernel with $m = 2$ for $Lu = 0$. This entails important simplifications in applications of operators of exponential type. (Received January 25, 1979.)

79T-B73 JU. ABRAMOVIČ, USSR, 197341 Leningrad, Serebristji Bulvar 24, korp. 4, kv. 197 and V. GEJLER, USSR, Saransk, Popova 65, kv. 19. On the one question of D. Fremlin.

Let Q be an extremally disconnected compact space, q_1, q_2 two nonisolated points in Q and φ a homeomorphism Q onto Q such that $\varphi(q_1) = q_2$ and $\varphi(q_2) = q_1$. We put $F = \{x \in C(Q) : x(q_1) = x(q_2)\}$, where C(Q) is the space of real-valued continuous functions on Q. The Archimedean vector lattice (VL) F possesses the following properties: (a) F is not Dedekind complete VL, (b) any order bounded operator T, acting from any Archimedean VL E into F, is regular, id est is the difference of two positive operators. This example gives an affirmative answer to the corresponding question of D. Fremlin. (If F is Dedekind complete then condition (b) is fulfilled by the well-known Kantorovič theorem.) (Received February 9, 1979.)

*79T-B74 Elemer E. Rosinger, Haifa Technion, Israel, Dept. of Computer Science. Necessary and sufficient condition for global weak solvability of nonlinear PDEs.

Defining the weak solutions of nonlinear PDEs as elements in algebras of classes of sequences of continuous functions on domains in Euclidian spaces, a general necessary and sufficient condition for the existence of such weak solutions is given. The nonlinear PDEs considered contain most of the cases encountered in applications. The necessary and sufficient existence condition is applied to several types of linear and nonlinear PDEs. Among others, the well known PDO of H. Lewy - with not even local distribution solutions - is proved to possess global weak solutions. (Received February 8, 1979.) (Author introduced by F.Treves).

*79T-B75 PEI YUAN WU, National Chiao Tung University, Hsinchu, Taiwan, Republic of China. On the weakly closed algebra generated by a weak contraction. Preliminary report.

In this paper we show that if T is a completely non-unitary (c.n.u.) weak contraction with finite defect indices, then $\{T\}' \cap \text{Alg Lat } T = \text{Alg } T$ holds. We also obtain necessary and sufficient conditions for the splitting of Alg $(T_1 \oplus T_2)$, where T_1 and T_2 are c.n.u. weak contractions with finite defect indices. Indeed, if m_j is the minimal function of the C_0 part of T_j and $E_j = \{t : \Theta_{T_j}(t)$ not isometric$\}$ for $j = 1, 2$, then the following are equivalent: (1) Alg $(T_1 \oplus T_2) = \text{Alg } T_1 \oplus \text{Alg } T_2$; (2)

Lat $(T_1 \oplus T_2)$ = Lat $T_1 \oplus$ Lat T_2; (3) $m_1 \wedge m_2 = 1$, $E_1 \cap E_2$ has Lebesgue measure zero and $C \setminus (E_1 \cup E_2)$ has positive Lebesgue measure, where C denotes the unit circle in the complex plane. These results generalize previous ones for $C_0(N)$ and C_{11} contractions. (Received February 12, 1979.)

*79T-B76 G. Koumoullis, Athens University, Panepistemiopolis, Athens 621, Greece. On perfect measures.

Let $(X,\mathcal{A})$ be a measurable space. A countably additive positive finite measure μ defined on $\mathcal{A}$ is called perfect if for every $\mathcal{A}$-measurable function $f: X \to \mathbb{R}$ there is a Borel set B of $\mathbb{R}$ such that $B \subset f(X)$ and $\mu(f^{-1}(B)) = \mu(X)$. Theorem 1. Let $(X,\mathcal{A})$ be a measurable space, μ a non-zero perfect measure on $\mathcal{A}$ and $\{A_i : i \in I\}$ a partition of X with $\mu^*(A_i) = 0$ for all $i \in I$, and the cardinal of I non-(Ulam-)measurable. Then there is $J \subset I$ such that $\bigcup_{i \in J} A_i$ is not μ-measurable. Theorem 2. Let X be a metric space and μ a Borel measure on X. Then, μ is a tight measure (i.e. there is a σ-compact set Y such that $\mu(Y) = \mu(X)$) iff μ is perfect and there is a subset R of X of non-measurable cardinal with $\mu^*(R) = \mu(X)$. Corollary 1. A metric space X is of non-measurable cardinal iff every perfect Borel measure on X is tight. Corollary 2. Let $(S, \mathcal{A}, \mu)$ be a perfect measure space, X a metric space and $f: S \to X$ a μ-measurable function such that the cardinal of f(S) is non-measurable. Then there is a σ-compact subset Y of X such that $\mu(f^{-1}(Y)) = \mu(S)$. Theorem 3. Theorem 2 and its corollaries remain valid when X is regular, weakly metacompact and developable space. The above extend results of V. Sazonov (A.M.S. Transl. 48(1965) 229-254), R. Solovay, and K. Prikry (unpublished manuscript). (Received February 12, 1979.) (Author introduced by S. Negrepontis).

79T-B77 WALTER A. STRAUSS, Brown University, Providence, Rhode Island 02912. Scattering for the nonlinear Klein-Gordon equation.

Consider the equation (1) $u_{tt} - \Delta u + u + u^3 = 0$, and the "free" equation (2) $v_{tt} - \Delta v + v = 0$ for $x \in \mathbb{R}^3$. Let $\|\ \|$ denote the free energy norm. Theorem. There exists $\delta > 0$ with the following property. Let u_- be an arbitrary solution of (2) with energy norm less than δ. Then there exists a solution u of (1) and a solution u_+ of (2) with energy norm less than 2δ such that $\|u(t) - u_\pm(t)\| \to 0$ as $t \to \pm\infty$. The proof of this theorem depends on certain estimates in L^4 as in my paper, "Everywhere-defined wave operators" [Nonlinear Evolution Equations, Academic Press, 1978]. The theorem works equally well in the abstract formulation of that paper. (Received February 13, 1979.)

79T-B78 TAKAYUKI FURUTA, Department of Mathematics, Faculty of Science, Hirosaki University, Bunkyo-cho 3, Hirosaki, Aomori 036 Japan. On relaxation of normality in the Fuglede-Putnam theorem.

An operator means a bounded linear operator on a complex Hilbert space. The familiar Fuglede-Putnam theorem asserts that if A and B are normal operators and if X is an operator such that $AX = XB$, then $A^*X = XB^*$. We shall relax the normality in the hypotheses on A and B. Theorem 1. If A and B^* are subnormal and if X is an operator such that $AX = XB$, then $A^*X = XB^*$. An operator T is called k-quasihyponormal if T satisfies $T^{*k}(T^*T - TT^*)T^k \geq 0$. Theorem 2. Suppose A, B, X are operators in the Hilbert space H such that $AX = XB$. Assume also that X is an operator of Hilbert-Schmidt class. Then $A^*X = XB^*$ under any one of the following hypotheses: (i) A is k-quasihyponormal and B^* is invertible hyponormal, (ii) A is quasihyponormal and B^* is invertible hyponormal, (iii) A is nilpotent and B^* is invertible hyponormal. (Received February 2, 1979.)

*79T-B79 A. STRAUSS, Inst. für Angewandte Math., Universität Erlangen-Nürnberg. Optimal quadrature formulae and perfect splines.

Let $\mathcal{J}$ be the class of all quadrature formulae $R(f) = \int_0^1 f(x)dx - \sum_{i \in I} A_i f^{(i)}(0) - \sum_{j \in J} B_j f^{(j)}(1) - \sum_{i=1}^{m} \sum_{j=0}^{m_i - 1} c_{ij} f^{(j)}(x_i)$, $\sum_{i=1}^{m} m_i = k$, $0 \leq m_i < n$, $0 < x_1 < \ldots < x_m < 1$, satisfying

$R(f)=0$ for the set of polynomials of degree at most n-1. There are no further restrictions, in particular the x_i are free knots. We study quadrature formulae R_o satisfying $\sup_{||f^{(n)}||_\infty \le 1} |R_o(f)| = \inf_{R \in \mathcal{T}} \sup_{||f^{(n)}||_\infty \le 1} |R(f)|$. The determination of the optimal formulae reduces to characterizing the monosplines of least L_1-norm in the case of free knots. We show that there exists a unique monospline of least L_1-norm. Furthermore, we characterize this monospline by perfect splines. For special boundary conditions the Euler-Mac laurin quadrature formula turns out to be the unique solution. (Received February 14, 1979.) (Author introduced by Professor Ovid Shisha).

*79T-B80 Robert Carroll, University of Illinois, Urbana 61801. Transmutation and transform theory.

Given suitable second order differential operators P(D) and Q(D) with $PH = \mu H$, $P^*\Omega = \mu\Omega$, $Q\Theta = \mu\Theta$, $Q^*W = \mu W$, $H(0,\mu) = \Theta(0,\mu) = 1$, and $H'(0,\mu) = \Theta'(0,\mu) = 0$ one obtains information about the corresponding integral transforms by studying the transmutation problem $P(D_x)\varphi = Q(D_y)\varphi$, $\varphi(x,0) = f(x)$ with $\varphi(0,y) = Bf(y)$ and vice versa (cf. Notices, AMS, June 1978, 78T-B114 and February 1979, *to appear*). Setting $\mathcal{B}f(\mu) = \langle \Omega(x,\mu), f(x)\rangle$, $\mathcal{P}f(\mu) = \langle H(x,\mu), f(x)\rangle$, $\mathcal{B}F(x) = \langle F(\mu), H(x,\mu)\rangle_\sigma$, $\mathcal{P}F(x) = \langle F(\mu), \Omega(x,\mu)\rangle_{\sigma'}$, $\mathcal{P}F(x) = \langle F(\mu), H(x,\mu)\rangle_\rho$, $\mathcal{Q}g(\mu) = \langle W(y,\mu), g(y)\rangle$, $\mathcal{Q}g(\mu) = \langle \Theta(y,\mu), g(y)\rangle$, $\mathcal{Q}G(y) = \langle G(\mu), \Theta(y,\mu)\rangle_\rho$, $\mathcal{Q}G(y) = \langle G(\mu), W(y,\mu)\rangle_{\rho'}$, and $\mathcal{Q}G(y) = \langle G(\mu), \Theta(y,\mu)\rangle_\sigma$ (where the subscripts σ, σ', ρ, and ρ' denote various spectral pairings) one obtains the following typical model diagram of spaces and maps: 1) $\mathcal{B}: E \to \hat{E}^\sigma$, $\mathcal{P}: E \to \tilde{E}^{\sigma'}$, $\mathcal{Q}: F \to \tilde{F}^\rho$, $\mathcal{P}: F \to \bar{F}^{\rho'}$, $\mathcal{P}: \tilde{F} \to E$, and $\mathcal{Q}: \hat{E} \to F$ with $\hat{E}' = \tilde{E}$, $\tilde{F}' = \bar{F}$, $E' = E$, and $F' = F$ 2) $D(\mathcal{Q}) = D(\mathcal{P}) = \hat{E} \cap \tilde{F}$, $R(\mathcal{Q}^*)$ and $R(\mathcal{P}^*) \subset \tilde{E} \cap \bar{F} = \hat{E}' \cap \tilde{F}'$ while $\mathcal{B} = \mathcal{P}^{-1}$, $\mathcal{Q} = \mathcal{Q}^{-1}$, $\mathcal{P} = \mathcal{P}^{-1}$, $\mathcal{Q} = \mathcal{Q}^{-1}$, $\mathcal{B}^* = \mathcal{P}$, $\mathcal{Q}^* = \mathcal{Q}$, $\mathcal{P}^* = \mathcal{P}$, $\mathcal{Q}^* = \mathcal{Q}$, $B^* = (\mathcal{Q}\mathcal{B})^* = \mathcal{P}\mathcal{Q}$, $\mathcal{B} = B^{-1} = \mathcal{P}\mathcal{Q}$, $\mathcal{B}^* = \mathcal{Q}\mathcal{P}$, $\mathcal{P}^{-1} = \mathcal{Q}\mathcal{Q}\mathcal{B}$, and $\mathcal{Q}^{-1} = \mathcal{B}\mathcal{P}\mathcal{Q}$. For example this fits together when $P(D) = L_m(D) = D^2 + ((2m+1)/x)D$ and $Q(D) = D^2$. Details and further results will appear in the author's book "Transmutation and operator differential equations", North-Holland, 1979 (to appear). (Received February 15, 1979.)

*79T-B81 PENG FAN, Indiana University, Bloomington, Indiana 47401. Which Operators Are the Self Commutators of Compact Operators?

Let T be a hermitian compact operator on a (separable, non-separable) Hilbert space H. Then the following statements are equivalent: (i) T = A*A - AA* where A is compact. (ii) There exists an orthonormal basis $\{b_i\}$ for H such that $\langle Tb_i, b_i\rangle = 0$, for all i. (iii) Let $\{p_i\}$ (resp. $\{-q_j\}$) be the collection of all non-negative (resp. negative) eigenvalues (with multiplicities) of T. Then, $\sum p_i = \sum q_j \le +\infty$. As a result of these characterizations, several consequences are derived. (E.g. Every compact hyponormal operator is normal.) (Received February 16, 1979.)

79T-B82 K.S. PADMANABHAN & R. BHARATI, The Ramanujan Institute, University of Madras, Madras, India. On a subclass of univalent functions. Preliminary report.

Let $S^*(\lambda)$ denote the class of holomorphic functions f in the unit disc E, with $f(0)=0$, $f'(0) = 1$, $f(z)f'(z)/z \neq 0$ for z in E and satisfying the condition $\left|\{(zf'(z)/f(z)) - 1\} / \{(zf'(z)/f(z)) + 1\}\right| < \lambda$, $0 < \lambda \le 1$, z in E. In this paper the class $M(\alpha,\lambda)$ consisting of functions f satisfying in E the condition $|(J(\alpha,f)-1)/(J(\alpha,f)+1)| < \lambda$, $0<\lambda\le 1$, where $J(\alpha,f) = \alpha[1+(zf''(z)/f'(z))] + (1-\alpha)(zf'(z)/f(z))$ $\alpha > 0$, is introduced and its properties investigated. It is proved that $M(\alpha,\lambda) \subset S^*(\lambda)$ and the sharp radius r_o, such that $f \in S^*(\lambda)$ also belongs to $M(\alpha,\lambda)$ for $|z| < r_o$, is determined. Further, a representation formula for $f \in M(\alpha,\lambda)$ and an inequality relating the coefficients of functions in $M(\alpha,\lambda)$ are obtained. (Received February 15, 1979.) (Authors introduced by Dr. D. Sundararaman).

WITHDRAWN

79T-B84 TOMA V. TONEV, Institute of Mathematics, Bulgarian Academy of Sciences, 1000 Sofia, Bulgaria, P.O. Box 373. The corona theorem about hyper-analytic functions.

If Γ is the additive group of rational numbers on the real line, G denotes the character group of Γ_d, $\Delta_G = G\times[0,1)/G\times\{0\}$ and $* = G\times\{0\}/G\times\{0\}$. If $p \in \Gamma_+ = \Gamma\cap[0,\infty)$, every character χ_p: $\chi_p(g) = g(p)$, $g \in G$, is extendable on the whole hyper-disc $\overline{\Delta}_G$ as follows: $\widetilde{\chi}_p(\lambda,g) = \lambda^p\cdot\chi_p(g)$ if $\lambda \neq 0$ and $p \neq 0$, $\widetilde{\chi}_p(*) = 0$ for $p \neq 0$ and $\widetilde{\chi}_0 \equiv 1$. A function f on Δ_G is called hyper-analytic, if it is approximable on Δ_G by hyper-polynomials, i.e. by finite linear combinations of functions $\widetilde{\chi}_p$.

Theorem. If $f_1, \ldots, f_n$ are bounded hyper-analytic functions on Δ_G, such that $|f_1(\lambda,g)| + \ldots + |f_n(\lambda,g)| \geq \delta > 0$ on Δ_G, then there exist n bounded hyper-analytic functions $g_1, \ldots, g_n$ on Δ_G, such that $f_1\cdot g_1 + \ldots + f_n\cdot g_n \equiv 1$.

The proof is based on the analogous Carleson's result about classical bounded analytic functions. An immediate consequence from the theorem is the nonexistence of corona in the maximal ideal space of the algebra of bounded hyper-analytic functions on Δ_G. (Received February 20, 1979.)

Applied Mathematics (65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

79T-C30 V. JA. KREINOVIC, USSR 196140 Leningrad Pulkovo Special Astrophysical Observatory. On scalar gravity. Preliminary report.

Freund and Nambu (Phys. Rev., 1968, 741) were the first to investigate scalar analogue of gravity - scalar field ζ whose source is the trace T of the total energy-momentum tensor (including energy of the field ζ itself). They investigated only the case when lagrangian $L = a(\zeta)\zeta_{,i}\zeta^{,i} + b(\zeta)$. We investigate the general case and the interaction of ζ with other physical fields: Theorem 1. In case for $L(\zeta, \zeta_{,i})$ its variational equations (1) $\delta L/\delta\zeta = 0$ are equivalent to (2) $\Box\zeta + m^2\zeta = gT(L)$ then $L = 1/2\,\zeta_{,i}\zeta^{,i}(1+2g\zeta)^{-1} + k(1+2g\zeta)^{-2} - 1/2\,m^2\zeta^2$. Here k is an analogue of gravitational Λ-term. Interaction: Theorem 2. In case $L(\zeta, \zeta_{,i}, \psi_x, \psi_{x,i})$, ψ_x - any other fields, is such that (1) is equivalent to (2) and $L_{\zeta=\zeta_{,i}=0} = l(\psi_x, \psi_{x,i})$, then $L = 1/2\,\zeta_{,i}\zeta^{,i}(1+2g\zeta)^{-1} - 1/2\,m^2\zeta^2 + \sum_{p=0} l_p(1+2g\zeta)^{-(2-p/2)}$, where l_p is the sum of all terms in L that are of pth degree with respect to $\psi_{x,k}$. In particular, test particles move along geodesics of the metric $g_{ij} = \eta_{ij}(1+2g\zeta)^{-3/2}$. (Received September 18, 1978.)

*79T-C31 Verma, H. K., P.A. U., Ludhiana, India. Gas absorption accompanied by a first order reaction in a falling film.

In this paper we consider the problem of gas absorption accompanied by a first order reaction in a falling film. Expressions are developed giving the point absorption rate and effective penetration depth as a function of distance from the liquid inlet (when $X \not< L$, i.e. X, the distance measured inwards from the surface of the film is not very much less than uniform thickness L of the film). (Received December 11, 1978.)

79T-C32 ALKA R. AGRAWAL, California State College, California, Pennsylvania 15419. Self-Consistent Field Numerical Analysis on Al_2^{+6}, Al_2^{+3}, Al_2, and Al_2H Systems to determine Potential Energy Curves. Preliminary report.

Self-Consistent-Field (S.C.F.) Numerical study has been carried out for Al_2^{+6}, Al_2^{+3}, and Al_2 using scaled even-tempered double-zeta Slater-type basis sets in the 0.1 to 5.0 Bohr region. An analysis on the nature of Al^{+3}-Al^{+3} Al- Al^{+3} and Al-Al interactions was done by observing changes in the total energies as functions of the internuclear distances. This basic research relates to radiation damage studies (Tables I, II and III of this report). Slater basis sets were replaced by Gaussian basis sets in anticipation of computations on larger clusters for which Gaussian basis sets are required. The S.C.F. calculations are adequate for representing the repulsive region to an accuracy of better than 1%. For the same range of internuclear distances (0.1-5.0 B), the potentials for Al_2^{+6}, and Al_2^{+3} have been studied in this paper. These results may be used to separate core-core, core-valence and valence-valence effects for comparision with approximate closed shell theories. This work was done at the Argonne National Laboratory under the supervision of Dr. Nora H. Sabelli [Theoretical Chemistry Group] and Dr. Thomas L. Gilbert [Solid State Science Division], using BISON and ALCHEMY computer programs and Roothan Expansion method to solve Hartree-Fock equation as a linear combination of atomic basis functions in a self-consistent manner. (Received February 5, 1979.) (Author introduced by Dr. Jagdish C. Agrawal).

79T-C33 E. YA. GABOVICH, VNIRO, Moscow, 107140 USSR. The positive solution of an equivalence problem in discrete programming. Preliminary report.

Let A be an additive totally ordered Abelian semigroup and $C = \| c_{ij} \|$ an $n \times n$-matrix over A. For every element $s: i \to s(i)$ of full symmetric group S_n we define $L_c(s)$ as the sum $c_{1\,s(1)} + \cdots + c_{n\,s(n)}$. Let H be an arbitrary subset of S_n. Then the (H, A, C)-problem of discrete programming is defined as follows: find $h_0 \in H$ for which $L_c(h_0) = \min_{h \in H} L_c(h)$. An (H, A, C)-problem is called equivalent to an (H, B, D)-problem if $(\forall s, t \in H)(L_C(s) < L_C(t) \Leftrightarrow L_D(s) < L_D(t))$. In my paper in "Semigroup forum", 1974, 8, 69-73, the following problem was discussed: is any (H, A, C)-problem equivalent to an (H, B, D)-problem over some finite semigroup B? The positive answer was given when A is the semigroup of all real numbers and in some other particular cases. Now I declare the positive answer in the general case. Theorem. Any (H, A, C)-problem is equivalent to an (H, B, D)-problem over finite semigroup B with an absorbing element ∞, having the following properties: $(\forall b \in B)(b + \infty = \infty + b = \infty + \infty = \infty \ \& \ b < \infty)$. (Received February 15, 1979.)

79T-C34 Dr. Irving H. Anellis, Dept. Philos., University of Florida, Gainesville, Florida 32611. A classical technique for description of quantal states.

An extrapolative measurement technique is suggested for full determination of quantal states, and a second-order functional chronogeometric calculus, with a quantum-mechanical model, is sketched for an algebraic representation of quantal behavior. (Received February 15, 1979.)

79T-C35 ANDRÉ GLEYZAL, 1965 S. E. 5th Court, Pompano Beach, Florida 33060. Enerel mathematical physics.

Let $m = \underset{\sim}{m} + i\underset{\sim}{e}$ denote enerel, where $\underset{\sim}{m}$ = mass and $\underset{\sim}{e}$ = electrical charge; let $\mathcal{Z}^n = (Z^n, z_{\alpha\beta})$ denote a complex Riemannian geometry in the theory of analytic functions of several complex variables with $ds^2 = z_{\alpha\beta} dz^\alpha dz^\beta$; let $R_{\alpha\beta} = 0$, $(u^{\beta\alpha} - u^{\alpha\beta})_\beta = I_0$, $mu_{\alpha\beta} u^\beta / u^\gamma = R_0$, $u^\alpha / u^\beta = I_0$, $u_\alpha u^\alpha = 1$, $z^{1/2} = R_0$, where

$z = \det z_{\alpha\beta} \neq 0$, $A = {}^{R}B$ signifies Re A = Re B if the complex coordinate $z^{\gamma} = x^{\gamma} + iy^{\gamma}$ is real on a thus defined observer submanifold X^n of an n complex dimensional complex analytic manifold Z^n, and $A = {}^{I}B$ signifies $A/i = {}^{R}B/i$. Suppose $\mathscr{M}^n$ is almost flat, $R_{\alpha\beta\gamma\delta} \approx 0$, except in the vicinity of a Schwarzschild-like singularity (m_0). The foregoing constitutive equations and coordinate conditions yield results which are extremely close to conventional results. (Received February 19, 1979.)

*79T-C36 Eduardo D. Sontag, Rutgers University, New Brunswick, NJ 08903. Length of inputs needed to identify a linear system.

Consider the class S(m,n,p) --resp.,C(m,n,p),-- of all linear constant systems --resp.,canonical such systems,-- (F,G,H) with m inputs, p outputs, and dimen--sion n, over an arbitrary fixed field. Let a(m,n,p) (c(m,n,p)) be the minimal length of inputs needed to (open-loop) identify the zero-state i/o behavior of systems in S(m,n,p) (C(m,n,p)); $\underline{a}$(m,n,p) ($\underline{c}$(m,n,p)) give the corresponding lengths for closed-loop testing (test inputs may depend on observed outputs). Primed quantities indicate analogous notions for systems (F,G,H,x(0)) with arbitrary initial state. Then these numbers are independent of p, and:

THEOREM. $a(m,n,p) = c(m,n,p) = 2mn$; $a'(m,n,p) = c'(m,n,p) = 2(m+1)n-1$;

$\underline{a}(m,n,p) = \underline{c}(m,n,p) = n(m+1)$; $\underline{a}'(m,n,p) = \underline{c}'(m,n,p) = n(m+2)-1$.

For systems over the reals or complexes, there is also a local result (identify systems in each element of a covering by open dense subsets of C(m,n,p)), and the open-loop local lengths coincide with the closed-loop global ones given above. Also for this case, generic inputs of the given length are suitable for identification. (Received February 16, 1979.)

*79T-C37 Matthew Witten, University of Southern California, Dept. of Biomedical Eng. Los Angeles, CA 90007 and James Smith W. Alton Jones Cell Science Center, Lake Placid, NY 12946. On the construction of a framework for testing aging theories in cell cultures.

This paper presents a minimal assumption general framework for the testing and/or examination of aging hypotheses in cell cultures. The algorithm presented assumes only that the cell culture is a synchronously dividing cell culture. Present work is being done to eliminate this assumption as well. (Received February 19, 1979.)

Geometry (50, 52, 53)

*79T-D5 THOMAS O. STROMMER, Louisiana State University, Baton Rouge, Louisiana 70803. The Maximal Sizes of Faces and Vertices in an Arrangement.

Let A be an arrangement of n lines in the plane. Suppose that $F_1, \ldots, F_r$ are faces of A, and that $V_1, \ldots, V_s$ are vertices of A. If each F_i is a $t(F_i)$-gon and $t(V_j)$ of the lines of A intersect at V_j, then we show that

$$\sum_{i=1}^{r} t(F_i) + \sum_{j=1}^{s} t(V_j) \leq n + 2r(r-1) + \tfrac{1}{2}s(s-1) + 2rs .$$

Further, we show that equality is always possible if n is at least $2r(r-1) + \frac{1}{2}s(s-1) + 2rs$ and definitely impossible if r is at least n or s is at least $n\sqrt{2}$. (Received February 9, 1979.)

*79T-D6 RALPH ALEXANDER, University of Illinois, Urbana, Illinois 61801. Metrics on R^n which possess a Crofton formula. Preliminary report.

Let d be a continuous metric on R^n. Then there is a positive Borel measure η on the hyperplanes of R^n such that d(p,q) equals the η-measure of the hyperplanes cutting the segment $\overline{pq}$ if and only if 1) d(p,r) = d(p,q) + d(q,r) whenever p, q, r are collinear in the given order, and 2) d is a hypermetric.

For the basic literature on hypermetrics see J. B. Kelly, "Hypermetric spaces" in: The geometry of metric and linear spaces, L. M. Kelly, ed., Lecture Notes in Mathematics, 490 (Springer-Verlag, 1975), 17-31. (Received February 19, 1979.)

*79T-E19 Saharon Shelah, The Hebrew University, Jerusalem, Israel. On successors of singular cardinals.

Ass ume for simplicity G.C.H.

Theorem 1: There is an $\aleph_{\omega+1}$-free not free (abelian) group of cardinality $\aleph_{\omega+1}$.

Theorem 2: Suppose $S \subseteq \lambda^+$ is fat (i.e. for every closed unbounded $C \subseteq \lambda^+$, and $\alpha < \lambda^+$ there is a closed $A \subseteq C \cap S$ of order-type α). Then some foreing notion P, do not add λ-sequences of ordinals but add a closed unbounded subset of S. (This improves previous results Avraham, Harrington Gregory and Stavi)

Theorem 3: There is $S^* \subseteq \lambda^+$ such that for $\mu \leq \lambda^+$, $S \subseteq \{\delta < \lambda^+ : \mathrm{cf}\ \delta < \mu\}$; the following are equivalent.

a) forcing by a μ- complete forcing preserve the stationarity of S

b) $S - S^*$ is stationary. (Received November 9, 1978.)

79T-E20 ROBERT A. DI PAOLA, Queens College, The City University of New York, Flushing, New York 11367. The Theory of Partial α-Recursive Operators. II.

This is intended as an emendation of our previous abstract of the same title, Abstract 78T-ES9, August 1978, Page A-497. On line 3, after the definition of α-recursive enumeration reducibility, we say "Each index ε thus defines a mapping Φ_ε from 2^α into 2^α". It has been called to our attention by M. Fitting that this is in error (as is easily seen). But for each ε, define $\Phi_\varepsilon(A) = \bigcup\{k_\delta \mid (\exists \eta)[\langle \delta, \eta\rangle \in W_\varepsilon \ \&\ k_\eta \subseteq A]\}$.

Each ε does define a mapping Φ_ε from 2^α into 2^α. Say that Φ_ε is an α-recursive enumeration operator if for all single-valued sets A, $\Phi_\varepsilon(A) \leq_{\alpha e} A$ via ε. Weak α-recursive enumeration reducibility and weak α-recursive enumeration operators are defined as for $\alpha = \omega$. Partial α-recursive functionals are based on α-recursive enumeration operators and weak partial α-recursive functionals on weak α-recursive enumeration operators. Theorem 1 of the cited abstract remains, modulo the typographical correction noted in the Errata of the Notices, October 1978. Theorem 2 applies to both kinds of α-recursive enumeration operators. For weak partial α-recursive operators and functionals, Theorem 3 applies to both forms of the Myhill-Shepherdson Theorem in Roger's book (p.196 and 359, respectively); for partial α-recursive functionals, the version of p.359 is claimed. But in all cases we further suppose that the domains of the partial α-recursive functions constituting the domain of the effective operation given in the hypothesis of the Myhill-Shepherdson Theorem are regular sets. In Theorem 4, the Kreisel-Lacombe-Shoenfield Theorem (p.362) is claimed for both kinds of α-recursive functionals. Likewise for the lift of Friedberg's Theorem (Theorems 5 and 6). (Received January 30, 1979.)

79T-E21 WITHDRAWN

79T-E22 STANLEY BURRIS, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1. An algebraic test for undecidability. Preliminary report.

An algebra $\underset{\sim}{C} \subseteq \underset{\sim}{A} \times \underset{\sim}{B}$ which is a subdirect product of $\underset{\sim}{A}$ and $\underset{\sim}{B}$ is skew-free if every congruence θ of $\underset{\sim}{C}$ is the restriction of a product congruence $\theta_1 \times \theta_2$ of $\underset{\sim}{A} \times \underset{\sim}{B}$. If θ is a congruence of $\underset{\sim}{A}$ let $\underset{\sim}{\theta}$ be the corresponding subalgebra of $\underset{\sim}{A} \times \underset{\sim}{A}$.

Theorem. Let $\underset{\sim}{A}$ be a finite non-simple directly indecomposable member of a congruence modular variety V. Let θ be a maximal congruence on $\underset{\sim}{A}$ with at most one complement in the lattice of congruences of $\underset{\sim}{A}$. If $\underset{\sim}{A} \times \underset{\sim}{A}$ and $\underset{\sim}{\theta}$ are skew-free then the first order theory of V is undecidable.

Corollary. A finitely generated congruence distributive variety with a decidable first-order theory is semi-simple and arithmetical.

We also obtain the following well-known results.

Corollary. The first-order theories of groups and rings are undecidable. (Received February 8,1979.)

*79T-E23 Bohuslav Balcar, ČKD-Polovodiče, 14003 Praha, Czechoslovakia and František Franěk, University of Toronto, Ontario, Canada M5S 1A1. Complete Boolean algebras are semifree.

Following Keslyakov and Monk, we call a Boolean algebra B semifree if there is an independent family $F \subseteq B$ of the same cardinality as B.
Theorem. Every infinite complete Boolean algebra is semifree.
Therefore, the cardinality of the set of all ultrafilters on an infinite complete algebra B is $2^{|B|}$, which solves Efimov's problem without any additional set theoretical assumptions. (Received February 8, 1979.)

79T-E24 JON PEARCE, University of California, Berkeley, California 94720
Constructive Cut Elimination Arguments and Applications, Preliminary report.

Let Λ be an ordinal (Λ interprets the first recursively inaccessible). For α an ordinal, I define $g_\alpha:\Lambda \to \Lambda$ analogous to the Bachmann functions on Ω_1 with $g_0(\gamma)=\Omega_\gamma$ (thus $\xi=g_{\varepsilon_{\Lambda+1}}(0)$ is the analogue of Bachmann's ordinal) and I let $\theta_\alpha:\Lambda \to \Lambda$ be the Fefferman Aczel functions extended to Λ (see Buchholz, Springer 500). Thus $\theta_0(\gamma)=\omega^\gamma$ and $\theta_\xi(0) < \Omega_1$.

Let T be the subsystem of second order arithmetic obtained by allowing Σ^1_2 axiom of choice plus bar induction. Using an argument similar to Tait (Buffalo Conference on Proof Theory 1968), the following is shown: Transfinite induction on $\theta_\xi(0)$ plus simple assumptions proves the consistency of T. Hence $\theta_\xi(0)$ is a bound for the provably well founded ordinals of T, this bound is shown to be exact. Ordinals for restrictions and extensions of T are also computed.(Received February 15, 1979.) (Author introduced by Sy D. Friedman).

79T-E25 F. GALVIN, University of Colorado, Boulder, CO 80309; J. MYCIELSKI, Institut des Hautes Études Scientifiques, 91440 Bures-Sur-Yvette, France; R.M. SOLOVAY, University of California, Berkeley, CA 94720. Strong measure zero sets.

Thm. 1. For a set X of real numbers, the following are equivalent: (1) X is strongly of measure zero; (2) every dense open set contains a translate of X; (3) every dense G_δ-set contains a translate of X; (4) for every dense G_δ-set D there is a nonempty perfect set P such that $X+P \subseteq D$; (5) for every dense G_δ-set D there are real numbers $a \neq 0$ and b such that $aX+b \subseteq D$.
Thm. 2. For a set X of real numbers the following are equivalent: (6) for every dense open set D there are real numbers $a \neq 0$ and b such that $aX+b \subseteq D$; (7) X is the union of a bounded set and a strong measure zero set. Remarks. K. Prikry had noted (3) $\Rightarrow$ (2) $\Rightarrow$ (1) and asked if the converses hold. J. Fickett had asked for a characterization of sets X satisfying (6). J.C. Morgan II has kindly informed us that Thm. 1 answers negatively a question of W. Sierpiński, Un théorème de la théorie générale des ensembles et ses applications, C.R. Varsovie 28 (1935), 131-135. Thm. 3. Let X be a set of real numbers. Consider the following game: at the n-th move player I chooses $\varepsilon_n > 0$ and then player II chooses an interval J_n of length ε_n; player II wins iff $X \subseteq \bigcup_{n=1}^{\infty} J_n$. Player I (II) has a winning strategy iff X is not strongly of measure 0 ($|X| \leq \omega$).
(Received February 15, 1979.)

Statistics and Probability (60, 62)

*79T-F6 JOHN D. EMERSON, Sidney Farber Cancer Institute and Harvard School of Public Health, Boston, Massachusetts 02115. Exact Distribution-Free Confidence Intervals for Quantiles in Right-Censored Data. Preliminary report.

Censored data is fundamentally different from other types of data in statistical problems in that the time until some specified event cannot always be fully observed. For each censored observation, it is known only that the time of the specified event (eg. failure) must exceed a known time.

A distribution-free confidence interval for a quantile is constructed by inverting a hypothesis test which is designed to accommodate partial censoring of the data. The proposed test is a generalization of the binomial test often used when no censoring exists. For each censored observation, a distribution-free estimate of the probability distribution for the eventual time of the event is used to modify the standard test statistic. These estimates are derived from a modification of the Kaplan-Meier estimates of the probability distribution of events. The modification is shown to satisfy a maximum likelihood condition, subject to constraints which reflect the null hypothesis. (Received February 20, 1979.)

Topology (22, 54, 55, 57, 58)

79T-G28 THEMISTOCLES M. RASSIAS, Research Center For National Defense, K.E.E®.A, Galatsi, Athens, GREECE. On a Generalization of a Geometric Theorem of Poincaré.

A geometric theorem of Poincaré that expresses an important property of one of the models of classical mechanics is formulated as follows:-
"Suppose T be a given area-preserving homeomorphism of a planar circular annulus onto itself that moves the bounding circles of the annulus in opposite directions. Then T has at least two fixed points."
A new proof of the above theorem and similar generalizations are obtained. Analogs of the Poincaré's theorem are proposed connecting it with a theorem of Von Neumann in game theory, the theory of vector fields and also with algorithms for the approximate determination of fixed points. Applications of the above results to the problem of periodic motions in celestial mechanics are given. (Received November 27, 1978.)

79T-G29 LESLIE FOGED, Washington University, St. Louis, Missouri 63130. A characterization of g-metrizability.

Siwiec [Pac. J. Math. 52 (1974), 233-245] speculated that g-metrizable spaces might be characterized in terms of k-networks. Indeed, a regular space is g-metrizable if and only if it is weakly first countable and has a σ-discrete k-network. Also, there is an example of a g-metrizable space which is not g-developable as defined by K. B. Lee [Pac. J. Math. 65 (1976), 113-118]. (Received December 26, 1978.)

79T-G30 JEROME MINKUS, 2011 Los Angeles Avenue, Berkeley, California 94707
On the Alexander Polynomials of 2 Bridge Knots.

In the proof of the Corollary of Abstract #78T-G119 (Notices, Oct. 1978, pg. A609) the following Lemma is used. Lemma: Let k and h be relatively prime odd integers, $1 < h < k$. Let $\Delta(t)$ be the normalized Alexander polynomial of the 2 bridge knot of type (k,h). Let $s_0 = 0$ and let s_r $(= s_r(k,h))$ be as defined in Abstract #78T-G60 (April 1978, pp. A367-68). Then

$$\Delta(t) = \pm t^i \sum_{r=0}^{\frac{k-1}{2}} (-1)^r t^{s_r} \quad \text{for some appropriate integer } i .$$

For many specific values of k and h the computation of $\Delta(t)$ is then relatively straightforward. For example: The 2 bridge knot of type $(2gh \pm 1, h)$ has Alexander polynomial $\Delta(t) = \frac{(h \pm 1)}{2} + h \sum_{j=1}^{2g-1} (-1)^j t^{j^2} + \frac{(h \pm 1)}{2} t^{2g}$. Using Cor. #78T-G119 it can then be shown that $M_g(2gh \pm 1, h)$ is a homology sphere for all odd $g > 1$. Here $M_n(k,h)$ denotes the n sheeted branched cyclic covering of the knot of type (k,h). (Received January 24, 1979.)

*79T-G31 T.C. Raghavan and Ivan L. Reilly, University of Auckland, Auckland, New Zealand.
A note on the lattice structure of topologies.

The following results are proved in this note. Theorem 1. Every sequential R_0 topology on a set X can be expressed as the lattice product of all finer completely pseudo-metrizable topologies on X. Theorem 2. Every T_1 topology on X with the topological property P can be expressed as the lattice product of all finer topologies on X with the topological property Q where $P \in$ {second countable, first countable, weakly first countable, bisequential, countably bisequential, Frechet, sequential}

and Q ∈ {completely metrizable, Baire, metrizable, hereditarily paracompact, hereditarily countably paracompact, realcompact, perfectly normal and T_1}. For instance, every Frechet T_1 topology can be expressed as the lattice product of all finer hereditarily countably paracompact topologies on X. (Received February 1, 1979.)

79T-G32 Louis M. Friedler, College of St. Scholastica, Duluth, Minnesota 55811. Hyperspaces of H-closed spaces.

All spaces are T_1. For a space X, 2^X is the set of all non-empty, closed subsets of X with the finite topology. For definitions of the other terms below, see Scarborough and Stone, Products of nearly compact spaces, Trans. Amer. Math. Soc. 124(1966), 131-147. Proposition 1. X is H(i) iff 2^X is H(i). Proposition 2. X is seminormal iff 2^X is semiregular. Proposition 3. If 2^X is R(i) [or R(ii), H(ii), feebly compact] then X is R(i) [or R(ii), H(ii), feebly compact]. The main lemma for Proposition 1 is a subbase theorem for H(i) spaces. (Received February 2, 1979.)

79T-G33 Nancy L. Rallis, Boston College, Chestnut Hill, Mass. 02167. Periodic Points and a Fixed Point Index Theory for Symmetric Product Mappings. Preliminary report.

We study questions concerning fixed points, fixed point index and periodic points of symmetric product mappings of the form $f:X \to X^n/G$, where G is a group of permutations of the numbers $[1,\ldots,n]$ and X^n/G is the orbit space of X^n under the action of G.

We define the concept of a periodic point of a symmetric product mapping and find sufficient conditions for the existence of periodic points of symmetric product mappings of metric ANRs. It is shown that for a compact ANR X where $H_i(X)=0$ for odd i any map $f:X \to X^n/G$ has a periodic point of period $\leq$ the Euler characteristic of X.

We also generalize the fixed point index theory developed by Dold [Topology 4 (1965), 1-8] to symmetric product mappings of compact ANRs. Properties analogous to the classical ones are shown; for example, the index is additive, commutative, multiplicative and preserved under homotopy. Finally, it is shown that the index is equal to the Lefschetz number as defined by C.N. Maxwell [Proc. Amer. Math. Soc. 8 (1956), 808-815]. (Received February 5, 1979.)

*79T-G34 Ludvik Janos, Mathematical Reviews, Ann Arbor, Michigan 48109. A retraction property of Ljapunov stable semiflows.

By a semiflow (R^+, X, α) we mean a continuous semigroup action $\alpha: R^+ \times X \to X$ of the additive semigroup of nonnegative reals R^+ on a nonempty compact Hausdorff space X such that the transition function $\alpha(t,\cdot): X \to X$ is one to one for every $t \geq 0$. By $C(\alpha)$ we denote the core of (R^+, X, α), i.e., the set $\bigcap \{\alpha(t, X): t \geq 0\}$, by $X/C(\alpha)$ the quotient space obtained from X by identifying $C(\alpha)$ to a point, and by $\pi: X \to X/C(\alpha)$ the natural projection. If $C(\alpha)$ is a singleton we say that (R^+, X, α) is squeezing. If $C(\alpha) = X$ then the semiflow is naturally a flow. We say that (R^+, X, α) is Ljapunov stable if the family $\{\alpha(t,\cdot): t \geq 0\}$ is evenly continuous. Theorem. If (R^+, X, α) is Ljapunov stable then: (1) There exists a retraction $\pi: X \to C(\alpha)$ commuting with $\alpha(t,\cdot)$ for every $t \geq 0$. (2) There exists a topological equivariant embedding $\tau: (R^+, X, \alpha) \to (R^+, X/C(\alpha), \alpha^*) \times (R^+, C(\alpha), \alpha^{**})$ where α^* and α^{**} are the actions naturally induced by α on $X/C(\alpha)$ and $C(\alpha)$ respectively. Moreover the first factor is squeezing and the second is a flow. (3) The embedding τ is defined by $\tau(x) = (\pi(x), \pi(x))$ for $x \in X$. (Received February 5, 1979.)

*79T-G35 JAN van MILL, Vrije Universiteit, De Boelelaan 1081, Amsterdam. More on remote points.

Van Douwen has shown that each nonpseudocompact space of countable π-weight has a remote point. There is an example of a space of weight ω_2 which has no remote point. We are concerned with spaces of π-weight ω_1 and show that many spaces of that class have a remote point. For example, each nonpseudocpmpact space which is a product of at most ω_1 spaces of countable π-weight has a remote point. (Received February 5, 1979.)

*79T-G36 JAN van MILL and CHARLES F. MILLS, Vrije Universiteit, De Boelelaan 1081, Amsterdam. A topological property enjoyed by near points but not by large points.

Let $\mathbb{H}$ denote the halfline $[0,\infty)$. A point $p \in \beta\mathbb{H} - \mathbb{H}$ is called a near point if p is in the closure of some countable discrete closed subspace of $\mathbb{H}$. In addition, a point $p \in \beta\mathbb{H} - \mathbb{H}$ is called a large point if p is not in the closure of a closed subset of $\mathbb{H}$ of finite Lebesgue measure. We will show that for every autohomeomorphism φ of $\beta\mathbb{H} - \mathbb{H}$ and for each near point p we have that $\varphi(p)$ is not large. In addition, we establish, under CH, the existence of a point $x \in \beta\mathbb{H} - \mathbb{H}$ such that for each autohomeomorphism φ of $\beta\mathbb{H} - \mathbb{H}$ the point $\varphi(x)$ is neither large nor near. (Received February 5, 1979.)

*79T-G37 RYSZARD FRANKIEWICZ, JAN van MILL, CHARLES F. MILLS, Vrije Universiteit, De Boelelaan 1081, Amsterdam, and KENNETH KUNEN, University of Wisconsin, Madison, Wisconsin 53706, Nowhere dense closed P-sets.

[KvMM] We show that no compact space of weight ω_1 can be covered by nowhere dense closed P-sets. In addition, we construct a compact space of weight ω_2 which can be covered by nowhere dense closed P-sets. As an application, we show that CH is equivalent to the statement that each small nonpseudocompact space has a remote point.

[FM] We prove it is consistent that ω^* is covered by nowhere dense closed P-sets. In addition, we consider what spaces can be closed P_c-sets in ω^*; we find in particular that under CH, these are precisely the compact zerodimensional F-spaces of small weight. (Received February 5, 1979.)

*79T-G38 CHARLES F. MILLS, Vrije Universiteit, De Boelelaan 1081, Amsterdam. When Colorado is homeomorphic to Utah.

We prove that if X is a compact connected nowhere separable LOTS then $[(\mathrm{Aut}\ X)^2 : \mathrm{Aut}(X^2)] = 2$; i.e. X^2 has few autohomeomorphisms. As an application for such X, $\square \not\approx \square$. (Received February 5, 1979.) (Author introduced by Jan van Mill).

*79T-G39 Carlos R. Borges, University of California, Davis, California 95616. Free Groups, Symmetric and Reduced Products.

We show that, for any Tychonoff space X with base point θ, the infinite symmetric product $SP^\infty X$ of X is a subspace of an abelian group $A(X)$ generated by X. (This clarifies the continuity of the multiplication in $SP^\infty X$.) Furthermore, $SP^\infty X$ is a retract of $A(X)$. Analogous results hold for reduced product spaces, with respect to non-abelian groups. (Received February 5, 1979.)

*79T-G40 Mary Anderson, University of California, Berkeley, California 94720. Representations of the Spherical functions for SL(3,R) in terms of elliptic functions.

Explicit representations of Harish - Chandra's integral are obtained for the spherical functions and the spherical functions of the second kind of SL(3,R). These functions are also represented as Laplace transforms of certain elliptic functions $x^{\frac{1}{2}}F(\frac{1}{2}, \frac{1}{2}, 1; x/y)$. Kummer's relations for these particular hypergeometric functions are shown to arise from the action of the Weyl group. The spherical functions are analytically coninued to $PSL(3,\mathbb{C})$ and the generators of the monodromy group found. Obstructions resulting from the existence of a second conjugacy class of Cartan subalgebras are shown to occur. (Received February 5, 1979.)

79T-G41 Peter A. de Caux, Southern Technical Institute, Marietta, Georgia 30060. A small countably compact C-embedding of the positive integers. Preliminary report.

A countably compact Hausdorff space $\alpha(N)$ of cardinality c is constructed such that 1) the positive integers N are densely embedded in $\alpha(N)$ as a discrete subspace and 2) each bounded real-valued function on N can be extended to a continuous real-valued function on $\alpha(N)$. The author has not been able to find in the literature an example of such a countably compact C*-embedding of N with cardinality less than 2^c. (Received February 7, 1979.)

79T-G42 Elyahu Katz, University of Haifa, Haifa, Israel. Cofibrations of Algebras. Preliminary report.

The chain complex of a twisted free product $A *_t FK$, is chain homotopy equivalent to a differential graded algebra, which is identified to be a ^{t}cofibration of algebras as defined by Quillen. Under certain connectivity conditions we obtain a long exact sequence connecting the homologies of A, K, and $A *_t FK$. In particular we derive a long exact sequence connecting the homologies of $\Omega Y, \Omega\Sigma X$ and $^t\pi_*(Y \cup_g CX)$ (Ω, C, Σ are the loop, the cone and the suspension constructions respectively). A chain complex equivalent to the chain complex of the Milnor free group FX is recognized, from which results a theorem of Bott and Samelson that $H(\Omega\Sigma X)$ is freely generated as a graded algebra by H(X). (Received February 9, 1979.)

79T-G43 Gadi Moran, University of Haifa, Haifa 31999, Israel. A T_2-image of a compact ordinal nonobtainable from ordinals by iterating finite-products and taking subspaces.

Let C denote the class of spaces obtained from compact ordinals by iteration of taking: (a)closed subspaces; (b)finite products; and (c)continuous T_2-images. C is discussed by Mrowka, Rajagopalan and Soundararajan(TOPO-72, Springer lecture notes 378, p.288-297). They ask whether (a) and (b) alone generate C. The negative answer is a consequence of Theorem: Let $W=\{\omega_i : 0 \le i \le \omega\}$. Let K be the space obtained from $\omega_\omega+1=\{\alpha : 0 \le \alpha \le \omega_\omega\}$ by reducing W into one point k. Then K is not homeomorphic to a space obtained from ordinals by iterating (a) and (b). Proof: There are infinitely many regular ordinals ρ such that k is a limit of a ρ-sequence in K. No point with this property exists in a space obtained from ordinals by iterating (a) and (b).$\square$. Devi, Meyer and Rajagopalan (General Topology and its Applications 6(1976),p.279-289) have shown that C is nonobtainable from compact ordinals by (a) and (c) alone. (Received February 12, 1979.)

*79T-G44 L. R. HITT, University of South Alabama, Mobile, Ala. 36688 and D. W. Sumners, Florida State University, Tallahassee, Fla. 32306. Many different disk knots with the same exterior.

An n-disk knot (D^{n+2}, fD^n) is a smooth codimension 2 disk pair. If X^{n+2} denotes the bounded exterior of an n-disk knot, then $D^{n+2} = X \cup_\alpha h^2$, where h^2 is a 2-handle sewn on by a meridian curve α, and the co-core of h^2 is the knotted submanifold. The indeterminacy index $\zeta(X)$ is the number of inequivalent n-disk knots with exteriors diffeomorphic to X (disregard orientations). By modification of an example of Kato, one can prove Theorem 1: For each $n \ge 5$, there exist infinitely many homeomorphically distinct n-disk exteriors $\{X_i^{n+2}\}$, each with $\zeta(X_i) \ge 10$. Theorem 2: If $|\pi'|$ denotes the order of $\pi' =$ commutator subgroup of $\pi_1(\partial X)$, then $\zeta(X^{n+2}) \le 2|\pi'|$ $(n \ge 3)$. As a corollary we obtain the well-known result that there are at most two n-sphere knots with the same exterior. We then study conditions which force $\zeta(X) = 1$. (See Abrstract 750-G6 for related results.) (Received February 12, 1979.)

79T-G45 John L. Harer, University of California at Berkeley, Berkeley, California 94720. How to Construct all Fibered Links.

Stallings has given several methods for building fibered links in S^3 ("Constructions of Fibered Knots and Links", Proceedings of Symposia in Pure Math., Vol. 32, 1978). Two of these are called plumbing and twisting. In this paper we show that for every fibered link L there is another fibered link L' such that (1) L' is constructed from the unknot by plumbing Hopf links and (2) L' is constructed from L by plumbing Hopf links and twisting. If L is a knot we may assume L' is also and that at each step between L and L' we have knots. An extension of the arguments gives a third move with which we may relate any two fibered links in an arbitrary 3-manifold. (Received February 12, 1979.)

*79T-G46 TEODOR C. PRZYMUSIŃSKI, Instytut Matematyczny PAN, 00-950 Warsaw,Poland. Normality and paracompactness of Pixley-Roy hyperspaces. Preliminary report.

Let $F[X]$ denote the Pixley-Roy hyperspace of a T_1-space X. THEOREM 1. TFAE: /i/ $F[X]$ is /hereditarily/ paracompact; /ii/ $F[X]^1$ is /hereditarily/ collectionwise Hausdorff; /iii/ $F[X]^n$ is /hereditarily/ paracompact for all natural n.

THEOREM 2. Let X be compact. TFAE: /i/ $F[X]$ is /hereditarily/ normal; /ii/ $F[X]$ is /hereditarily/ paracompact; /iii/ X is scattered /countable/.

THEOREM 3. Let X be metrizable. $F[X]$ is /hereditarily / paracompact iff X is σ-discrete.

THEOREM 4. There exists a metric X such that $F[X]$ is normal non-metrizable iff there exists a strong q-set.

THEOREM 5. If X is scattered, then $F[X]$ is paracompact. THEOREM 6. If X is a σ-locally finite union of closed subspaces whose PR-hyperspaces are /hereditarily/ paracompact, then $F[X]$ is /hereditarily/paracompact.

THEOREM 7. If every point $x \in X$ has a neighbourhood U_x such that $F[U_x]$ is /hereditarily/ paracompact, then $F[X]$ is /hereditarily/ paracompact.

THEOREM 8. If X is of point-countable type and $F[X]$ is hereditarily normal, then X is first countable and thus $F[X]$ is perfectly normal. (Received February 13,1979.)

79T-G47 GERARD A. VENEMA, Institute for Advanced Study, Princeton, New Jersey 08540. An approximation theorem in the shape category.

In this paper it is shown that if X is a compactum in the interior of a PL manifold M and if U is a neighborhood of X in M, then there is a compactum X' in U such that X and X' have the same relative shape in U and the embedding dimension of X' equals the fundamental dimension of X. Whenever the dimension of M is not equal to three, the relative shape equivalence from X' to X can be realized by an infinite isotopy of M. (Received February 15, 1979.)

79T-G48 WITHDRAWN

79T-G49 Gary Gruenhage, Auburn University, Auburn, AL 36830. Paracompactness in normal locally compact spaces. Preliminary report.

Theorem 1. Every normal, locally compact, locally connected, θ-refinable space is paracompact.

Theorem 2. Every normal, rim-compact, locally connected, subparacompact space is paracompact.

Theorem 3. (MA + $\neg$CH). There is no locally connected rim-compact L-space. Theorem 4 (MA). Every perfectly normal locally compact space of cardinality less than c is subparacompact (and, in fact, a Moore space). Theorem 5. (MA + $\neg$CH). If X is perfectly normal, locally compact, and collectionwise normal with respect to compact sets, then X is paracompact. Theorems 1 and 2 improve results of Reed and Zenor, and Chaber and Zenor, respectively. Theorem 3 answers a question of Zenor. Theorems 4 and 5 make use of the technique developed by M.E. Rudin in proving that, under MA + $\neg$CH, every perfectly normal manifold is metrizable, and the modification of this technique due to D. Lane who proved that, under MA + $\neg$CH, every perfectly normal, locally compact, locally connected space is paracompact.(Received February 19, 1979.)

79T-G50 VO T. LIEM, Louisiana State University, Baton Rouge, LA 70803. Some results on Group Actions on Hilbert cube. Preliminary report.

Let G be a topological group. Two actions F and H of G on a space X are conjugate if there is a homeomorphism h of X onto itself such that $g_F = hg_Hh^{-1}$ for all g of G. Let Q denote the Hilbert cube and G a finite group, Theorem 1. If H is a semi-free action of G on Q such that (i) its fixed point set is a copy of Q and is a Z-set in Q, (ii) its orbit space Q/H is an ANR, then Q/H is homeomorphic to Q./ Now, we assume that G is a finite group or a torus T^n and H is the standard semi-free action of G on Q. Theorem 2. The homeomorphism

group of the orbit space Q/H is locally contratible. Theorem 3. Let F be a fiber preserving semi-free action of G on $Q \times [0,1]^n$ over $[0,1]^n$ such that the fixed point set of $F \mid Qxt$ is $\{0xt\}$ for each t of $[0,1]^n$. (a) If $F \mid Qxt$ is equivalent to the standard semi-free action H of G on Q, then F is fiber preserving equivalent to the product action $H \times Id_{[0,1]^n}$. (b) If $F \mid Qxt$ is weakly equivalent to the standard semi-free action H on Q, then F is fiber preserving weakly equivalent to the product action $H \times Id_{[0,1]^n}$.

Corollary. (generalization of Wong's theorem) Let F be a fiber preserving semi-free action of G on $Q \times [0,1]^n$ over $[0,1]^n$ such that the fixed point set of F is $\{0\} \times [0,1]^n$. Then the natural map $p: [(Q-\{0\}) \times [0,1]^n] / F \longrightarrow [0,1]^n$ is a Hurewicz fibration. (Received Feburary 20, 1979.)

Miscellaneous Fields (00, 01, 96–99)

79T-H1 PAUL STEWART SCHNARE, University of Petroleum and Minerals, Dhahran Airport, P.O. Box 144, UPM no. 172, Dhahran, Saudi Arabia.
Astronomical Calendar Calculations, I.

The author is convinced that the programmable pocket calculator should now be used to obviate the necessity of various tables and hand computations in calendar calculations. He is concerned in this and subsequent announcements with the Egyptian (era of Nabonassar, EN), Alexandrian (era of Diocletian, A), Persian (era of Yazdigird, EY), Muslim (era of the Hijra, EH), Julian (J), and Gregorian (G) calendars as described in R. Newton, Ancient Planetary Observations..., Johns Hopkins, 1976. (It should be noted that the Muslim calendar, EH, is emphatically not the religious calendar, currently used in Saudi Arabia). Based on Newton (op. cit.) algorithms are constructed and programs written for the TI-59 to calculate from a date in any of the six calendars, the Julian day (JD) = the number of days since 1 January 4713 B.C. (See Neugebauer, A History of Ancient Mathematical Astronomy Vol. 3, Springer, 1975). The programs also give the feria or (Newton's) day of the week (cf. Neugebauer's) and the number of days between two dates (even in different calendars). (Received January 25, 1979.)

LATE PAPERS — *Presented at past meetings*

764-A42 Ann Miller, F. D. Pedersen, and Walter S. Sizer, Southern Illinois University, Carbondale, IL 62901. The Lattice of Finite Complexes of a Group.

The finite subsets, F(G), of a group G form a semigroup and a lattice under the obvious operations for multiplication and order. The main theorem of this paper gives an algebraic characterization of F(G). Other results offer necessary and sufficient conditions for the lattice to be distributive.

(Received March 2, 1979.)

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

*765-A1 GORDON D. PRICHETT, Hamilton College, Clinton, New York 13323 and A. L. Ludington, Hamilton College, Clinton, New York 13323 and J. F. Lapenta, Hamilton College, Clinton, New York 13323. An algorithm to determine self-producing r-digit g-adic integers. Preliminary report.

Let a be an r-digit integer expressed in base g with not all digits equal. Let 'a' be the integer formed by arranging these digits in descending order, and let a" be the integer formed by arranging these digits in ascending order. Define T(a) = a' - a". If T(a) = a we call a self-producing. Self-producing integers originated with D. R. Kaprekar and were later brought to notice again by J. H. Jordan. In this paper we present an algorithm which enables one to calculate self-producing r-digit g-adic integers for all r and for all $g \geq 2$. These results reveal an unexpected link between the factorization of certain permutations and the existence of r-digit g-adic self-producing integers. (Received January 12, 1979.)

765-A2 HOWARD STRAUBING, Reed College, Portland, Oregon 97202. Recognizable Sets and Power Sets of Finite Semigroups.

Let $\underline{V}$ be a variety of finite semigroups; that is, $\underline{V}$ is a collection of finite semigroups closed under subsemigroups, homomorphic images and finite direct products. Let $\underline{P(V)}$ be the smallest variety containing $\{\mathcal{P}(S) \mid S \in \underline{V}\}$ where $\mathcal{P}(S)$ denotes the power set of S, given a semigroup structure by the usual multiplication of subsets. Here it is shown that the operation $\underline{V} \longrightarrow \underline{P(V)}$ on varieties corresponds to a particularly simple operation on the family of recognizable sets whose syntactic semigroups belong to $\underline{V}$. This theorem leads to nice descriptions of $\underline{P(V)}$ for various choices of $\underline{V}$; several examples are given. (Received January 22, 1979.)

*765-A3 H. H. Andersen, Institute for Advanced Study, Princeton, New Jersey 08540. Cohomological Representations of Algebraic Groups.

Let G be a connected reductive algebraic group over an algebraically closed field of prime characteristic, and denote by B a Borel subgroup. We prove that the "strong linkage principle" holds for all cohomology groups of homogeneous line bundles on G/B. This gives in particular the first general proof of a conjecture of D.-N. Verma for Weyl modules (earlier proved only for primes bigger than the Coxeter number) which in turn implies that the highest weights of two composition factors of an arbitrary indecomposable G-module must be linked under the affine Weyl group. However, some of the higher cohomology groups are not indecomposable. Our proof of the strong linkage principle relies on a study of certain natural homomorphisms between the cohomology groups. These homomorphisms are then also used to give filtrations of Weyl modules and thereby to prove the existence - as conjectured by R. Carter and G. Lusztig - of some intertwining homomorphisms between these. (Received January 25, 1979.)

*765-A4 STEVEN ZUCKER, Rutgers University, Hill Center, Busch Campus, New Brunswick, New Jersey 08903. Hodge Theory with Degenerating Coefficients: L_2 cohomology in the Poincaré metric.

Let j denote the inclusion of the non-singular complex algebraic curve S in its smooth completion $\overline{S}$. Let V be the underlying locally constant system for a polarized variation of Hodge structure on S. Endow S with the Poincaré metric (or equivalent) and V with the Hodge metric. We establish an isomorphism of $H^i(\overline{S}, j_*V)$ (= parabolic cohomology) with the L_2 cohomology of V-valued forms, and obtain a corresponding Hodge decomposition into (P,Q) components. The construction is

functorial in both S and V; it generalizes a construction of Deligne (unpublished), where S is taken compact but of arbitrary dimension. Of interest to algebraic geometers are the cohomology systems $V = R^q f_* \mathbb{C}$ for some projective $f: X \to S$. As applications, we prove a theorem on normal functions (intermediate Jacobians), interpret the isomophism of Shimura and the Hodge structures attached to symmetric spaces, and generate most of the H^2 of elliptic surfaces by automorphic forms with singularities. (Received January 29, 1979.)

765-A5 SARASWATHI SUBBIAH, Daemen College, Amherst, New York 14226. Finitely generated semigroups of continuous selfmaps. Preliminary report.

X is a locally compact Hausdorff space and S(X) is the topological semigroup of all continuous selfmaps with the compact-open topology. It has been known for a long time that for the Euclidean N-cell I^N, $S(I^N)$ contains finitely generated subsemigroups which are dense in $S(I^N)$. In fact, it contains dense subsemigroups which have as few as two generators. This is a consequence of the fact that $S(I^N)$ is separable and has the property that each countable subsemigroup of $S(I^N)$ is contained in a subsemigroup with two generators. This suggests that it may be worthwhile to investigate more thoroughly semigroups with the property that each countable subsemigroup is contained in a finitely generated subsemigroup. Past results (both distant and recent) are surveyed. Some new results are discussed and various conjectures are considered. (Received February 2, 1979.)

765-A6 JOHN K. LUEDEMAN, Clemson University, Clemson, South Carolina 29631. Torsion Theories and Semigroups of Quotients.

Let S be a monoid with 0 and Σ a collection of left ideals of S satisfying (Q1): If $f \in \mathrm{Hom}(A,S)$, $A,B \in \Sigma$, $f^{-1}(0) = 0$ then $f^{-1}(B) \in \Sigma$, and (Q2): If $I \in \Sigma$, J is a left ideal with $Ja^{-1} \in \Sigma$ for all $a \in I$, then $J \in \Sigma$. Σ is called a left quotient filter (l.q.f.). Σ is shown to characterize a special torsion theory for ${}_S M$, the category of unitary left S-systems with 0; an idempotent radical for ${}_S M$; and a torsion congruence τ for ${}_S M$. These concepts are used to give a new proof of the existence of a Σ-injective hull for each $M \in {}_S M$, and to develop an S-systems of quotients $Q_\Sigma(M)$ for each $M \in {}_S M$ which specializes to a semigroup of quotients for S. Moreover, we show that the direct sum of Σ-injectives is Σ-injective iff Σ is noetherian, and we relate the ideal structure of $Q_\Sigma(S)$ to the ideal structure of S.
(Received January 22, 1979.)

*765-A7 Mohan S. Putcha, North Carolina State University, Raleigh, NC 27650. Linear algebraic semigroups

Linear algebraic groups have been extensively studied in the last 25 years. However, the related subject of linear algebraic semigroups has received very little attention. We will present many results on the J-class structure of a connected linear algebraic semigroup. These results are especially detailed when the semigroup is also a Clifford semigroup. The proofs make use of results in algebraic geometry, the theory of linear algebraic groups and abstract semigroup theory. (Received January 26, 1979.)

*765-A8 Charles Wells, Case Western Reserve University, Cleveland, Ohio 44106. Extension theories for monoids and small categories. Preliminary report.

The work described here shows some of the ways in which a certain categorial construction shows up in the theory of monoids, and on the other hand illustrates the way in which semigroup-theoretic methods may be used to study small categories. The categorial construction is the cohomological classfication of "extensions" yielded by the triple-theory. The extension theory and cohomology theory thus obtained for the underlying set functor is described completely in terms of

the theory of Leech. Certain functors from monoids to small categories defind by Leech are also shown to be tripleable and some conjectures are made about their extension and cohomology theories. It is then shown that many of the constructions and methods basic to the study of semigroups, including for example all the basic ideas surrounding Green's relations, Leech's entire extension theory and the Krohn-Rhodes Theorem, go through for small categories; one regards a small category as a "monoid with several objects", following Barry Mitchell's point of view concerning rings and abelian categories. Some examples of monoid-theoretic constructions which don't work for small categories are also discussed. (Received February 1, 1979.)

765-A9 C.E. CLARK and J.H. CARRUTH, University of Tennessee, Knoxville, TN 37916. Generalized Green's Theories. Preliminary report.

Let X be a set and let $\mathcal{P}(X)$ denote the semigroup of partial transformations on X. Let $\leq (\mathcal{L})$, $\leq (\mathcal{R})$ be quasi-orders on S, and $G:\leq(\mathcal{L}) \to \mathcal{P}(X)$, $D:\leq(\mathcal{R}) \to \mathcal{P}(X)$ with dom $G(y,x)=R(x)\cap\{z \mid z\leq(\mathcal{R})x\}$, dom $D(y,x)=L(x)=\{z \mid z\leq(\mathcal{L})x\}$, cod $G(y,x)=$cod $D(y,x)=X$. Then the 4-tuple $(\leq(\mathcal{L}), \leq(\mathcal{R}), G, D)$ is a Green's theory on X if: (i) $G(x,x)(z) = z$, $D(x,x)(w)=w$ for all $z \in R(x)$, $w \in L(x)$; (ii) $G(z,y) \circ G(y,x)=G(z,x)$, $D(z,y) \circ D(y,x)=D(z,x)$; (iii) $G(y,x)(z)=D(z,y)(y)$ for $y \in L(x)$, $z \in R(x)$. A Green's theory on a semigroup S is a Green's theory on the set S^1 such that each $G(y,x)$ $(D(y,x))$ is a partial left (right) translation. Properties of a Green's theory are developed including an analog of Green's lemma and the existence of a "Schützgenberger monoid" of an $\mathcal{L}$-class. Further properties are developed in the semigroup case including an analog of the Clifford-Miller theorem. The results reduce to the classical results in the case that $\leq(\mathcal{L})$ and $\leq(\mathcal{R})$ are the naturally defined quasi-orders on a semigroup. The theory also includes several other generalizations of Green's relations (e.g. Anscombre (1973), Marki & Steinfield (1974), Pastijn (1975)). (Received February 6, 1979.)

765-A10 J. H. CARRUTH, University of Tennessee, Knoxville, Tennessee 37916 and C. E. CLARK, University of Tennessee, Knoxville, Tennessee 37916. Constructing generalized Green's theories. Preliminary report.

A Green's pair on a set (x) is a pair (Λ,P) where Λ and P are subsemigroups of $\mathcal{P}(x)$, (the semigroup of partial transformations on (x)), each containing the identity map on (x) and satisfying: (i) λ (Dom $\lambda \cap$ Dom $\rho) \subseteq$ Dom ρ, ρ (Dom $\lambda \cap$ Dom $\rho) \subseteq$ Dom λ, for $\lambda \in \Lambda$, $\rho \in P$; and (ii) $\lambda \rho$ (x) = $\rho \lambda$ (x) for $x \in$ Dom $\lambda \cap$ Dom ρ. A Green's pair on a semigroup S is a Green's pair on the set S^1 such that each $\lambda \in \Lambda$ ($\rho \in P$) is a partial left (right) translation. It is shown that a Green's pair yields a Green's theory and that every Green's theory is obtained from a Green's pair in a natural manner. Examples illustrating the generality of the theory are given and the relationship between Green's theories and potential divisibility is shown. The results are used to give a simple proof of a theorem of Šutov giving necessary and sufficient conditions for potential left (right) divisibility. (Received February 6, 1979.)

*765-A11 JOSEPH ARKIN, 197 Old Nyack Turnpike, Spring Valley, New York 10977; VERNER E, HOGGATT JR. San Jose State University, San Jose, California 95192 and E. G. STRAUS, UCLA, Los Angeles, California 90024. Introducing a new type of problem and researches on an old Diophantine problem by Fermat.

In this paper we have combined the Fibonacci numbers with algebraic logic to solve the following type problem: 1) We find five numbers such that the product of any two of the five numbers when increased by 1 is a square. 2) We find two different sets of four numbers each (say set A & set B) such that the product of any two of the four numbers in set A when increased by an x will then be a square - and the product of any two of the four numbers in set B when decreased by an x will then be a square.

Among the ways in which we solve (2) in this paper, perhaps the following new problem, which the authors introduce for the first time in mathematics, is the most interesting:

We consider

$a_1\ a_2\ \cdots\ a_n$

$b_1\ b_2\ \cdots\ b_n$ with $a_ib_j \pm a_jb_i = \mp 1$ for all $1 \le i < j \le n$.

(Received February 19, 1979.)

765-A12 MICHEAL J. KENT, Rutgers University, New Brunswick, NJ 08903. Computing the bilinear pairing on rational sections of certain elliptic surfaces. Preliminary report.

For $\bar{S} \to \mathbb{P}^1(\mathbb{C})$ an elliptic fibration, there is a known bilinear pairing on the group of rational sections (the Mordell-Weil group). When the singular fibers of $\bar{S} \to \mathbb{P}^1$ lie over the points $\{a_m;\ m = 1, \ldots, n\}$ with the fiber above each a_m of Kodaira type $I_{k(m)}$, and a certain monodromy representation $M: \pi_1(\mathbb{P}^1 - \{a_m\}) = \Gamma \to SL_2(\mathbb{Z})$ is known, a closed expression is given for this form. This result is related to the associated parabolic cohomology group $H^1_p(\Gamma, M)$. In case all singular fibers are of type I_1, Moishezon has given the representation M, and the matrix of the form is computed explicitly. The surface $y^2 = 4x^3 - 3t^{12}x - t^{12}$ illustrates these results.
(Received February 6, 1979.)

*765-A13 Robert D. M. Accola, Brown University, Providence, Rhode Island 02912 Generalized Weierstrass Points and fixed points of automorphisms on closed Riemann surfaces. Preliminary report.

W_p is a closed R. S. of genus $p \ge 2$; T an automorphism of prime order n; $\phi: W_p \to W_q$ the quotient map. $y^n = f$ (f meromorphic on W_q) defines the cover where $(f) = \sum_{i=1}^{s} f_i a_i + nD_0$ $(0 < f_i < n;\ \sum_{i=1}^{s} f_i \equiv 0 \pmod n)$. For $i = 1, \ldots, s$, $A_i = \phi^{-1}(a_i)$ the fixed points of T. (If $q = 0$, W_p is the R. S. for $y^n = (x-a_1)^{f_1} \cdots (x-a_s)^{f_s}$.) $|G|$ a non-special linear series on W_p, invariant under T, where $G = \sum_{i=1}^{s} g_i A_i + \phi^{-1}(D_1)$, $(0 \le g_i < n)$. $|kK|$ the k-canonical series. $w(G, A_j)$ the generalized Weierstrass weight of $|G|$ at A_j. Generically we have: Theorem: (1) $w(G, A_j)$ depends only on the integers $j, f_1, \ldots, f_s, g_1, \ldots g_s$ and is independent of q. Thus for arbitrary $|G|$, $w(kG, A_j)$ is periodic in k with period n for large k. (2) if $H = \sum_{i=1}^{s} (n-1-g_i)A_i + \phi^{-1}(D_2)$ then $w(G, A_j) = w(H, A_j)$. (3) If $n \ne 2, 3$ then $\sum_{k=1}^{n} w(kG, A_j) \equiv 0 \pmod n$. Corollaries: (1) If $k + k' \equiv 1 \pmod n$ then $w(kK, A_j) = w(k'K, A_j)$. (2) If T has composite even order and at least 3 fixed points, $k \ge 2$, then $w(kK, A_j) \ne 0$. Remarks: For all choices of $a_1, \ldots, a_s$ the above results give lower bounds on $w(G, A_j)$ and correct results if reduced monulo n. (Received February 6, 1979.)

765-A14 HENRI A. GILLET, Princeton University, Princeton, New Jersey 08540. Universal cycle classes.

Theorem. There is for each $p \ge 0$ a universal smooth simplicial variety over any given field k, $BL^p_\cdot$ which has a subscheme $Z_\cdot$ with the properties: (i) For all $k \ge 0$ $Z_k \subset BL^p_k$ is a codimension p local complete intersection (l.c.i.) and is transverse to all the face and degeneracy maps of $BL^p_\cdot$. (ii) If $Y \hookrightarrow X$ is a codim p l.c.i. there is a classifying map $\eta: X \longrightarrow BL^p_\cdot$ such that $\eta^{-1}(Z_\cdot) = Y$. (iii) $Z_\cdot$ has a cycle class $[Z_\cdot] \in H^p_{Z_\cdot}(BL^p_\cdot, \underline{K}_p)$ ($\underline{K}_p$ = sheaf associated to Quillen K-theory) and we define $[Y] = \eta^*[Z_\cdot]$. (iv) The definition of $[Y]$ is compatible with Verdier's Gysin homomorphism $A^*(X) \longrightarrow A^*(Y)$.

Remarks. a) A similar construction is possible when Y is determinental. b) This theorem shows that $[Y]$ has a 'universal' cocycle representation. The existence of such a cocycle was a question first raised by Bloch (Annals, Vol. 99). (Received February 7, 1979.)

*765-A15 William E. Lang, Institute for Advanced Study, Princeton, New Jersey 08540. On the Euler number of algebraic surfaces in characteristic p. Preliminary report.

Let X be a non-singular algebraic surface over an algebraically closed field k. If $c_2(X) < 0$, and char k = 0, then a classical theorem of Castelnuovo asserts that X is ruled. Counterexamples in characteristic p were given by M. Raynaud and W. E. Lang in 1976. These

counterexamples carry an irrational pencil of singular rational curves, and thus are "falsely ruled." Raynaud has conjectured that all counterexamples to Castelnuovo's theorem are falsely ruled. This is still open, but we have the following theorem: If $c_2(X) < 0$, then either X is ruled or falsely ruled, or the Albanese map is inseparable with two-dimensional image.
(Received February 7, 1979.)

*765-A16 STUART W. MARGOLIS, University of California, Berkeley, California, 94720 and BRET R. TILSON, Queens College (CUNY), Flushing, New York, 11367, On $\bar{n}$-free transformation semigroups.

A finite transformation semigroup (ts) $X=(Q,S)$ has complexity $\leq n$ (written $Xc\leq n$) iff $X \prec A_n \circ G_n \circ A_{n-1} \circ \cdots \circ A_1 \circ G_1 \circ A_0$ where $\prec$ denotes division of ts, $\circ$ is wreath product, G_i $i=1,\cdots,n$ are transformation groups and A_j $j=0,\cdots,n$ are group-free ts. The first named author has recently proved: THEOREM 1 : Let $X=(Q,S)$ be a ts. If $|qs^{-1}| \leq n$ $\forall q \in Q$ $\forall s \in S$ then $Xc \leq n$. (Margolis, S.W., "K-transformation semigroups and a Conjecture of Tilson" to appear Jour. of Pure and App. Alg.) If $X=(Q,S)$ is a ts let $X^\bullet$ be the ts obtained from X by adjoining the identity function $1:Q \to Q$ to S. Let $\langle X \rangle = \{Y \mid Y$ is a ts and $X \notin Y\}$. THEOREM 2 Let X be a ts with $S_X \neq \emptyset$ and which contains at least one (total) function. Then $Y \in \langle X^\bullet \rangle \Leftrightarrow Y \prec Z \circ D$ where $Z \in \langle X \rangle$ and D is a definite ts. Let $n = \{0, \cdots, n-1\}$ and let $\hat{i}: n \to n$ be the constant map to i, $0 \leq i \leq n-1$. Define $\bar{n}$ to be the ts $(n, \{\hat{i} \mid 0 \leq i \leq n-1\})$. The main result of this paper is: THEOREM 3 If $n \geq 1$, $X \in \langle \bar{n} \rangle \Rightarrow (X)c < n$.
(Received February 7, 1979.)

765-A17 BRIDGET B. BAIRD, University of Florida, Gainesville, Florida 32611 and K. D. MAGILL, SUNY at Buffalo, Buffalo, N. Y. 14214. Green's $\mathcal{R}$-relation and climbing mountains. Preliminary report.

The original mountain climbing problem asks if two climbers on two paths on opposite sides of a mountain can ascend in such a way that their elevations are equal at all times. It is permissible for either climber to pause at times or even to retrace steps previously taken. The only requirement is that they eventually must reach the top. A number of related questions immediately suggest themselves. Is it possible for the two climbers to ascend, always maintaining the same elevation, in such a manner that the first climber never pauses nor retraces steps previously taken? Does there also exist a method of ascent to that the second climber always presses forward? If two such methods exist will there then exist a third method in which both climbers continually press forward? These and some other questions are really questions about Green's $\mathcal{R}$-relation for the semigroup under composition of all rectifiable continuous selfmaps of the closed unit interval which fix the points zero and one. The original mountain climbing question really asks when two principle right ideals have nonempty intersection. The related questions also have equivalent formulations. Previous work by other authors on the original problem is reviewed and we then treat the various related problems.
(Received January 22, 1979.)

*765-A18 Marvin Marcus, University of California, Santa Barbara, CA 93106. Variations on the Cauchy-Schwarz Inequality.

In a recent query (Notices of AMS, 25,7(1978), 506), A. Abian posed the following question. Let V be an n-dimensional inner product space and let A, B, P, Q be linear on V. What relations must exist among these operators so that the inequality $(Av,u)(Bu,v) \leq (Pu,u)(Qv,v)$ (1) holds for all u and v? If V is unitary and A, B, P, Q are non-singular, then the following result describes the situation.

Theorem. Let $\dim V \geq 3$. Then (1) holds iff (i) $P = \alpha H$, $Q = \beta K$, $\alpha\beta = \epsilon = \pm 1$, H and K are definite hermitian and (ii) $A^* = \lambda B$, λ real so that (1) reads $\lambda|(Bu,v)|^2 \leq \epsilon(Hu,u)(Kv,v)$ and (iii) if $\epsilon = 1$, $\lambda > 0$ then H and K have the same sign and $\lambda_{max}(P^{-1}AQ^{-1}B) \leq 1$; or (iv) if $\epsilon = 1$, $\lambda < 0$ then H and K have the same sign or (v) if $\epsilon = -1$, $\lambda > 0$ then H and K have opposite signs and $\lambda_{min}(P^{-1}AQ^{-1}B) \geq -1$; or (vi) if $\epsilon = -1$, $\lambda < 0$ then H and K have opposite signs. (Received January 19, 1979.)

765-A19 WILLIAM R. NICO, Tulane University, New Orleans, Louisiana 70118. Applications of categorical extension theory to monoid extensions. Preliminary report.

An extension setting $\{L,\mathcal{B},\Omega,\phi\}$ consists of small categories L and $\mathcal{B}$, a functor $\Omega : L \longrightarrow \mathcal{B}$, and a function $\phi : |\mathcal{B}| \longrightarrow |L|$ satisfying certain axioms. An extension for this setting is a small category E such that $\mathcal{B}$ is a quotient of E modulo a congruence on E which is (essentially) induced by L. Every such extension is determined by a functor $T : \mathcal{B}^{op} \longrightarrow Cat$ such that, in particular, $T(x) \subset L$ for all $x \in |\mathcal{B}|$, and isomorphic extensions correspond to naturally isomorphic functors.

When $\mathcal{B}$ is a monoid, i.e., has only one object, then E is, too. In this way extensions of monoids can be considered as a special case.

Extensions of various classes of monoids are described from this point of view.

(Received February 5, 1979.)

*765-A20 TAKAYUKI TAMURA, University of California, Davis, California 95616 and DEBORAH GALE, Montana State University, Bozeman, Montana 59717. On $Z(p^\infty)$-$\mathfrak{N}$-semigroups. Preliminary report.

An $\mathfrak{N}$-semigroup S is called a $Z(p^\infty)$-$\mathfrak{N}$-semigroup if one of the structure groups is isomorphic to a quasi-cyclic group $Z(p^\infty)$ for some prime number p. A defining function φ on $Z(p^\infty)$ is a function $Z(p^\infty) \to R_+$ (the positive reals) satisfying $\varphi(0) = 1$ and $\varphi(\alpha)+\varphi(\beta)-\varphi(\alpha+\beta) \in Z_+^0$ (non-negative integers) for all $\alpha,\beta \in G$. A $Z(p^\infty)$-$\mathfrak{N}$-semigroup S determined by φ is denoted by $S = (Z(p^\infty),\varphi)$. 1. The group of quotients $Q(S)$ is either (i) $Z \oplus Z(p^\infty)$ or (ii) $Q_{p^\infty} \oplus Z(p^N)$ where $Z(p^N)$ is a cyclic group of order N, and Q_{p^∞} is the group of $\frac{m}{p^n}$ for infinitely many distinct n's. Thus $Z(p^\infty)$-$\mathfrak{N}$-semigroups are classified into the tyo types (i) and (ii). 2. Every structure group of S is isomorphic to $Z(p^\infty) \oplus Z(m)$ for some m. 3. $(Z(p^\infty),\varphi_1) \cong (Z(p^\infty),\varphi_2)$ if and only if $\varphi_1(\alpha) = \varphi_2(f(\alpha))$ for all $\alpha \in Z(p^\infty)$ where f is some automorphism of $Z(p^\infty)$. We note that every power joined $\mathfrak{N}$-semigroup has the same property as 3. (Received February 5, 1979.)

*765-A21 KARL BYLEEN, Marquette University, Milwaukee, WI 53204; JOHN MEAKIN, University of Nebraska, Lincoln, NE 68588; and FRANCIS PASTIJN, Rijksuniversiteit Gent, Gent, Belgium. The Double Four-Spiral Semigroup.

The double four-spiral semigroup DSp_4 is a bisimple combinatorial semigroup generated by 5 idempotents. If a semigroup S contains two distinct comparable idempotents which are linked to each other by an E-chain of length 4, then these idempotents belong to a subsemigroup of S which is a non-completely simple homomorphic image of DSp_4. The semigroup DSp_4 is represented in several ways and the congruences on DSp_4 are described. (Received February 5, 1979.)

*765-A22 Peter F. Stiller, Texas A&M University, College Station, Texas 77843. Elliptic curves over function fields and Picard numbers.

Let E be an elliptic surface having a global section over its base curve X. We compute explicitly the Gauss-Manin connection of E/X and use it to study the rank of the group $E^{gen}(K(X))$ of rational points on the generic fibre (an elliptic curve over the function field $K(X)$ of X) and the Picard number of E. By analytic means we obtain bounds on these numbers via a map $E^{gen}(K(X))/torsion$ to $K(X)$ -- the image being in $L(\mathcal{A})$ for a divisor $\mathcal{A}$ which can be determined by examining the singularities of the Gauss-Manin connection. (Received February 8, 1979.)

*765-A23 Noriko Yui, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5. On the p-divisible groups arising from the Fermat curves.

Let $C : X^m + Y^m = 1$, $m \geq 3$ be a Fermat curve of genus $g = \frac{(m-1)(m-2)}{2}$ defined over a finite field $k = GF(p^f)$ of characteristic $p \neq 0$, where $(p,m) = 1$

and p^f is the least power of p such that $p^f \equiv 1 \pmod{m}$. Denote by J the Jacobian variety of C defined over k and by $J(p)$ the associated p-divisible group.

In this paper, we shall determine the structure of $J(p)$, up to isogeny. Essentially the isogeny class of $J(p)$ depends on f. (Received February 9, 1979.)

765-A24 HARVEY COHN, Math. Dept. City College, CUNY, New York, NY 10031. Parametrized ring class fields and the icosahedron. Preliminary report.

The prime $p = x^2 + 4^{t+1}y^2$ (in Z) if and only if $a_1, a_2, \ldots, a_t$ are residues modulo p where $a_1 = 9/8$, $a_{s+1} \equiv 1 + (r_s-1)^2/8(r_s+1), r_s^2 \equiv a_s$. Many such results (of disc $d_o 4^t$) lead to ring class fields for parameter t and are derived from the Klein modular equation using the 3-dihedral group. Corresponding results for cubic residues (disc $d_o 9^t$) come from the tetrahedral group, and for a solvable quintic (disc $d_o 25^t$) from the icosahedral group. The modular-functional technology is classical but the representation of primes is seen expressible in time-$(\log p)^k$ according to current computer complexity work of D. Shanks and, more recently, J. Lagarias.(Received February 19, 1979.)

765-A25 WAYNE W. BARRETT, Texas A&M University, College Station, Texas 77843 and PHILIP J. FEINSILVER, Southern Illinois University, Carbondale, Illinois 62901. A determinant formula for inverses of banded matrices.

Let A be a nonsingular banded matrix with $A_{ij} = 0$ for $|i - j| > p$ and let $R = A^{-1}$. Let $D_1, \ldots, D_{n-p}$ be the $n-p$ consecutive $p+1 \times p+1$ principal minors of R and let $d_1, \ldots, d_{n-p-1}$ be the consecutive $p \times p$ principal minors of R excluding the first and the last. Assume $d_1, \ldots, d_{n-p-1}$ are nonzero. Then the determinant of R is given by $\det R = D_1 \cdots D_{n-p}/d_1 \cdots d_{n-p-1}$. The discovery of this formula was motivated in a natural way by an examination of determinants of covariance matrices for Gaussian-Markovian processes which corresponds to the case $p = 1$ above. The proof for certain symmetric matrices R can be done by associating with R a p-Markov sequence of vectors. The proof for general R uses standard facts about matrices and determinants. (Received February 20, 1979.)

*765-A26 R. K. JAIN, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1B 3X7. On $(\lambda, 1)$-Designs.

The purpose of this paper is to develop the theory on λ-designs. In this paper, $(\lambda, 1)$-designs are defined and necessary conditions for their existence are obtained. It is observed that all $(\lambda, 1)$-designs are λ-designs, but the converse is not true. (Received February 20, 1979.) (Author introduced by Professor S. P.Singh).

765-A27 Anthony M. Gaglione, U. S. Naval Academy, Annapolis, Maryland 21402 and Hermann V. Waldinger, Polytechnic Institute of New York, Brooklyn, New York 11201. Generalizations of the Bracketing Process Applied to the Commutator Calculus. Preliminary report.

The rank $\Phi(n)$, of the free Abelian group $\overline{F}_n = F_n/F_{n+1}$ is given by the Witt formula, $\Phi(n) = \frac{1}{n} \sum_{d/n} \mu(d) r^{n/d}$ where F is the free group of rank r. This was derived by H. Meier-Wunderli (Commentarii Math. Helvetici, 1951) and by M. Hall, Jr. (The Theory of Groups, 1959) by means of a bracketing process.

This investigation generalizes the bracketing process to completely solve a problem of H. V. Waldinger (J. Algebra, 1965). We note that our result is a special case of a more general theorem of J. Labute (J. Algebra, 1970) which was obtained by Lie algebra methods. This

paper should, nevertheless, be of interest as a contribution to the commutator calculus.

It is also noted that further generalations of the bracketing process are useful to solve other problems in the commutator calculus. (Received February 19, 1979.)

765-A28 J. CHIDAMBARASWAMY, University of Toledo, Mathematics Department, Toledo, OH 43606. Totients and unitary totients with respect to a set of polynomials.

For any given integer coefficient polynomials $f_1 = f_1(x)$, $f_2 = f_2(x),\ldots, f_s = f_s(x)$ of positive degrees and positive integers $u_1, u_2,\ldots,u_s$ and k, and multiplicative function $\eta(n)$, the totients $\phi_F^{k,\eta}(n)$, $\phi_F^{k,\eta}(n)$ and their unitary analogues $\phi_{F^*}^{k,\eta}(n)$ and $\phi_{F^*}^{k,\eta}(n)$ are defined and studied where F is written, for simplicity, for $f_1, u_1; f_2, u_2;\ldots; f_s, u_s$. When s=1, for special choices of k, $f_1(x)$, u_1 and $\eta(n)$, $\phi_F^{k,\eta}(n)$ includes as special cases, Euler's totient function and its various generalizations and $\phi_{F^*}^{k,\eta}(n)$ includes the unitary analogues of some of these functions studied before. The well known identities $\sum_{d|n} \phi(d) = n$ and $\phi(ab)\phi((a,b)) = \phi(a)\phi(b)\ (a,b)$ are generalized for these functions and the average orders of these functions are obtained subject to certain restrictions on the sizes of $N_{f_i}(n)$ and $\eta(n)$, $N_f(n)$ being the number of incongruent solutions mod n of $f(x) \equiv 0 \pmod n$. (Received February 23, 1979.)

765-A29 GEORGE KEMPF, Department of Mathematics, The Johns Hopkins University, Baltimore, Maryland 21218. Inversion of abelian integrals.

• Indefinite integrals of the form $\int X dx$, where X is an algebraic function of the complex variable x, have a rather uncontrollable nature. They are multivalued transcendental functions of the variable x, but they are so closely related to algebraic functions that one can hardly resist the temptation of hoping to understand them. From the modern point of view, we are dealing with an indefinite integral $I(s) = \int_{s_0}^{s} \omega$, gotten by integrating a meromorphic differential ω on a compact Riemann surface S from a fixed point s_0 to a variable point s of S. The Riemann surface S is an algebraic plane curve $f(x,y) = 0$, which has been appropriately modified into a compact one-dimensional complex curve. If the differential ω is abelian (i.e., has no poles), the integral $I(s) = \int_{s_0}^{s} \omega$ is an abelian integral (i.e., locally analytic in s). The abelian integral $I(s) = \int_{s_0}^{s} \omega$ is only mildly multivalued and is determined up to an additive constant depending on the homology class of the path from s_0 to s, which is used to compute the integral. The usual strategy to eliminate the multivaluedness is to regard the expression as defining a linear functional on the space $\Gamma(S, \Omega_S)$ of all abelian differentials on S, which is determined modulo the lattice L of functionals $\oint \omega$ obtained by integrating along a closed path beginning and ending at s_0. Thus we have an analytic mapping $\int_{s_0} : S \to J \equiv (\Gamma(S, \Omega_S))^*/L$, where J is an abelian variety of dimension equal to the genus g of S. This abelian variety J is called the Jacobian (variety) of S and the mapping $\int_{s_0}$ is called a universal abelian integral. Let $S^{(i)}$ be the symmetric product of S with itself i-times. Similarly, the abelian sum $\int_{s_0}^{s_1}\omega + \cdots + \int_{s_0}^{s_i}\omega$ defines an analytic mapping $\Sigma_i \int_{s_0} : S^{(i)} \to J$. If $i > 2g-2$, then $\Sigma_i \int_{s_0}$ is a projective bundle over J. An important problem in the study of abelian integrals is to describe how these bundles $\Sigma_i \int_{s_0}$ are twisted up over the Jacobian. A good solution to this inversion problem would lead to a much deeper understanding of complex algebraic curves. I plan to discuss many known facts about these bundles and to indicate some related problems. (Received February 26, 1979.)

*765-A30 R. Shantaram, University of Michigan-Flint, Mi. 48503. Some combinatorial identities generated by a problem in characterization.

Riordan(Combinatorial identities(1968), Wiley, page 66) has the following result: (*) For $n \geq 1$, $\sum (-1)^j \binom{n+j}{n-j} \binom{2j}{j} \frac{1}{j+1} = 0$. Throughout this abstract the summation

is taken over j=0,1,...,n. Several identities of this type as well as generalizations of (*) are proved in this note. A sample of the results follows.

(i) For $n \geq 1$, $\sum (-1)^j \binom{n+j}{n-j} \binom{2n+2j}{n+j} \frac{1}{j+n+1} = (-1)^n$

(ii) For $k \geq 0$ & $k+1 \leq r \leq n$, $\sum (-1)^j \binom{n+j}{n-j} \binom{2j+2k}{j+k} \frac{1}{j+r} = 0$

For k=0 and r=1, (ii) reduces to (*). The identities proved in this note were suggested during the construction of discrete, independent and identically distributed random variables X and Y with the property that X+Y has the same distribution as XY. (Received February 26, 1979.)

765-A31 RICK MIRANDA, MIT, Cambridge, Ma, 02139. The Moduli of rational elliptic surfaces with section. Preliminary report.

A morphism $f: X \longrightarrow P^1$ is a rational elliptic surface with section (RESS) if X is a rational surface, f is a flat proper map whose generic fibre is a smooth elliptic curve, and a section of f is given. We construct, using the Weierstrass form $y^2 = x^3 + A_4(t)x + B_6(t)$ for X and geometric invariant theory, the 8-dimensional moduli space M for those RESS's which have only reduced fibres; these are the stable ones, in the sense of invariant theory. A natural compactification $\bar{M}$ of M is obtained by adding one smooth rational curve to M, whose points represent RESS's with a singular fibre having a component of multiplicity 2 (but no worse), classified by the j-invariant of that singular fibre. The unstable RESS's, not represented in $\bar{M}$, are those with a fibre having a component of multiplicity 3 or more. (Received February 26, 1979.)

*765-A32 FRANCIS PASTIJN, Rijksuniversiteit Gent, B-9000 Gent, Belgium, Biordered sets and complemented modular lattices.

A strongly regular Baer semigroup S is a regular semigroup for which the set of the principal right [left] ideals coincides with the set of the right [left] annihilators of the elements of S. The multiplicative semigroup of a regular ring is a strongly regular Baer semigroup. If S is a strongly regular Baer semigroup, then $S/\mathcal{L}$ is a complemented modular lattice [Janowitz, Canad. J. Math. (1966) 1212-1223]. We show that there exists up to isomorphism a unique fundamental idempotent-generated strongly regular Baer semigroup which coordinatizes a given complemented modular lattice. This implies that the biordered set of a strongly regular Baer semigroup is completely determined by the lattice which is coordinatized by this semigroup; this remark applies for regular rings in particular. We give a construction for the biordered set of a strongly regular Baer semigroup S in terms of the lattice which is coordinatized by S. (Received February 26, 1979.) (Author introduced by Professor Gerard J. Lallement).

*765-A33 JONATHAN M. WAHL, University of North Carolina, Chapel Hill, North Carolina 27514. Elliptic deformations of unimodal singularities.

V. I. Arnold classifies isolated hypersurface singularities by modality. In dimension 2, the 0-modal (or simple ones) are the rational double points; the unimodal ones have also been studied widely. Karras, Brieskorn, and others have computed the adjacencies (= deformations) between them. We give a simple geometric description (in terms of "partial desingularizations") of these adjacencies. Our method works for a larger class of elliptic surface singularities, of arbitrary embedding dimension e. A typical corollary gives the smoothability of certain cusps for the Hilbert modular group, even for e large. (Received February 26, 1979.)

765-A34 WILLIAM F. KEIGHER, Rutgers University, Newark, New Jersey 07102. Going down in differential polynomial rings. Preliminary report.

Let R be a differential domain, S a differential domain between R and its integral closure, x a differential indeterminate and x_n the nth derivative of x for each $n \geq 0$. We extend a theorem about going down in polynomial rings due to S. McAdam (Duke Math. J. 39(1972), 633-636). Theorem. The following are equivalent. (1) $R[x_0] \subset S[x_0]$ has going down (as polynomial rings). (2) $R[x_0] \subset S[x_0]$ is unibranched (as polynomial rings). (3) $R\{x\} \subset S\{x\}$ has going down (as differential polynomial rings). (4) $R\{x\} \subset S\{x\}$ is unibranched (as differential polynomial rings. (Received February 27, 1979.)

*765-A35 KENNETH KRAMER, Queens College (CUNY), Flushing, New York, 11367. Elliptic curves over quadratic fields. Preliminary report.

Let E be an elliptic curve defined over $\mathbb{Q}$, of square-free conductor N, and let $k = \mathbb{Q}(d^{\frac{1}{2}})$. We are interested in the (free) rank of the Mordell-Weil group E(k) of points of E defined over k. Let S be the Selmer group containing $E(\mathbb{Q})/2E(\mathbb{Q})$ and determined from a knowledge of $E(\mathbb{Q}_p)$ at each completion $\mathbb{Q}_p$ of $\mathbb{Q}$. Similarly, define S' containing E(k)/2E(k). Assume that N is odd and (2N,d) = 1. Proposition: If the norm mapping from S' to S is surjective and the 2-primary component of the Tate-Shafarevitch group for E is finite, then the rank of E(k) is even or odd according to whether the quadratic character $\chi_d(-N)$ is ± 1. When E is a modular curve, this agrees with the parity predicted analytically from the L-function for E by the conjectures of Birch and Swinnerton-Dyer. The proof depends on computing the cokernels of the local norm mappings N_p: $\coprod_{v|p} E(k_v)/2E(k_v) \to E(\mathbb{Q}_p)/2E(\mathbb{Q}_p)$. (Received February 27, 1979.)

765-A36 SHIGEFUMI MORI, Harvard University, Cambridge, Massachusetts 02138, and Kyoto University, Kyoto, Japan. Projective manifolds with ample tangent bundles.

My theorem verifies Hartshorne's conjecture: if X is a non-singular projective variety with ample tangent bundle over an algebraically closed field k of arbitrary characteristic, then X is isomorphic to a projective space. This, in particular, implies Frankel's conjecture in differential geometry: every Kaehler compact manifold with positive sectional curvature is biholomorphic to a complex projective space. In the process of the proof, it is shown that an arbitrary non-singular projective variety with ample anti-canonical bundle contains a rational curve (which may be singular). (Received February 27, 1979.)

765-A37 STEPHEN S.-T. YAU, Harvard University, Cambridge, Massachusetts 02138. New invariants for isolated singularities.

Let V be a complex analytic variety with an isolated singularity $p \in V$. We introduce a bunch of invariants which are naturally attached to the singularity p. These invariants can be used to characterize the various sheaves of germs of holomorphic forms on V introduced by Grauert-Grothendieck, Griffiths and Ferrari and can be calculated explicitly. One of the formulaes which can be stated in this short note is the following.

Let f(x,y,z) be a homogenous polynomial which defines a nonsingular curve A of genus g in $\mathbb{CP}^2$. Let M be the dual of the hyperplane bundle restricted to A. Let $\mu = \dim \mathbb{C}[[x,y,z]]/(\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}, \frac{\partial f}{\partial z})$. Then $\dim H^1(M,\Omega^1) = \frac{-1}{12}(\frac{2g-2}{A\cdot A} - 1)^2 (A\cdot A) + \frac{11}{12} - \frac{5}{6}g + \frac{\mu}{12}$. (Received February 27, 1979.)

765-A38 JEROME HOFFMAN. University of Pennsylvania, Philadelphia, Pennsylvania 19104. Hodge theory of singular curves.

Let M_g denote the moduli space of stable curves of genus g. Let $\overline{A}_g$ denote the compactification of the moduli space of abelian varieties of dimension g recently constructed by Carlson, Cattani and Kaplan. Is there a morphism $t : M_g \to \overline{A}_g$ extending the Torelli map on smooth curves? Given a stable curve Y, it is easy to show that there is a stable curve X over the unit disc D which has Y as its special fiber and is a minimal model. The limiting Hodge structure of this family corresponds to a point in $\overline{A}_g$. The difficulty is showing that this point depends essentially only on Y and not on X. This amounts to showing that the mixed Hodge complex constructed by Steenbrink can be defined by data intrinsic to Y. (Received February 27, 1979.)

*765-A39 Charles A. Weibel, University of Pennsylvania, Philadelphia, PA 19104. The Cartan map $K_*(R) \longrightarrow G_*(R)$ factors through the map $K_*(R) \longrightarrow KV_*(R)$.

If R is a noetherian ring, the groups $G_*(R)$ denote the K-theory of the finitely generated R-modules. $K_*(R)$ and $KV_*(R)$ are the Quillen and Karoubi-Villamayor K-theories, respectively. The proof is a simple application of the theory of bisimplicial sets. (Received February 27, 1979.)

765-A40 HEISUKE HIRONAKA, Department of Mathematics, Science Center 325, Harvard University, Cambridge, Massachusetts 02138. Equisingular stratifications of an algebraic variety.

• The purpose of my lecture is to report on the recent development on the problems of equisingular stratification of algebraic and complex-analytic varieties with singularities. In the case of complex-analytic plane curve singularities, a complete topological classification of singularities has been known for a long time. Based on this classification, we had an established theory of equisingularity for a singular algebraic surface along a curve in it, or a family of its transversal sections which are plane curves. In the case of a family of singular hypersurfaces of higher dimensions, topology is not strong enough for characterizing equisingularity, or equivalence of singularities, from the point of view of algebraic geometry. This has been suggested by several concrete examples. There has been suggested a differential-geometric criteria for equisingularity in terms of the limits of tangent planes and secant lines, such as Whitney stratification, Verdier's modification of Whitney's, and very recently, more algebro-geometric criteria by a close analysis of the limit set of tangent planes in relation with tangent cones (works of Teissier and Lê). Meanwhile, Zariski made substantial progress in extending his old idea of equisingularity criterion in terms of generic projections and the discriminant loci associated with it. This approach is inductive in nature with respect to the dimension of the variety and the codimension of singular loci, and thus the theory is applicable to hypersurfaces of all dimensions. This new theory of Zariski will be the center of my lecture on general equisingularity problems. References: 1. H. Hironaka, On Zariski dimensionality type, Amer. J. Math. (to appear); 2. O. Zariski, Foundations of a general theory of equisingularities on r-dimensional algebroid and algebraic varieties, of embedding dimension r + 1, Amer. J. Math. (to appear). (Received February 27, 1979.)

*765-A41 Jin Bai Kim, West Virginia University, Morgantown, W.V. 26506 and Yong M. Lee, Trenton State College, Trenton, N. J. 08625. A determinant of a matrix.

$M(p^n)$ denotes the set of all $p\times p\times..\times p=p^n$ matrices over a field R. Let $S(p)$ be the symmetric group on $\{1,2,..,p\}$. $S(p)^n$ denotes the set of all sequences $\pi=(\pi_1,\pi_2,..,\pi_n)$ of $\pi_i \in S(p)$. Define a relation $\underline{=}$ on $S(p)^n$ by $\pi\underline{=}\pi'=(\pi'_1,\pi'_2,..,\pi'_n)$ iff $\pi'=\pi\lambda=(\pi_1\lambda,..,\pi_n\lambda)$ for some $\lambda\in S(p)$. $\underline{=}$ is an equivalence and we denote by $S(p)^n/\underline{=}$ the equivalence classes. Let $[\pi]\in S(p)^n/\underline{=}$. For a positive integer $j \leq p$, there is $\lambda=(\lambda_1,..,\lambda_n)$ in $[\pi]$ such that $\lambda_j=1$, the identity of $S(p)$. Define $\operatorname{sign}[\pi]=\prod_{j=1}^{n}\operatorname{sign}\lambda_i$. For $A=(a_{ij\ldots k}) \in M(p^n)$, define $A[\pi]=\prod_{1=t=p} a_{\pi_1(t)\pi_2(t)..\pi_n(t)}$ and $\det_j A=\sum_{[\pi]\in S(p)^n/\underline{=}} \operatorname{sign}[\pi]\, A[\pi]$. We prove some propositions about a determinant $\det_j A$ for $A\in M(p^n)$.

If n=2, then $\det_1 A=\det_2 A=\det A$, where detA denotes the usual determinant of A. (Received February 27, 1979.)

*765-A42 Stephen S. Shatz, University of Pennsylvania, Philadelphia, PA 19104. The Geometry of Certain 3-folds. Preliminary report.

We study the Geometry on smooth 3-folds over an algebraically closed field of characteristic zero (for example, over $\mathbb{C}$). One main interest is in determining reasonable criteria that a 3-fold be ruled. (The "interesting" ruled 3-folds are the $\mathbb{P}^1$ bundles over surfaces.) Numerical criteria are the most desirable, but in our current state of ignorance there is small chance that we will succeed soon. Nevertheless some criteria do exist - for example:

Theorem. Let X be a smooth 3-fold and assume that X carries a ruled surface S (with base curve C and morphism $\rho: S \to C$). If $N_{X/S}$ is the normal bundle to S, suppose that $N_{X/S} = \rho^*D$ for some line bundle D on C with $\deg D > 0$. Then X is birationally equivalent to a ruled three-fold over a surface T. Conversely, every ruled three fold over a surface, T, carries a surface S whose normal bundle is ρ^*D, where D is a positive degree divisor on C, and where $\rho: S \to C$ is the morphism of S to its base curve.

On 3-folds, codim 2 phenomena play a crucial role. We have given an adjunction formula for curves which are locally complete intersections in a 3-fold, have determined the 2nd Chern class in the ruled case and have investigated the intermediate Jacobian for ruled three folds. (Received February 27, 1979.)

Analysis (26, 28, 30–35, 39–47, 49)

765-B1 S.ZAIDMAN, Université de Montréal, Montréal, Québec, Canada. On qualitative properties of abstract differential equations. Preliminary report.

In this work we study trajectories and semi-trajectories of C_0-semi-groups in Banach spaces. We prove some simple properties similar to classical results in the theory of dynamical systems (for example: rest-points, invariant sets, and α - limit points); we consider also relatively compact and asymptotic almost-periodic trajectories or semi-trajectories under some boundedness conditions on the semi-group or on its adjoint semi-group. (Received October 19, 1978.)

*765-B2 T. K. Puttaswamy, Ball State University, Muncie, Indiana 47306. Asymptotic behavior of solutions of a certain second order differential equation.

This paper is devoted to the study of the asymptotic behavior of the second order differential equation (1) $z^2(a_0 + a_1 z^m + a_2 z^{2m}) \frac{d^2y}{dz^2} + z(b_0 + b_1 z^m + b_2 z^{2m}) \frac{dy}{dz} +$ $(c_0 + c_1 z^m + c_2 z^{2m})\, y = 0$ with z complex and the constants a_i, b_i, c_i ($i = 0, 1, 2$) real or complex, and $a_0 \neq 0$, $a_2 \neq 0$, $a_1^2 - 4a_0 a_2 \neq 0$. Then, if μ_i ($i = 1, 2, \ldots, 2m$) are the roots of $a_0 + a_1 z^m + a_2 z^{2m} = 0$, (1) will have regular singular points at $z = 0$, $z = \mu_i$ ($i = 1, 2, \ldots, 2m$) and $z = \infty$. The indicial equation about $z = 0$ is found to be

$$(2)\quad a_0 h(h - 1) + b_0 h + c_0 = 0$$

It is also assumed that the difference of roots of (2) are incongruent to zero modulo m. (Received January 18, 1979.)

*765-B3 H.D. JUNGHENN, The George Washington University, Wash. D.C., 20052.
Topological left amenability of locally compact Borel subsemigroups.

Let S be a locally compact topological semigroup and T a locally compact Borel subsemigroup of S. The following question is considered: When does topological left amenability (tla) of T imply that of S, and conversely ? We prove three theorems which give partial answers. The first is a generalization from the discrete setting of a result of M.M. Day [Illinois Jour. of Math. 1(1957), 509-544], and was obtained independently by J.C.S. Wong for the case T a group [preprint]. The second is an improvement of Theorem 3.2 of [J.C.S. Wong, Canad. Math. Bull. 19 (1976), 231-234]. The proofs of theorems 1 & 2 make essential use of Arens multiplication on $M(S)^*$ and $M(S)^{**}$, a general technique suggested by work of Day.

Theorem 1. If $\exists$ a topological left invariant mean Γ on $M(S)^*$, $\Gamma(\chi_T) > 0$, then T is tla.

Theorem 2. If T is topologically left lumpy, then T is tla if and only if S is tla.

Theorem 3. Let S be a semidirect product, $S = T \textcircled{P} U$, where U is a locally compact topological group. Then S is topologically left amenable uniformly on compacta (tlauc) if and only if T and U are tlauc.

An application of Theorem 3 is made to wreath products. (Received February 2, 1979.)

765-B4 PETER A. McCOY, U. S. Naval Academy, Annapolis, Maryland, 21402. Best L^p-Approximation of Generalized Biaxisymmetric Potentials.

Let $F \in L^p(\Sigma)$, the set of all real-valued GBASP regular on Σ: $x^2+y^2<1$ for which $\iint_\Sigma |F|^p dxdy < \infty$.

For $p \geq 1$ define

$$\Delta_n^{(p)}(F) = \inf\{[\iint_\Sigma |F-\Phi|^p dxdy]^{1/p} : \Phi \in H_n\}, \quad n=1,2,\ldots,$$

the minimum error in the approximation of F over H_n, the set of all real-valued biaxisymmetric harmonic polynomials of degree atmost 2n. Then NASC that F continue harmonically as an entire fcn. GBASP of given order and type are specified as limits of fcns. of the $\Delta_n^{(p)}$. That is, certain local approximation properties of solutions to the GBASP equation,

$$[\partial^2/\partial x^2 + \partial^2/\partial y^2 + (2\alpha+1)/x\ \partial/\partial x + (2\beta+1)/y\ \partial/\partial y]F=0,$$

$\alpha>\beta>-1/2$ characterize global existence and growth. (Received January 22, 1979.)

765-B5 JOHN SCHMEELK, Virginia Commonwealth University, Richmond, Virginia 23284. Extending the Ovsjannikov Theorem to a Scale of Fréchet Spaces.

The proof of the Ovsjannikov Theorem in 1965 began a new era in proving existence and uniqueness theorems for many types of differential equations. However the original work of Ovsjannikov proved the theorem in the milieu of a scale of Banach Spaces. I am interested in generalized functions and almost all of the interesting test spaces (e.g. the space of rapid descent functions, the space of infinitely differentiable functions having compact support, etc.) are best studied in the milieu of a Fréchet space. (i.e. a vector space not necessarily finite dimensional, equipped with a denumerable set of separating semi-norms and complete with respect to these semi-norms). The natural question to ask is "Can the Ovsjannikov Theorem be extended to a scale of Fréchet Spaces?". The answer is yes and the techniques establishing this extension will be discussed in this presentation. (Received January 29, 1979.)

765-B6 CASPER GOFFMAN, Purdue University, W. Lafayette, Indiana 47906, FON-CHE LIU, Academia Sinica, Tapei, Taiwan, and DANIEL WATERMAN, Syracuse University, Syracuse, New York 13210. A remark on the spaces $V^p_{\Lambda,\alpha}$

A function f in L^p, $p \geq 1$, over an interval in R^n, is in $V^p_{\Lambda,\alpha}$ if, corresponding to the i-th coordinate direction, i=1,...,n, there is an equivalent function which is of Λ-bounded variation on a.e. line ℓ_i in that direction and whose Λ-variation on those lines is in L^α, $\alpha \geq 1$, as a function of the other (n-1) variables. For each i, another equivalent function may be chosen so that on a.e. ℓ_i it has an internal saltus at each point. It is shown that for this function, the Λ-variation on the lines ℓ_i is a measurable function of the other variables. This was known for n=2; for n>2, the measurability was previously assumed as an additional hypothesis. The classes $V^p_{\Lambda,\alpha}$ are Banach spaces and have been shown to be of interest in the study of localization of multiple Fourier series. (Received February 1, 1979.)

*765-B7 OKAN GUREL, IBM Corporation, White Plains, New York 10604. Models with exploded points.

The mathematical models of real systems are only convenient approximations to discover various aspects of these systems. Here we are concerned with mathematical models of the dynamic systems, thus certain differential equations are considered. It is not too long ago that the nonlinearity of these equations was shown to be a key element in approximating some of the dynamic phenomena observed in experimenting with real systems. Moreover, as our knowledge of these systems increased, it was obvious that the nonlinear models can be even richer and some new mathematical objects representing the complex natural phenomena may be obtained. One of such generic objects is an exploded point (O. Gurel, Exploded Points, 1978,Preprint). Some simple examples will be discussed to illustrate this concept and its potential role in mathematical modeling of complex systems exhibiting a nonperiodic oscillatory behavior. (Received January 31, 1979.)

*765-B8 PATRICK AHERN, University of Wisconsin, Madison, Wisconsin 53706 and ROBERT SCHNEIDER, Herbert Lehman College of CUNY, Bronx, New York 10468.
A smoothing property of the Henkin and Szegö projections.

Let D be a strictly pseudoconvex domain in $\mathbb{C}^n$ with a smooth boundary, say $D = \{\rho < 0\}$ and grad $\rho \neq 0$ on ∂D. The vector field $r = i$ grad ρ is tangent to ∂D. We prove the following

Theorem. Suppose f is a function defined on ∂D and there are constants $K > 0$, $0 < \alpha < 1$, such that $|f(\gamma(t)) - f(\gamma(s))| \leq K|t - s|^{\alpha}$ for every integral curve γ of the vector field r, then the Henkin and Szego projections of f satisfy a Lipschitz condition of order α in D.

There are corresponding results for $\alpha \geq 1$. (Received February 8, 1979.)

*765-B9 R. BOJANIC, The Ohio State University, Columbus, Ohio 43210. Necessary and sufficient conditions for the convergence of the extended Hermite-Fejér interpolation.

If x_{kn} are the zeros of the Chebyshev polynomial $T_n(x)$, the polynomial $R_n(f,x)$ of the extended Hermite-Fejér interpolation is defined by $R_n(f,x_{kn}) = f(x_{kn})$, $R_n(f,\pm 1) = f(\pm 1)$, $R_n'(f,x_{kn}) = 0$, $R_n'(f,\pm 1) = 0$, $k = 1,\ldots,n$. It was proved by D.L. Berman that $(R_n(f,x))$ is divergent at every point of $(-1,1)$ if $f(x) = x^2$ and that the same result is true for the function $f(x) = x$, with the exception of the point 0. The following, more general results can be proved about $(R_n(f,x))$. THEOREM 1. If f is a continuous function on $[-1,1]$ and if the left and right derivatives $f_L'(1)$, $f_R'(-1)$ exist, then

$$\limsup_{n\to\infty} |R_n(f,x) - f(x)| = \tfrac{3}{4}(1-x^2)\,|(1+x)f_L'(1) - (1-x)f_R'(-1)|.$$

THEOREM 2. If f is as in Theorem 1, necessary and sufficient conditions for the uniform convergence of $(R_n(f,x))$ to $f(x)$ on $[-1,1]$ are $f_L'(1) = 0$, $f_R'(-1) = 0$. THEOREM 3. For an arbitrary continuous function f on $[-1,1]$, $(R_n(f,x))$ converges to $f(x)$ uniformly on $[-1,1]$ if and only if

$$\lim_{n\to\infty} (1/n^2) \sum_{k=1}^{n} (f(1)-f(x_{kn}))/(1-x_{kn})^2 = 0 \quad \text{and} \quad \lim_{n\to\infty} (1/n^2) \sum_{k=1}^{n} (f(-1)-f(x_{kn}))/(1+x_{kn})^2 = 0.$$

(Received February 9, 1979.)

*765-B10 D. Blackmore and M. Cooper, New Jersey Institute of Technology, Newark, New Jersey 07102. Simple complex singularities are Brieskorn.

Let $f:U\to\mathbb{C}$ be analytic, where U is an open neighborhood of 0 in complex n-space $\mathbb{C}^n$ and $f(0)=0$. We assume 0 is an isolated singular point which is simple in the sense of Arnol'd [Normal forms near degenerate critical points..., Functional Anal. Appl., 6, No. 5 (1972), 54-123]. The aim of this paper is to describe the local topology of $f^{-1}(0)$; in particular, to decide whether or not $f^{-1}(0)$ is locally homemorphic to $\mathbb{C}^{n-1}$ (0 is a uniformizable point). Definition. The singular point 0 of f is said to be Brieskorn if there exists a local homeomorphism h of $\mathbb{C}^n$ such that $h(0)=0$ and $f(h(z)) = z_1^{k_1} + \ldots + z_m^{k_m}$ $(m \leq n)$ for all $z=(z_1,\ldots,z_n)$ in the domain of h, where $k_1,\ldots,k_m$ are positive integers. Theorem. If 0 is an isolated, simple singular point of f, then 0 is a Brieskorn singularity. In order to prove this theorem it is necessary only to construct homeomorphisms for the D_k and E_7 normal forms of Arnol'd. This result allows us to utilize the extensive work of Brieskorn and others on the topology of the hypersurfaces defined by Brieskorn polynomials to obtain a topological description of $f^{-1}(0)$. In addition, we are able to show that theorem 1 applies to an even greater variety of isolated singular points of complex hypersurfaces.
(Received February 12, 1979.)

*765-B11 V. LAKSHMIKANTHAM, The University of Texas at Arlington, Arlington, Texas 76019. Quasi-solutions and their role in initial and boundary value problems. Preliminary report.

In the study of comparison theorems and extremal solutions for systems of differential equations, one usually imposes a property known as quasi-monotone property. In systems which result from physical applications, we sometimes find that this required quasi-monotone property is not satisfied. In such situations, the notion of quasi-solutions introduced in [Comparison results for reaction-diffusion equations in a Banach space, Technical Report University of Texas at Arlington 94, 1978], is very

helpful and is expected to play an important role in obtaining convenient upper and lower bounds for solutions and improving existence of extremal solutions. Furthermore, quasi-solutions have some computational advantages. These ideas will be discussed in this paper. (Received February 15, 1979.)

765-B12 Charles R. Deeter and Kiritkumar K. Talati, Texas Christian University, Fort Worth, Texas 76129. Models of Analytic Function Theory.

Discrete analytic functions and monodiffric functions, defined on the set of Gaussian integers, are models of analytic functions of a continuous complex variable. They are the two best known analogues of analytic functions. This paper establishes a relationship between these two classes in terms of vector space isomorphism, Hilbert space structure, and isometry. It further illustrates how certain properties of either class can be transferred to the other class by means of those relationships, thus establishing a possible means of relating widely varying types of models to each other. (Received February 16, 1979.)

*765-B13 I. ERDELYI, Temple University, Philadelphia, Pennsylvania 19122. Spectral resolutions of operators with disconnected spectra.

The spectral resolution concept, introduced by the author in an earlier paper (Boll. Mat. to appear), is applied to linear operators with disconnected spectra. Among the results, is a spectral property of the conjugate operator, the existence of two nontrivial invariant subspaces Y, Z of the dual space with the sum Y+Z direct and a spectral property of the coinduced operator on an appropriate quotient space. (Received February 16, 1979.)

765-B14 LEONARD ASIMOW and ANDREW SIMOSON, Syracuse University, Syracuse, New York 13210. Decomposability and a separation theorem. Preliminary report.

We generalize the notion of decomposability of sets as discussed in Interpolation in Banach spaces by the first author (RMJM, to appear). We prove a generalized weak* separation theorem utilizing decomposability and apply this result to various problems involving duality in convex programming. Also, in the finite dimensional case, we show that decomposability with respect to each affine variety characterizes polyhedral sets of the form A + B, where A is compact convex and B is a closed cone. Decomposability in general is dual to a positive extension property in the continuous affine function space and hence equivalent in the finite dimensional case. (Received February 16, 1979.)

*765-B15 R. B. Ram, SUNY, Oneonta, N.Y., 13820. Uniqueness of Dirichlet and mixed boundary value problems for the biharmonic equation for a rectangle. Preliminary report.

In this paper an effort has been made to formulate and prove uniqueness theorems for the solution of Dirichlet and mixed boundary value problems for the biharmonic equation (homogeneous & nonhomogeneous both) for a rectangle. The general procedure used is to reduce the irregular boundary value problem (the supposed solution is not known, a-preori, to be of class C^4 in the closed rectangle) to a regular boundary value problem (in which the solution is of class C^4 in the closed rectangle). This additional regularity is achieved by smoothing out the solution near the corners of the rectangle by using first the biharmonic reflection principles and then the isolated singularity theorem for the biharmonic functions. The main result is summarized in the following theorem: Let D be the interior of a finite plane rectangle, and suppose that the real valued, four times continuously differentiable function u is defined on D, and satisfies the biharmonic equation $u_{xxxx} + 2u_{xxyy} + u_{yyyy} = 0$ throughout D. Further, suppose that the function u and its first and second partial derivatives are bounded in absolute value on D. Let R denote the rectangular boundary of D (R is then the union of four open straight line intervals, call them I_1, I_2, I_3, I_4, plus four vertices). Suppose, further, that the function u satisfies, on each open interval I_i, where i = 1,2,3,4, a boundary condition of the following form: either at all points of the open interval I_i one has $\lim u(x,y) = 0$ and $\lim \frac{\partial u}{\partial n}(x,y)=0$, whenever the point $(x,y) \in D$ tends to a point of the open interval I_i; or else, at all points of the open interval I_i, one has $\lim u(x,y) = 0$ and $\lim \Delta u(x,y) = 0$, whenever the point $(x,y) \in D$ tends to a point of the open interval I_i, where $\frac{\partial}{\partial n}$ denotes the directional derivative in the direction normal to the open interval I_i and Δ is the two dimensional Laplacian. Then the function u must be identically zero on D.(Received February 19, 1979.)

*765-B16 A. S. Vatsala, University of Texas at Arlington, Arlington, Texas 76019 and R. L. Vaughn, Texas Christian University, Fort Worth, Texas 76129. Existence of extremal solutions and comparison results for delay differential equations in abstract cones. Preliminary report.

In this paper, we investigate the existence of maximal and minimal solution for the following type of delay differential equations

$$x'(t) = f(t,x,x_t), \quad x_{t_0} = \phi_0$$

where $f \in C[R^+ \times E \times C,E]$, $C = C[[-\tau,0],E]$, $\phi_0 \in C$, E being a Banach space. For this purpose, we need to develop the corresponding theory of delay differential inequalities and comparison theorems. (Received February 21, 1979.)

*765-B17 ALBERT EDREI, Syracuse University, Syracuse, New York 13210. Zeros of successive derivatives of entire functions of the form $h(z)\exp(-e^z)$.

Consider $f(z)=h(z)\exp(-e^z)$ $(z=x+iy)$ where $h(z)$ is a real entire function of finite order having no zeros in some strip $\{x+iy: |y-\pi|<\eta_1,\ x>x_0\}$ $(0<\eta_1)$. The author studies the power series (1) $f(\tau+z)=\sum_{n=0}^{\infty} a_n z^n$ (τ real) and the number $N(\tau_1,\tau_2;n)$ of real zeros of $f^{(n)}(z)$ which lie in the interval $[\tau_1,\tau_2]$. He proves (2) $N(\tau_1,\tau_2;n) \sim \frac{(\tau_2-\tau_1)n}{(\log n)^2}$ $(n\to\infty)$. With regard to the expansion (1) he determines a positive, strictly increasing, unbounded sequence $\{\nu_k\}_{k=1}^{\infty}$ such that $\frac{\nu_{k+1}-\nu_k}{\log \nu_k} \to 1$ $(k\to\infty)$ and having the following properties: (i) if $\nu_k<n<\nu_{k+1}$, then $a_n\neq 0$ and all the a_n have the same sign; (ii) if in addition $\nu_{k+1}<m<\nu_{k+2}$, then $a_m a_n<0$. It is possible to deduce from (2) the complete characterization of the final set (in the sense of Pólya) of $\exp(-e^z)$. (Received February 22, 1979.)

*765-B18 W. LAYTON, University of Tennessee, Knoxville, Tennessee 37916. Periodic Solutions of Nonlinear Delay Equations.

Existence and uniqueness of 2π-periodic solutions of the equation

(A) $d^j x(t) / dt^j + \text{grad } G(x(t-\tau)) = e(t)$ $(j=1,2)$, where $x(t)$ is in $\mathcal{R}^n$ and $e(t)$ is a given 2π-periodic vector in $L^2(0,2\pi)$, are shown under conditions on the spectrum of the Hessian of G. Equation (A) is studied using a fixed point theorem in a suitable Hilbert space. One feature of this approach is that no relationship between the delay and the period is necessary. (Received February 23, 1979.)

*765-B19 JAMES V. PETERS, State University of New York at Purchase, Purchase, N.Y. 10577. A Tauberian Theorem for the Radon Transform. Preliminary report.

In its original form, Tauber's theorem asserts that a sequence $\{a_k\}$ such that $ka_k \to 0$ as $k \to \infty$ is in ℓ^1 iff the limit, as $r \to 1$, of $\sum a_k r^k$ exists. By analogy, we determine when a function $f(x)$ is in $L^1(\mathbf{R}^n)$ from the Radon transform of its convolution with the Gaussian kernel. One result is as follows:

Theorem. Suppose that the Radon transform $f(\xi,p)$ is an infinitely differential function having compact support. Then $\int \check{f}(\xi,p)dp$ has a finite value, independent of ξ, iff $f(x) \in L^1(\mathbf{R}^n)$. (Received February 23, 1979.)

765-B20 SCOTT O'HARE, State University of New York at Stony Brook, Stony Brook, New York 11794. Spectral Invariance for Normal Operators Under Trace Class Perturbations. Preliminary Report.

Let Γ be a subset of $\mathbb{C}$, λ a positive Borel measure on Γ, $\mathbf{H}$ a seperable Hilbert space. We say that the K-R (Kato-Rosenblum) Result holds for (Γ,λ) when, given normal operators N_1,N_2 in $\mathbf{H}$ with $\sigma(N_1)\cup\sigma(N_2) \subset \Gamma$ and $T = N_2 - N_1$ trace class, the spectral multiplicity functions for N_1,N_2 are equal a.e.(λ). When $\Gamma = \mathbb{R}$ and λ is Lebsgue measure,

this is just the classical Kato-Rosenblum Theorem. In this paper we show that the K-R Result holds for (Γ, λ) when

i) Γ is the image of $[0,1]$ under a C^1 map γ, and λ is arclength, provided $\lambda(\overline{F})=0$, where $F = \{\zeta \in \Gamma \mid \gamma^{-1}(\zeta)$ contains more than one point$\}$,

ii) Γ is a convex rectifiable Jordan curve, λ arclength on Γ,

iii) $\Gamma = \cup_{k=1}^{\infty} \Gamma_k$, where each Γ_k satisfies either i) or ii) above, $\lambda \gg \lambda_k$ $\forall k$, and $\forall k$, $\lambda_k(\Gamma_k \setminus \overline{\cup_{k \neq j} \Gamma_j}) = 0$. There are no boundedness requirements. (Received February 23, 1979.)

765-B21 HAJIMU OGAWA, State University of New York at Albany, Albany, New York 12222. Energy inequalities for ultrahyperbolic operators in a Hilbert space. Preliminary report.

Let $Lu = B_y u - A_x u$ where A_x and B_y are linear second-order elliptic operators in the variables $x \in \mathbb{R}^m$, $m \geq 2$, and $y \in \mathbb{R}^n$, respectively. L is assumed to be defined on $D \times \Gamma$ where D is a bounded domain in $\mathbb{R}^m$ and Γ is a cone in the exterior of the unit ball in $\mathbb{R}^n$. The asymptotic behavior of solutions as $|y| \to \infty$ and uniqueness of the mixed initial-boundary problem for equations of the form $Lu = F(x,y,u,\nabla_x u, \nabla_y u)$ have been studied by Murray and Protter (Indiana U. Math. J. 24 (1974), 115-130) in the case $B_y = \Delta_y$ and Murray (J. Diff. Equations 23 (1977), 200-215) in case B_y is close to Δ_y and Γ is the exterior of the unit ball in $\mathbb{R}^n$. We obtain extensions of these results by considering L to be an ordinary second-order differential operator in a Hilbert space. The method, used previously by the author (to appear in J. Diff. Equations) in the case $B_y = \Delta_y$, consists in establishing a lower bound for a suitably defined weighted quadratic functional. (Received February 23, 1979.)

*765-B22 C. CORDUNEANU, University of Tennessee, Knoxville, Tennessee 37916. ODE approximating PDE in unbounded domains: the elliptic case.

The equation (E) $u_{xx} + u_{yy} = f(x,y,u)$ is considered in the strip $D = \{(x,y); -\infty < x < +\infty, 0 \leq y \leq 1\}$, with boundary value conditions $u(x,0) = u(x,1) = 0$. The lines method leads to the following OD systems: (S_n) $d^2u/dx^2 + (n+1)^2 A_n u = \overline{f}(x,u)$, where $u = \mathrm{col}(u_1, u_2, \ldots u_n)$, $u_k(x) \cong u(x,y_k)$, $y_k = k/n+1$, $k = 0,1,\ldots,n$, $\overline{f}(x,u) = \mathrm{col}\,(f(x,y_1,u_1),\ldots, f(x,y_n,u_n))$ and

$$A_n = \begin{bmatrix} -2 & 1 & 0 & \ldots & 0 \\ 1 & -2 & 1 & \ldots & 0 \\ 0 & 1 & -2 & \ldots & 0 \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ 0 & 0 & 0 & 1 & -2 \end{bmatrix}$$

Qualitative results regarding (S_n) are used in order to derive similar results for the solution of (E) in D (e.g., boundedness, almost periodicity, periodicity). (Received February 23, 1979.)

*765-B23 ROBERT C. McOWEN, Courant Institute of Mathematical Sciences, New York, New York 10012. The Behavior of the Laplacian on Weighted Sobolev Spaces.

If we let $M^p_{s,\delta}$ be the completion of $C_0^\infty(R^n)$ under the norm $\sum_{|\alpha| \leq s} \| (1+x^2)^{(\delta + |\alpha|)/2} D^\alpha \phi \|_{L^p}$ (where $1 < p < \infty$, $s \in N$ the nonnegative integers, and $\delta \in R$), then we obtain a continuous map

(*) $\Delta : M^p_{2,\delta} \to M^p_{0,\delta+2}$.

The following theorem completely describes the behavior of (*):

THEOREM. The map (*) is Fredholm if and only if $\delta \neq -2 + n/p'$ (mod N) and $-\delta \neq n/p$ (mod N). In fact when Fredholm, the kernel and cokernels are explicitly describable in terms of harmonic polynomials, whereas for the exceptional δ values (*) does not have closed range.

This result generalizes to powers of the Laplacian and general constant coefficient homogeneous elliptic operators and perturbations by variable coefficient operators. The theorem also generalizes earlier work by M. Cantor who defined the spaces. (Received February 26, 1979.)

*765-B24 Howard Jacobowitz, Rutgers University, Camden, New Jersey 08102. Mappings between CR manifolds.

Let M_1 and M_2 be strictly pseudo-convex, integrable CR manifolds of the same dimension and let $F: M_1 \longrightarrow M_2$ be a CR map. Theorem: (a) If F and the CR structures are real analytic and M_1 is connected, then F is either a local diffeomorphism or $F(M_1)$ is a single point. (b) If F and the CR structures are C^k for k large enough and if q is a non-flat point, then F is either a local diffeomorphism at q or maps an open set containing q to a single point. Stronger results are known when M_1 and M_2 are real hypersurfaces in $\mathbb{C}^N$. (Received February 26, 1979.)

765-B25 JEAN-MARC BELLEY and PEDRO MORALES*, Université de Sherbrooke, Sherbrooke, Québec. Semigroup-valued Baire and Borel measures.

Let G be a uniform semigroup, X a Hausdorff topological space, $\mathcal{R}$ a ring of subsets of X and $\lambda: \mathcal{R} \to G$ a set function such that $\lambda(\phi)=0$. We can extend in an obvious manner the usual definition of regularity to λ. Using a result of Weber [Arch. Math. 27 (1976), 412-423] on the existence of semi-invariant pseudo-metric generators for the uniformity of G, the properties of semi-variation induced by λ and the σ-additivity of a compact semigroup-valued additive set function, we are able to establish the following results: Theorem 1. Let X be a Hausdorff locally compact space, let $\mathcal{B}_0$ be the δ-ring generated by the compact G_δ sets of X, and let $\lambda: \mathcal{B}_0 \to G$ be additive. Then λ is a measure if and only if λ is regular.

Theorem 2. Let X be a Polish space, let $\mathcal{B}$ be the δ-ring generated by the closed sets of X, and let $\lambda: \mathcal{B} \to G$ be additive. Then λ is a measure if and only if λ is regular. The above results generalize the classical results (Halmos [Measure Theory, D. van Nostrand Company, Inc., New York (1950)]) and the more recent results of Sundaresan and Day [Proc. Amer. Math. Soc. 36 (1972), 609-612]. We will also discuss the possibility of extending, in this context, a Baire regular measure to a Borel regular measure (see Khurana [Bull. Acad. Polon. Sci. Sér. Sci. Math., Astr., Phys. 22 (1974), 891-895]). (Received February 26, 1979.)

*765-B26 Benjamin Lepson, Charles F. Osgood, and Chung-Chun Yang, U. S. Naval Research Laboratory, Washington, D. C. 20375. The distribution modulo 1 of unbounded real sequences.

A well known result due to Hermann Weyl [Math. Ann. 77 (1916)] may be stated as follows:

Theorem W. If x is any irrational number, then the infinite sequence $\{nx\}$, n=1,2,$\cdots$, is uniformly distributed modulo 1.

This implies the following, which is essentially due to Dirichlet:

Corollary. If x is any irrational number, then the infinite sequence $\{F(nx)\}$, n=1,2,$\cdots$, is everywhere dense in $[0,1]$, where F(u) denotes the fractional part of u.

In this note, we prove the following partial generalization of the above Corollary:

Theorem. Let $\{a_n\}$, n=1,2,$\cdots$, be any unbounded sequence of real numbers. Then there exists an everywhere dense set E of real numbers such that, if $c \in E$, then the sequence $\{F(ca_n)\}$, n=1,2,$\cdots$, is everywhere dense in $[0,1]$, where, as above, F(u) denotes the fractional part of u.

This result implies an affirmative answer to a question raised by K. N. Chow concerning sequences of the form $\{\cos(ca_n)\}$, where $\{a_n\}$ is an unbounded sequence of real numbers. (Received February 26, 1979.)

765-B27 HIMAT S. BATRA, Marist College, Poughkeepsie, New York 12601. On the determination of the density of a vibrating string from its asymptotic phase. Preliminary report.

Consider the differential equation $y'' + (\lambda^2 - P(x))y = 0$ with initial values $y(0,\lambda) = 0$, $y'(0,\lambda) = 1$. The solution $y(x,\lambda)$ of this problem satisfies $\lim_{x\to\infty} y(x,u) = (A(u)/u)\,\mathrm{Sin}\,(ux - \phi(u))$, where $A, \phi \in C(0,\infty)$ and $\lambda = u \neq 0$, u real. Levinson proved that under suitable conditions, any of the three functions P(x), A(u) and $\phi(u)$

determines the other two. We prove a parallel result for the differential equation $-y'' = \lambda^2 \rho(x)y$ where $x \in [0,\infty)$, $\rho(x) > 0$, $\rho(0) = 1$ and initial values $y(0,\lambda) = \sin\alpha$, $y'(0,\lambda) = -\cos\alpha$. The solution $y(x,\lambda)$ of this problem satisfies $\lim_{x\to\infty} y(x,u) = (C(u)/u\rho^{1/4}(x))\cos(uX - \phi(u))$ where $X = \int_0^x \sqrt{\rho(t)}\,dt$, $u = \mathrm{Re}(\lambda)$, $u \neq 0$ and $C, \phi \in C(0,\infty)$. Theorem. Let $\rho(x) \approx k$ ($k \geqq 0$) asymptotically as $x \to \infty$, $\lim_{x\to\infty} x^2\rho'(x)$ exists finitely, $\rho'(x)$ be bounded at $x = 0$ and $\rho''(x)$ be ultimately of constant sign. Further let $\int_0^\infty (\rho(x) - k)\,dx < \infty$. Then $y(x,u)$ is given as before. If also $\phi(\infty) - \phi(0^+) < \pi$, then any one of the three functions ρ, ϕ and C determines the other two uniquely. ■ It is known that if there exists a discrete spectrum, then the phase ϕ does not determine $\rho(x)$. The conditions on ρ and ϕ in this theorem are formulated so as to ensure that the entire spectrum is continuous. (Received February 26, 1979.) (Author introduced by Professor Harry Hochstadt).

765-B28 HENRY B. LAUFER, SUNY at Stony Brook, Long Island, NY 11794. Projective one-space as an exceptional set. Preliminary report.

Let CP^1 be the exceptional set in the n-dimensional manifold M. Let V be the blow-down of M. Then V can be a hypersurface only if n=2 or n=3. The hypersurfaces for n=3 are described. Additional information beyond the normal bundle of CP^1 in M is involved. (Received February 26, 1979.)

765-B29 ALLAN J. FRYANT, U. S. Naval Academy, Annapolis, Maryland 21402. Spherical harmonic expansions.

As is well known, if $f(z) = \sum_{n=0}^{\infty} a_n z^n$, then the radius of convergence R of the series is given by $R^{-1} = \overline{\lim_{n\to\infty}} |a_n|^{1/n}$. Further if f is entire, the order ρ and type τ of f can be expressed in terms of the Taylor coefficients as

$$\rho = \overline{\lim_{n\to\infty}} \frac{n \log n}{\log |a_n|^{-1}} \quad \text{and} \quad \tau = (e\rho)^{-1} \overline{\lim_{n\to\infty}}\, n|a_n|^{\rho/n}.$$

We show that these same expressions give the radius of convergence, order, and type for harmonic functions in R^3 having expansion in spherical harmonics

$$H(r,\theta,\phi) = \sum_{n=0}^{\infty} \sum_{m=0}^{n} (a_{nm}^{(1)} \cos m\phi + a_{nm}^{(2)} \sin m\phi)\, r^n P_n^m(\cos\theta),$$

when the Taylor coefficients $|a_n|$ are replaced by

$$\max_{m,i} \sqrt{\frac{(n+m)!}{(n-m)!}}\, |a_{nm}^{(i)}|\ .$$ (Received February 26, 1979.)

765-B30 E. J. MOULIS, Jr., U. S. Naval Academy, Annapolis, Maryland 21402. The modulus of the Schwarzian derivative for several classes of analytic functions. Preliminary report.

$P_\alpha^K(\rho)$ denotes the class of functions p(z) analytic in the unit disk $E = \{z: |z| < 1\}$ with $p(0) = 1$ and

$$\int_0^{2\pi} |\mathrm{Re}\{e^{i\alpha} p(z)\} - \rho\cos\alpha|\, d\theta \leq K\pi(1-\rho)\cos\alpha,$$

$z = re^{i\theta}$, $0 \leq r < 1$, α real, $|\alpha| < \pi/2$, $0 \leq \rho < 1$, $K \geq 2$. Denote by $V_\alpha^K(\rho)$ the class of functions f(z) analytic in E with $f(0) = f'(0) - 1 = 0$ and $1 + zf''(z)/f'(z)$ in $P_\alpha^K(\rho)$, and by $\{f,z\}$ the Schwarzian derivative of f with respect to z. We prove that for all f in $V_\alpha^K(\rho)$

$$|\{f,z\}| \leq \frac{(1-\rho)\cos\alpha}{2(1-|z|^2)^2}\, [(1-\rho)K^2\cos\alpha + K|\sin\alpha| - 4\cos\alpha + 4|\rho + (1-\rho)\sin\alpha|(K|z| + |z|^2)],$$

$K \geq 4/(1-\rho)$, z in E.

We discuss the sharpness of this result for various subclasses of $V_\alpha^K(\rho)$ and an application to the radius of convexity of a related class of analytic functions. (Received February 27, 1979.)

*765-B31 Robert Atalla, Ohio University, Athens, Ohio 45701. A class of Markov-operators on C(X).

A Markov operator T on C(X) (X compact) is quasi-bipositive (qbp) if $Tf \geq 0$ implies $Tf = Tf_o$ for some $f_o \geq 0$. If T is a closed range qpb, we give con-

ditions under which (1) there exists a Banach subalgebra B such that T is 'essentially' an isometry of B onto range(T). (2) there exists a vector sublattice L such that T is 'essentially' a lattice isomorphism of L onto range(T). Applications to matrix summability are discussed. (Received February 27, 1979.)

*765-B32 STEPHEN F. ROEHRIG, University of Rhode Island, Kingston, Rhode Island 02881. Fixed points in ℓ_1.

Let C be a conves, weakly compact subset of ℓ_1. A simple proof of the known fact that any nonexpansive selfmap of C has a fixed point is given. More generally, it is shown that any continuous selfmap of C has a fixed point. (Received February 27, 1979.)

*765-B33 Jamil A. Siddiqi, Laval University, Quebec, Canada, G1K 7P4. On approximation by translates in $L_2(\mathbb{R})$. Preliminary report.

A classical theorem due to N. Wiener asserts that if $f \in L_2(\mathbb{R})$, then $\{f_c;\ c \in \mathbb{R}\}$ spans $L_2(\mathbb{R})$ if and only if its Fourier transform $\hat{f} \neq 0$, where f_c denotes the translate $t \to f(t-c)$ of f. In this paper we prove among others the following theorems: (I) Let $f \in L_2(\mathbb{R})$ be such that $\hat{f} \neq 0$, $f(t) = O(\exp -A|t|^{\alpha})$ $(|t| \to 0)$ and let (c_n) be a sequence of real numbers such that $\sum_{c_n \neq 0} |c_n|^{-\alpha'}$ diverges, where α' is the conjugate index of $\alpha > 1$. Then $\{f_{c_n}\}$ spans $L_2(\mathbb{R})$. (II) Let $f \in L_2(\mathbb{R})$ be such that $\hat{f} \neq 0$ and let the function $t \to \exp(-B|t|^{\alpha}) f(t)$ belongs to $L_2(\mathbb{R})$, where $\alpha > 1$. If the series $\sum_{c_n \neq 0} |c_n|^{-\alpha'}$ converges then f_{c_n} does not span $L_2(\mathbb{R})$. These theorems settle a question raised by R.A. Zalik in a similar context. (Received February 27, 1979.)

765-B34 CLAUDI ALSINA, Universitat Politècnica de Barcelona, Barcelona, Spain. Idempotent elements of $\tau_{T,L}$-semigroups of distribution functions. Preliminary report.

Let $\tau_{T,L}$ be the binary operation defined on Δ^+ by means of $\tau_{T,L}(F,G)(x) = \sup\{T(F(u),G(v)); L(u,v)=x\}$. We solve some functional equations related to these semigroups. Let L be a strictly increasing multiplicative binary operation on $[0,+\infty]$.

Theorem: $\tau_{Min,L}(F,F)=F$, if and only if there exists a constant $K \in [0,1]$ such that $F(x)=K$ on $(0,1]$ and $F(x)=1$ on $(1,+\infty]$.

Theorem: If L is associative, T is a strict t-norm and $F(1)=1$ then $\tau_{T,L}(F,F)=F$, if and only if there exists a nondecreasing subadditive function f such that $f(0)=0$, $f(+\infty)=+\infty$ and $F=t^{-1}$ o f o ℓ, being t and ℓ the additive generators of T and L respectively.

Theorem: If M is an additive binary operation on $[0,+\infty]$ and T is a continuous t-norm then $\tau_{T,M}(F,F)=F$, if and only if T=Min on RanF x RanF and M=Supremum on RanF^ x RanF^. (Received February 27, 1979.)

Applied Mathematics
(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

765-C1 LOUIS J. GROSS, Cornell University, Ithaca, New York 14853. Modeling the Dynamics of Photosynthesis

I will discuss models of the photosynthetic process at levels above the biochemical when a leaf is exposed to a variable light environment. This includes models for the transients of CO_2 diffusion within a leaf and the dynamics of whole leaf photosynthesis in a given varying environment. Also to be considered are models for optimal leaf form in a random environment and for the phenotypic response of a plant over a long time period. The phenotypic response model is viewed as a two time scale stochastic control problem, with total photosynthate being the quantity to be maximized. The ecological significance of these results will be indicated. (Received January 17, 1979.)

765-C2 LEV R. GINZBURG, State University of New York at Stony Brook, Stony Brook, New York 11774. Modelling of Natural Selection. Preliminary report.

Since the majority of traits evolutionists are interested in are controlled by many genes, understanding of polygenic systems is the most important unresolved problem of population genetics. The problem has been attacked from two different angles.

Some authors concentrated their attention on two and three locus models as systems of minimal dimension. The others looked at the general m-locus system with very restricted assumptions on the fitness and recombination structure. Difficulties of the exact analysis, mostly due to the dimensionality problem, led to the common feeling that a radical change of the point of view should be attempted. In this presentation I am trying to make such a change. The question asked is what is "typically" more important for the genetic frequency changes, selection or recombination? It is shown that the likelihood of selection to prevail with respect to recombination is growing dramatically with the number of loci involved.
(Received January 29, 1979.) (Author introduced by Professor Gangaram S. Ladde).

765-C3 JEROME EISENFELD, University of Texas at Arlington, Arlington, Texas 76019. System Identification Modeling.

We shall survey the system identification procedure for estimating parameters in compartmental models emphasizing relationships between graph theory, Markov processes and compartmental (differential equations) models. We shall also discuss some recent results on structural identifiability. As examples we use: the biliary system, fluorescence decay experiments and a two interacting population model.
(Received January 25, 1979.)

*765-C4 Carl N. DeSilva, Wayne State University, Detroit, Michigan 48202.
A mathematical theory for the elastic response of the aorta in vivo.

A general theory is developed for the elastic response of the aorta which experiences small changes about an initially deformed and stressed configuration. The theory yields three sets of stress measures and three sets of strain measures. It is possible to write simple and elegant constitutive equations for the theory. This approach, however, does not address itself to the special dependence of the constitutive coefficients on the geometry of the configuration. The main thrust of the paper shows that the constitutive coefficients depend not only on the initial stress and the classical material elastic moduli but also on weighted moments of these quantities with respect to a transverse cross section. These coefficients may, in turn, be expressed in terms of the area and of the second moment of the cross section.
(Received February 6, 1979.)

765-C5 HERBERT E. SALZER, 941 Washington Avenue, Brooklyn, New York 11225. Some economic parallels to equilibrium thermodynamics.

"Ecodynamics" is an economic theory that parallels equilibrium thermodynamics. Terms like wealth, capital and labor, employed in a very broad sense, correspond to total heat, internal energy and mechanical work, while value is here made an intensive potential function analogous to temperature. A first law expresses the conservation of wealth or economic energy, in terms of capital and labor. A second law based upon the tendency of wealth, capital or labor to go spontaneously where its value is greater (opposite sense of heat flow from hotter to colder bodies) defines an economic entropy or "ecentropy" ("negecentropy") function which usually tends to decrease (increase). Fairly detailed quantitative illustrations are given for both laws. There are ecodynamic analogues of various free energy functions and the third law of thermodynamics. A wide and fruitful extension is possible with the introduction of ecodynamic analogues of chemical components and potentials to denote specific forms of capital and labor with corresponding potentials. A nonequilibrium ecodynamics, modeled upon near-equilibrium thermodynamics, would treat fluxes or flows of different forms of wealth, capital or labor in conjunction with various specific capital potential functions. (Received February 8, 1979.)

765-C6 THOMAS G. HALLAM, University of Tennessee, Knoxville, Tennessee 37916. Persistence-Extinction Mechanisms in Ecosystem Models.

The persistence-extinction mechanism in simple Lotka-Volterra food chains, where the dynamics of a trophic level is determined by the adjacent food levels, is coalescence of equilibria. A persistence hierarchy can be determined. When complexity is introduced into a trophic level, the persistence-extinction mechanism for Lotka-Volterra models becomes more complicated, even for low dimensional problems. Discussion will include effects of competition, predation, and mutualism on competitive subsystems. (Received February 14, 1979.)

*765-C7 ROBERT ROSEN, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4H7. On Anticipatory Systems.

Analytic modelling of natural system behaviors has typically relied heavily on stability analysis of dynamical systems. Such a mathematical framework is essentially equivalent to the modulation of system activity via feedback mechanisms, and is thus appropriate for reactive behavior. In biology, however, much behavior of primary interest is not reactive, but rather predictive or anticipatory. The basis of anticipatory behavior lies in the employment of internal models, coupled with a pre-setting of controls through feedforward mechanisms. We discuss the development of a mathematical framework appropriate for the study of anticipatory systems, together with a number of biological implications, such as the temporal spanning of system properties. (Received February 16, 1979.) (Author introduced by Professor Gangaram S. Ladde).

*765-C8 David J. Wollkind, Washington State University, Pullman, Washington 99164. A tectonophysical phenomenon: The onset of folding viewed as an instability in a layered Newtonian fluid involving surface tension. Preliminary report.

A number of classical geological problems must now be reconsidered in light of the fact that the large scale convection cells necessary to explain continental drift require the earth's mantle to behave over long periods of time like a viscous Newtonian fluid. The onset of folding in a layer of rock, which is undergoing a uniform parallel-layer compression strain while being more resistant to deformation than the embedding medium, is such a phenomenon. The mathematical model employed represents this situation in terms of a Newtonian fluid layer involving surface tension effects. The critical conditions for the onset of folding are developed by performing a linear stability analysis of the appropriate exact solution to this governing system of equations using a modified normal mode approach. These results are then interpreted physically. (Received February 19, 1979.) (Author introduced by Professor H. C. Wiser).

*765-C9 JOE THRASH, University of Southern Mississippi, Hattiesburg, MS 39401 Approximation of Improper Integrals. Preliminary report.

H. L. Gray and T. A. Atchison in their paper The Generalized G-Transform (Mathematics of Computation, July, 1968, Vol. 22, No. 103, pp. 595-606.) presented a nonlinear transformation that can be used to accelarate the conergence of some improper integrals. Here a modification of their transformation is studied. (Received February 22, 1979.)

*765-C10 LYNNELL E. STERN, University of Rhode Island, Kingston, Rhode Island 02881. On optimality of control systems in infinite time intervals.

An example is given of a control system which has different solutions, all satisfying Halkin's definition of optimality in the infinite time interval (Econometrica, 42, 1974, 267-272). A theorem is given stating conditions under which any two solutions, which are optimal in Halkin's sense, are asymptotically equivalent. This settles a conjecture of von Weizsäcker, C.C. (Review of Economic Studies, 32, 1965, 85-104). (Received February 22, 1979.)

*765-C11 EMILIO O. ROXIN, University of Rhode Island, Kingston, Rhode Island 02881. Differential games in infinite time intervals.

Given a pair of strategies for a two person zero sum differential game, a definition is given for them to constitute a Nash-optimal pair in the infinite interval $[t_0,+\infty)$. This definition is similar to Halkin's definition of optimality for control systems. Some properties of such Nash pairs are discussed. In particular, periodic solutions of a differential game may arise in an infinite time interval. A **necessary** condition for such a periodic solution to exist, in autonomous differential games with terminal payoff, is the existence, when the finite time-interval game is solved, of a "closed solution" such that $x(t+T) = x(t)$. (Received February 22, 1979.)

765-C12 C. R. Giardina, Singer-Kearfott Division, Wayne, N.J. 07470; Fairleigh Dickinson University, Teaneck, N.J. 07666; Stevens Institute of Technology, Hoboken, N.J. 07030. Fuzzy Relational and L Relational Data Bases. Preliminary Report.

Conventional Relational Data Base Operators and recent Relational Operators as defined by Codd are re-examined under the sometimes necessary restriction that certain domains be partially ordered. These operators are then generalized. "Fuzzy" operators are defined to handle Fuzzy Relations as given by Zadeh. "L" Operators are then introduced to deal with L Relations - $R \in \mathcal{L}^{E_1 \times E_2 \times \cdots \times E_n}$ as defined by Goguen with $\mathcal{L}$ a Lattice. Completeness and consistency is discussed as well as applications to a Signature Recognition System. Here a Data Base is employed with attributes of; sound pressure, temporal acceleration, harmonic vibration content, as well as psychoacoustical sound acceptability determination as given by a jury. (Received February 26, 1979.)

765-C13 WITHDRAWN

*765-C14 CARLA C. NEADERHOUSER, Texas A&M University, College Station, Texas 77843. Convergence of block spins defined by a random field.

We discuss the asymptotic behavior of families of dependent random variables called "block spins" which are associated with random fields arising in statistical mechanics. We show that if a certain mixing property, weaker than the so-called "strong" mixing property, is satisfied then these families can converge weakly only to families of normal or degenerate random variables. We also give a proof that the 2-dimensional Ising model at the critical temperature is not strong mixing. (Received February 26, 1979.)

765-C15 ERIC S. ROSENTHAL, Princeton University, Princeton, New Jersey 08544. Fast algorithms for singular matrices. Preliminary report.

Ever since the surprising discovery of an algorithm which multiplies two n x n matrices using $O(n^{\log_2 7})$ arithmetic operations, there has been much interest in fast algorithms (i.e., algorithms asymptotically faster than the classical ones) for other matrix operations. The first fast algorithms for certain matrix operations without restrictions on the ranks of matrices involved are presented.

Let $M(n)$ denote the time required to multiply two n x n matrices. An algorithm that finds the lexicographically first set of linearly independent columns of an m x n matrix of rank r in time $O(mnM(r)/r^2)$ is used to construct fast algorithms for many matrix operations. Other fast algorithms can be obtained from formulas for generalized inverses of partitioned matrices. The above time estimate must be modified if M does not satisfy a growth condition made plausible by a regularity theorem for solutions of a functional inequality. (Received February 27, 1979.)

765-C16 M. ZUHAIR NASHED, University of Delaware, Newark, Delaware 19711. On the dilemma and methodologies of mathematical modeling of ill-posed problems.

For a long time following Hadamard it was an accepted point of view in the mathematical literature that ill-posed problems (IPP) cannot describe real phenomena and physical systems. It is now recognized that this attitude about IPP is erroneous and that many (if not the majority) of applied problems are, and always have been, ill-posed problems, particularly when they require numerical answers in the presence of contamination in the data. We only consider inherently ill-posed problems (IIPP), i.e. problems where ill-posedness is inherent in the phenomenon and is not due to a poorly chosen mathematical model. IIPP cannot be remedied by changing the model. This has led to several concepts of regularizable ill-posed problems (RIPP) which circumvent the lack of continuous dependence (as well as to bring about existence and uniqueness if necessary). This raises

several questions about the relation between IIPP (that cannot be described by a well-posed model) and the associated RIPP. The dilemma is that the better the RIPP model describes the IIPP, the worse is the conditioning of the RIPP. Several methodologies for a compromise resolution will be described. A fuzzy hierachy of classes of IPP in terms of "degree" of ill-posedness will be described and illustrated by several examples. (Received February 27, 1979.)

Geometry (50, 52, 53)

765-D1 T. Y. LIN, National Taiwan University and University of South Carolina, Aiken, South Carolina 29801. On injective stable homotopy modules and a solution to the generating hypothesis.

One of the most interesting conjectures in the "global" homotopy theory is Freyd's generating hypothesis (abb. FGH). [See (1) T. Y. Lin, Adams type spectral sequences and stable homotopy modules, Indiana Univ. Math. J. 25(1976), 135-158.] Use the notations in (1). Theorem. If X is a finite CW-complex and $\Pi_*(X)$ is an injective Π_*-module, then $\Pi_*(X)$ is a finitely generated Π_*-module. On the other hand, FGH implies that if X is a torsion complex (the identity map has a finite additive order), then $\Pi_*(X)$ is Π_*-injective and, further, an infinitely generated Π_*-module. This is a contradiction, hence the generating hypothesis is false. The theorem above follows from the following more technical theorem. Theorem. Suppose X is a finite CW-complex and $\Pi_*(X)$ is an injective Π_*-module. Then, if α is an element of $\Pi_*(X)$ and decomposable by a higher order Toda bracket, then α is decomposable in primary order. There are other interesting consequences. (Received January 26, 1979.)

*765-D2 ULF A. PERSSON, COLUMBIA UNIVERSITY, NEW YORK, NEW YORK 10027 On Chern numbers of surfaces of general type. Preliminary report.

Given x,y positive integers, when does there exists a surface of general type X with $\chi(X) = x$, $c_1^2(X) = y$? It is known that $2x-6 \leq y \leq 9x$ are necessary, but what is sufficient?

The paper shows that the converse holds if $2x-6 \leq y \leq 8x$ y is even, $2x-6 < y \leq 8x - 13$ y is odd. Furthermore if $y \leq 8(x - k\,x^{2/3})$ (where $k = 9\cdot 12^{-\frac{1}{3}}$)X can be chosen to be simply connected.

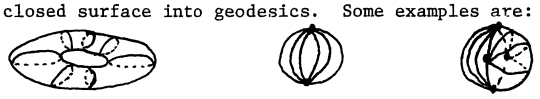
The techniques are those of double coverings of ruled surfaces along singular branchcurves, having complete control over their singularities. (Received February 23, 1979). (Author introduced by Professor George R. Kempf).

765-D3 Philip H. Turner, Wesleyan University, Middletown, CT 06457. Differential Geometric Aspects of Billiard Ball Dynamical Systems. Preliminary report.

This work is motivated by the study of billiards on a convex plane table. We generalize the notion of a caustic for billiards as presented by Ya Sinai as follows: A curve Γ inside the table is a caustic if any billiard trajectory which travels on a line of support drawn to Γ before reflection remains on a line of support after reflection. We call a curve γ a profile of Γ if every point P of γ satisfies the metric equation: $|\overleftrightarrow{PA}| + |\overleftrightarrow{PB}| + \mathrm{lng}(\overset{\frown}{AB}) = \mathrm{const} > \mathrm{lng}(\Gamma)$, where $\overleftrightarrow{PA}$ and $\overleftrightarrow{PB}$ are lines of support drawn to Γ from P and $\mathrm{lng}(\overset{\frown}{AB})$ is the arclength from A to B along Γ. Theorem 1: Suppose Γ is a convex polygon. Then any profile γ of Γ is a C^1 curve such that Γ is a caustic for billiards inside γ. Theorem 2: Suppose Γ is a convex, closed, piecewise C^2 curve and that γ is a C^1 profile of Γ. Then Γ is a caustic for billiards inside γ. Theorem 3: Suppose Γ is a convex, closed, piecewise C^2 curve. Then the sum of the unit tangents to the winding and unwinding involutes through any point P of a C^1 profile γ is a C^1 function if and only if γ has continuous curvature. Theorem 4: Suppose γ is a C^2 profile of convex Γ. Then every member of the family of instant ellipses drawn to γ with foci on Γ has contact at least of order 2 with γ. (Received February 26, 1979.)

*765-D4 Alan H. Kafker, University of Pennsylvania, Philadelphia, Pennsylvania 19174. Geodesic fields with singularities.

The question under consideration is whether or not you can find a Riemannian metric to make a given curve field on a closed surface into geodesics. Some examples are:



Allowing singularities frees us from the restriction to Euler characteristic zero, where the geodesic fields are already known. The main results are:

A. Only two types of isolated singularities can occur in a geodesic field on a surface; both are shown above.

B. No geodesic fields exist on a surface with Euler characteristic less than zero. If the Euler characteristic is zero, such a geodesic field can have only removable singularities.

C. Only a limited number of geodesic fields exist on S^2 and RP^2.

D. A closed geodesic (perhaps made from several curves and singularities) always appears in such a field.

Many of the techniques used are borrowed from dynamical systems. (Received February 26, 1979.)

Logic and Foundations (02, 04)

765-E1 Russell W. Myers, Southampton College, Southampton, N. Y. 11968. Complexity of Two Model-Theoretic Predicates. Preliminary report.

Assume that some standard Godel numbering of the language L of the full countable predicate calculus is given, so that theories and types can be viewed as sets of natural numbers. We show that the predicate "T has a model omitting the type Γ" (as a predicate in the set variables T and Γ) is sharply Σ^1_1, and "T is ω_0-categorical" is arithmetical in the sense of recursion theory. (Received February 22, 1979.)

765-E2 GERHARD F. KOHLMAYR, Mathmodel Consulting Bureau, Glastonbury, CT 06033. A topological proof for the inconsistency of ZFC.

Lemma (ZFC). Let F be a Hausdorff field, R a connected locally compact ordered field. A bijection $f: F \to R$ is a homeomorphism. Sketch of proof. Without loss of generality, consider a compact neighborhood of 0 in R. f^{-1} exists and sends converging ultrafilters to converging ultrafilters; thus F becomes locally compact. A Hausdorff field is either connected or totally disconnected. If connected, nothing to prove. If totally disconnected, then f is continuous, as all sets in F are open. A bijection continuous on all compact subsets of F is a homeomorphism. Theorem (ZFC). There are no infinite sets. Sketch of proof. Suppose there is an infinite set A. Then A contains a countably infinite set B. Let U be a free ultrafilter on B and let R^U be the U-ultrapower of R (the reals). R^U is a nonarchimedean ordered field; moreover, R^U is a Hausdorff field (order topology). R^U contains a Hausdorff subfield F which is a bijective image of R. By the Lemma, the relative topology of F induced by the (order) topology of R^U is the usual topology for F=R; thus F is connected. On the other hand, the intersection of infinitesimal neighborhoods of 0 in R^U with F is the singleton $\{0\}$ in F, making the relative topology of F discrete. Thus F is totally disconnected. We have a contradiction which establishes the Theorem. Remark. I have worked out numerous other proofs for the inconsistency of ZFC. (Received February 22, 1979.)

Statistics and Probability (60, 62)

765-F1 MAURY BRAMSON, Courant Institute of Mathematical Sciences, New York, New York 10012 and DAVID GRIFFEATH, University of Wisconsin, Madison, Wisconsin 53706. Asymptotic behavior of the d-dimensional biased voter model.

We investigate here the limiting behavior as $t \to \infty$ of the continuous time two-state biased voter model on Z^d, $d \geq 1$. We show that conditional on its nonextinction,

the privileged state of the voter model grows, and will (almost surely) eventually permanently occupy any finite $A \subset Z^d$. This strengthens known weak convergence results. We examine the rate of this growth, which we show to be linear by applying a modification of the subadditivity techniques used by Richardson in his paper "Random growth in a tessellation". In this connection, it is relevant to note that the biased voter model may be interpreted as a model for the spread of cancer cells where recovery is permitted. (Received December 11, 1978.)

*765-F2 JOHN C. WIERMAN, University of Minnesota, Minneapolis, Minnesota 55455. First-passage percolation on the square lattice. Preliminary report.

A percolation process is a mathematical model of the random spread of a fluid through a medium, where the random mechanism governing the spread of fluid is ascribed to the medium rather than the fluid itself. Modelling the medium by a graphical lattice, a random variable may be assigned to each bond of the lattice to represent the time required for fluid to travel the bond. For two fixed sites there then exists a minimum travel time over all connected paths between the sites, called the first-passage time. The theory of first-passage percolation studies the properties of first-passage times, specifically the asymptotic behavior as the separation of sites tends to infinity. Recent developments in the theory of first-passage percolation will be discussed, including the topics of integrability of first-passage times, the length of the optimal path, and asymptotic behavior of first-passage times when the travel time for a single bond has infinite mean. (Received December 19, 1978.)

*765-F3 Richard S. Ellis, University of Massachusetts, Amherst, Massachusetts 01003. The Asymptotics of Certain Random Fields Defined on a Circle. Preliminary report.

For each $n \in \{1,2,\ldots\}$, dependent random variables $\{X_i^{(n)};\ i=1,\ldots,n\}$ are defined which represent the strengths of magnetic spins located at sites $\{i/n;\ i=1,\ldots,n\}$ on a circle of fixed circumference one. The random variables define a model of a magnet on a subset of the circle which becomes dense as $n \to \infty$, yielding a random field. Let $S_n = \sum_{i=1}^{n} X_i^{(n)}$. The asymptotic behavior of S_n as $n \to \infty$ depends crucially upon the critical points of a so-called free energy functional f defined on a Sobolev space. Depending upon the structure of the set on which f achieves its global minimum, S_n may not satisfy the law of large numbers or the central limit theorem, but rather other explicitly given limit laws. By means of conditioning, the fluctuations of S_n about a function which gives a local minimum of f is determined. This work is being done jointly with Jay Rosen. (Received January 8, 1979.)

765-F4 Gregory F. Lawler, Princeton University, Princeton, NJ 08540, A Self-Avoiding Random Walk. Preliminary report.

A self-avoiding random walk is defined on the integer lattice Z^d $(d \geq 3)$ by erasing loops from the paths of simple random walk. For $d \geq 5$, this process is shown to have the same limiting behavior as the simple random walk, i.e., properly normalized the process approaches the d-dimensional Wiener Process. Discussion and partial results for the $d = 4$ case are given. Techniques of non-standard analysis are used in the proofs. (Received January 15, 1979.)

*765-F5 STEPHEN JAMES WOLFE, University of Delaware, Newark, DE 19711. On a continuous analogue of the stochastic difference equation $X_n = \rho X_{n-1} + B_n$

Let $B_1, B_2, \ldots$ be a sequence of independent, identically distributed random variables, let X_0 be a random variable that is independent of B_n for $n \geq 1$, let ρ be a constant such that $0 < \rho < 1$ and let $X_1, X_2, \ldots$ be another sequence of random variables that are defined recursively by the relationships $X_n = \rho X_{n-1} + B_n$. It can be shown that the sequence of random variables $X_1, X_2, \ldots$ converges in law to a random variable X if and only if $E[\log^+ |B_1|] < \infty$.

In this paper we let $\{B(t): 0 \leq t < \infty\}$. be a stochastic process with independent, homogeneous increments and define another stochastic process $\{X(t): 0 \leq t < \infty\}$ that stands in the same relationship to the stochastic process $\{B(t): 0 \leq t < \infty\}$ as the sequence of random variables $X_1, X_2, \ldots$ stands to $B_1, B_2, \ldots$. It is shown that $X(t)$ converges in law to a random variable X as $t \to +\infty$ if and only if $E[\log^+|B(1)|] < \infty$ in which case X has a distribution function of class L. Several other related results are obtained. (Received January 22, 1979.)

*765-F6 Janos Galambos, Temple University, Philadelphia, Pa. 19122. Limit Theorems with Random Sample Sizes. Preliminary report.

In limit theorems with constant sample size, a centering (usually at expectations) has no effect on the generality of a result. However, if the sample size itself is a random variable, a random sum of centered terms may have a completely different limiting distribution from the one that we would obtain without centering (see the author's paper Math. Proc. Cambridge Philos. Soc. 79 (1976), 531-532). In particular, the asymptotic normality of $(X_1+\ldots+X_{N(n)})/b_n$, where $N(n)$ is a random variable and the X_j are i.i.d., as guaranteed by a theorem of F.J. Anscombe (Proc. Cambridge Philos. Soc. 48 (1952), 600-607), may merely be due to the assumption $E(X_1) = 0$. The aim of the present paper is to give some initial results on the possible limit laws for $(X_1+\ldots+X_{N(n)}-a_n)/b_n$ and to compare $X_1+\ldots+X_{N(n)}$ with $\max(X_1,\ldots,X_{N(n)})$ when $E(X_1) > 0$. For a general result on $\max(X_1,\ldots,X_{N(n)})$, see Chapter 6 in the author's book "The Asymptotic Theory of Extreme Order Statistics" (Wiley, New York, 1978). (Received January 25, 1979.)

*765-F7 R.D.S. Wenocur, Drexel University, Philadelphia, Pennsylvania 19104. Waiting times related to order statistics.

Both K. Sarkadi and D. Morgenstern discuss the relationship between exceedances of order statistics from a continuous parent and a specific univariate Pólya distribution. In this paper, the applicability of a multivariate Pólya scheme to problems involving order statistics is demonstrated, and other appropriate urn models are examined; finally, these models are utilized in an analysis of waiting times related to order statistics. Many results derived are valid for small, as well as large, sample size; in addition, asymptotic and almost sure laws are determined. Decompositions of waiting times are examined, and the case of observations made at the points of a Poisson process is considered. (Received January 25, 1979.)

765-F8 E. B. DYNKIN, Department of Mathematics, Cornell University, Ithaca, New York 14853. Markov processes and random fields.

• A Gaussian random field is associated with each time reversible Markov process. (The free Euclidean field of quantum field theory corresponds to Brownian motion.) Additive functionals of the process form a natural index space for the field. Markov property of the field can be described in terms of hitting times of the process. The Dirichlet form of the process can be interpreted as an interaction potential for the field. Additive functionals of the field correspond to k-linear forms of special type on the Dirichlet space. A picture of Gaussian field and its functionals is described in terms of an infinite system of indistinguishable particles whose distribution at each time is given by a Poisson random measure with a density tending to infinity. (Received February 26, 1979.)

765-F9 GEORGE C. PAPANICOLAOU, Courant Institute of Mathematical Sciences, New York University, New York, NY 10012. Properties of some diffusions that arise in the analysis of waves in random media.

The diffusions describe the behavior of the complex-valued wavemode amplitudes as functions of distance from the source. To arrive at this description, several approximations are made (cf. Springer Lecture Notes in Physics, #70 (1977), pp. 153-223) which appear reasonable for some physical problems.

We shall discuss some of the properties of these diffusions and in particular of certain infinite dimensional (measure valued) versions of them. (Received January 25, 1979.)

*765-F10 S.N. ETHIER, Dept. of Stat. & Prob., Michigan State U., E. Lansing, MI 48824 and THOMAS NAGYLAKI, Dept. of Biophysics & Theor. Biol., U. of Chicago, Chicago, IL 60637. Diffusion approximations of Markov chains with two time scales.

For $N = 1,2,\ldots$, let $\{(X^N(k),Y^N(k)),\ k = 0,1,\ldots\}$ be a homogeneous Markov chain in $R^m \times R^n$. Suppose that, asymptotically as $N \to \infty$, the "infinitesimal" covariances and means of $X^N([\cdot/\varepsilon_N])$ are $a_{ij}(x,y)$ and $b_i(x,y)$, and those of $Y^N([\cdot/\delta_N])$ are 0 and $c_\ell(x,y)$. Assume $\lim \delta_N = \lim \varepsilon_N/\delta_N = 0$ and the zero solution of $\dot{y} = c(x,y)$ is globally asymptotically stable. Then, under some technical conditions, it is shown that (i) $X^N([\cdot/\varepsilon_N])$ converges weakly to a diffusion process with coefficients $a_{ij}(x,0)$ and $b_i(x,0)$, and (ii) $Y^N([t/\varepsilon_N]) \to 0$ in probability for every $t > 0$. (The case $\lim \delta_N = \delta_\infty > 0 = \lim \varepsilon_N$ is also treated.) This result was motivated by and is applied to a variety of stochastic models in population genetics. Its proof is based on the discrete-parameter analogue of a generalization of Kurtz's limit theorems for perturbed operator semigroups. (Received January 29, 1979.)

*765-F11 URIEL FRISCH, Div. of Appl. Sci., Harvard University, and CNRS, Observatoire de Nice, France and RUDOLF MORF, Dept. Phys., Harvard University. A nonlinear stochastic ODE as a model of high-frequency intermittency in turbulent flows.

Turbulent velocity signals from e.g. a wind tunnel, processed through a high-pass filter with characteristic frequency Ω, are found to be increasingly non-Gaussian (strong bursts separated by long quiescent periods) as $\Omega \to \infty$. A phenomenological interpretation of this *high frequency intermittency* due to Kraichnan (1967 Phys. Fluids 10, 2080) suggested to us that the simplest model exhibiting this phenomenon is a nonlinear stochastic Langevin equation $\varepsilon\dot{x} = -\gamma x - x^3 + f(t)$ $(\varepsilon,\gamma > 0)$ where $f(t)$ is a band-limited noise; numerically the solutions are indeed found intermittent.

We have shown that this intermittency is related to the singularities (branch points) of the stochastic equation in the complex time domain. The location of the singularities can be obtained numerically or by singular perturbation of the stochastic algebraic equation $(\varepsilon = 0)$. From the distribution of singularities the high-frequency behavior of the spectrum and cumulants of the solutions can be calculated. (Received February 1, 1979.) (Author introduced by Professor Harry Kesten).

*765-F12 CHARLES M. NEWMAN, University of Arizona, Tucson, Arizona 85721 (on leave from Indiana University, Bloomington, Indiana 47401). Self-similar random fields in mathematical physics.

We consider "self-similar" (generalized) random fields $\{\phi(r);r\in\mathbb{R}^d\}$ which arise as scaling limits in statistical mechanics and quantum field models with $d \geq 2$. Except for certain critical values of the model parameters, ϕ is a multidimensional white noise. In the physically interesting critical case, $\mathrm{Cov}(\phi(r),\phi(s)) = \text{Const.}\ |r - s|^{-(d-2+\eta)}$ with $\eta \in [0,2)$. If $\eta = 0$, then ϕ is Gaussian (this is believed to be the case when $d \geq 4$). If $\eta > 0$, then under appropriate assumptions $X \equiv \int_{\text{cube}} \phi(r)dr$ can be shown to have a non-Gaussian tail: $P(X \geq x) \leq \exp(-\text{const.}\ x^q)$ for $x > 0$, with $q = 2d/(d - 2 + \eta) \in (2,2d/(d - 2))$. (Received February 2, 1979.)

765-F13 MURAD S. TAQQU, Cornell University, Ithaca, New York 14853. Renormalization group transformation and the central limit theorem.

The renormalization group transformation T acts on probability laws P of stationary sequences, as follows: for given $N \geq 1$, $T^N P$ is the probability law of a new sequence obtained by summing N contiguous random variables of the original sequence and renormalizing that sum by an adequate power of N. $\tilde{P}$ is a fixed point of the transformation T if $T\tilde{P} = \tilde{P}$.

The weak limit of $T^N P$, $N \to \infty$ yields a fixed point $\tilde{P}$ of T. The study of the weak limit of $T^N P$ can be reformulated in terms of a central limit theorem, by rescaling the labeling parameter of the sequence. Non-Gaussian fixed points of the transformation T are of particular interest. A non-Gaussian fixed point can arise as limit of $T^N P$, when P is the probability law of a stationary sequence with long-range dependence. (Received February 2, 1979.)

*765-F14 FRANK J. WANG, University of Montana, Missoula, Montana 59812. The convergence of a branching Brownian motion used as a model describing the spread of an epidemic.

A supercritical position-dependent Markov birth and death Brownian motion is used as an approximation to a model describing the initial geographical spread of an epidemic. The individuals that move in R^2 according to independent Brownian motions with diffusion coefficient σ^2 reproduce according to a birth and death process with birth and death rate λ and μ respectively. Let $\alpha = \pi\int_0^\infty r^3 h(r)dr$ and $\beta = \sigma^2 + \lambda\alpha$ where $h(r)/\lambda$ is the p.d.f. of the distance of the new individual from the parent. Let $Z(D, t)$ be the number of individuals in the set D at time t and $\sqrt{\beta t}\, D = \{\sqrt{\beta t}\, x: x \in D\}$. The almost everywhere convergence of the random variables $\exp\{-(\lambda-\mu)t\}\ Z(\sqrt{\beta t}\, D, t)$ to a limit random variable $W(D)$ is established. (Received January 29, 1979.)

*765-F15 LEONARD GROSS, Cornell University, Ithaca, N.Y. 14853. Decay of correlations in classical statistical mechanical lattice models.

A random field on Z^d with compact state space X arises naturally in statistical mechanical lattice models as a Gibbs state of a potential. A potential φ is a real valued function on UX^Λ, the union running over all non empty finite subsets Λ of Z^d. Assume φ is translation invariant and entails finite energy per site. According to folklore (abetted by theorems in various special cases) the pair correlation for a Gibbs state behaves asymptotically at large distances like the potential φ when φ is small. This can be made somewhat more precise as follows. Let $\zeta(a) = \sup_s |\Sigma_{\Lambda \supset \{0,a\}} \varphi(s|\Lambda)| e^{d(0,a)}$ where d is a translation invariant semi-metric on Z^d. Let $\psi(a) = |E(f(s_0)g(s_a)) - E(f(s_0))E(g(s_a))| e^{d(0,a)}$ for f and g in $C(X)$. If φ is sufficiently "small" then $\Sigma_a \zeta(a) < \infty$ implies $\Sigma_a \psi(a) < \infty$. (Received February 8, 1979.)

765-F16 DAVID ISAACSON and SANDY ZABELL, Rutgers University, New Brunswick, New Jersey 08903. Scaling Limits and Weak Convergence. Preliminary report.

The Gibbs measure for the one-dimensional Ising model gives rise to a random element in $D(R)$ which suitably scaled converges weakly to the symmetric Bernoulli process $\{b_t, t \in R\}$. A special case of the scaling limit conjecture of Glimm and Jaffe states that in the scaling limit the moments of the φ_1^4 Markov process converge to the moments of $\{b_t\}$, and was proved in [1]. The extension of this result to weak convergence in $D(R)$ is discussed.

[1] Isaacson, D. The critical behavior of φ_1^4. Commun. Math. Phys. 53 (1977), 257-275.

(Received February 8, 1979.)

*765-F17 FRANCINE ABELES, Kean College of New Jersey, Union, New Jersey 07083. Ranking by inversion: A note on C. L. Dodgson.

Between 1873 and 1876, C. L. Dodgson (Lewis Carroll) published three pamphlets on procedures to govern elections in which he studied the problem of cyclical majorities. It can be shown that his inversion approach predates by about ninety years a maximum likelihood model for weak stochastic order developed by Thompson and Remage (Ann. Math. Stat. 35(1964), 739-747). This model generalizes Slater's nearest adjoining order as a method of achieving a best order. (Received February 8, 1979.)

765-F18 WOJBOR A. WOYCZYNSKI, Cleveland State University, Cleveland, Ohio 44115. Rate of convergence in the weak law of large numbers in Banach spaces. Preliminary report.

We show how various differentiability properties of the norm in a Banach space E influence the rate of convergence in the weak law of large numbers for independent identically distributed random vectors with values in E. This complements earlier work by J. Kuelbs on the rate of convergence in the central limit theorem in spaces with twice differentiable norm. (Received February 8, 1979.)

*765-F19 PHILIP FEINSILVER, Southern Illinois University, Carbondale, Illinois 62901. An Analytic Approach to Multivariate Probability Distributions.

We present a method for classifying certain probability distributions p(dx) on R^N. Consider $L(z)=\log \phi(z)$, where $\phi(z)$ is the moment generating function of p(dx), $z \in C^N$, and $e(x,z)=\exp(xz - L(z))$. Assume e(x,z), analytic in z, has an expansion with coefficients that form a system of orthogonal polynomials relative to p. One can show that L must satisfy a system of PDE's of a particular type. The distributions corresponding to the L's obtained are natural generalizations of the familiar Gaussian, Poisson, gamma and Bernoulli distribution of R^1. Some of the theory of the associated orthogonal polynomials will be mentioned. (Received February 12, 1979.) (Author introduced by Professor Harry Kesten).

*765-F20 R. M. DUDLEY, Massachusetts Institute of Technology, Room 2-245, Cambridge, Massachusetts 02139. Empirical measures on Vapnik-Chervonenkis classes.

• Let X be any set, $\mathcal{A}$ a σ-algebra of subsets of X, and P a probability measure on $\mathcal{A}$. Let $X_1, X_2, \ldots,$ be independent X-valued random variables with distribution P. Let P_n be the random empirical probability measure, the sum of masses 1/n at each of $X_1, \ldots, X_n$. Then for each $A \in \mathcal{A}$, $P_n(A) \to P(A)$ with probability 1 as $n \to \infty$; the probability that $n^{1/2}(P_n(A) - P(A)) < t$ converges for all t to a Gaussian probability; and $\lim \sup_{n\to\infty} n^{1/2} |(P_n - P)(A)| / (\log \log n)^{1/2}$ is finite with probability 1. These theorems hold uniformly over certain subclasses $\mathcal{C} \subset \mathcal{A}$. A sufficient condition, due to V. N. Vapnik and A. Ya. Chervonenkis (Theor. Probability Appl., 1971) is that for some n, no set F with n elements has all its subsets of the form $A \cap F$, $A \in \mathcal{C}$. (Received February 26, 1979.)

765-F21 RICHARD GUNDY, Rutgers University, New Brunswick, New Jersey 08903. Recent developments in probability and classical analysis.

• This lecture is a commentary and review of certain recent developments that have enriched both probability theory and harmonic analysis. Included in such a list of developments are: inequalities for the Fourier transform and conjugate function; the use of Brownian motion and martingales in one and several complex variables; probabilistic aspects of the Hardy classes; some new results in the geometry of Banach spaces. (Received February 27, 1979.)

Topology (22, 54, 55, 57, 58)

*765-G1 JOHN F. BERGLUND, Virginia Commonwealth University, Richmond, Virginia 23284. Problems about Semitopological Semigroups.

Several open questions in the theory of compact semitopological (separately continuous multiplication) semigroups are discussed. Some of the problems are analogous to questions originally raised for topological (jointly continuous multiplication) semigroups (e.g., "Is a compact irreducible semigroup Abelian?"), while others would be trivial in that context (e.g., "Is the set of idempotents closed in a compact monothetic semigroup?"). Most of the well-known problems about compact topological semigroups (Wallace, Bulletin A.M.S. 68(1962), 447-448; Hofmann and Mostert, *Semigroups* (Folley, ed., 1969), 85-100) continue to be interesting, and unsolved, in the semitopological setting. (Received January 18, 1979.)

765-G2 J. F. Jardine, University of British Columbia, Vancouver, B.C., Canada. Algebraic Homotopy Theory. Preliminary report.

Let $\mathcal{S}$ = simplicial sets, R = an arbitrary unique factorization domain, $\mathcal{A}$ = the category of commutative R-algebras, and pro$\mathcal{A}$ = the pro-category corresponding to $\mathcal{A}$. It is shown that the natural map $\eta : K \longrightarrow F^0A^0K$ corresponding to the adjoint pair $A^0 : \mathcal{S} \longrightarrow \mathcal{A}$, $F^0 : \mathcal{A} \longrightarrow \mathcal{S}$ is not a weak equivalence in general if R is a finite field, thus answering a question of Kan and Miller. It is shown that there is an adjoint pair $\hat{A} : \mathcal{S} \longrightarrow$ pro$\mathcal{A}$ and $\hat{F}$: pro$\mathcal{A} \longrightarrow \mathcal{S}$ which is closely related to A^0 and F^0 respectively, together with a closed model structure on pro$\mathcal{A}$ such that $\hat{A}$ and $\hat{F}$ induce an equivalence of the associated homotopy categories Ho(pro$\mathcal{A}$) and Ho($\mathcal{S}$), where $\mathcal{S}$ is a closed model category in the usual way. (Received January 29, 1979.)

765-G3 P.T. CHURCH, Syracuse University, Syracuse, NY 13210 and J.G. TIMOURIAN, University of Alberta, Edmonton T6G 2G1, Alberta, Canada. Deficient points of discrete maps on manifolds.

Let M^n and N^n be connected, oriented n-manifolds without boundary, and let f: $M^n \to N^n$ be a proper continuous function with degree deg f $\neq$ 0. A point y $\in N^n$ is called deficient (resp., componentwise deficient) if the number of points (resp., components) of $f^{-1}(y)$ is less than $|\deg f|$. Let Δ_f (resp., D_f) be the set of deficient (resp., componentwise deficient) points. According to a theorem of Hopf, Δ_f is discrete for n=2, and Shepardson showed that D_f is also discrete for n=2. For arbitrary dimension n questions about the character of Δ_f were raised by Hopf and by Hocking and Young (Topology, p.270). Honkapohja showed that the non-deficient points are dense in N^n; thus dim $\Delta_f \leq n - 1$. On the other hand, Wilson's examples of monotone maps f: $S^3 \to S^3$ of arbitrary degree show that D_f may equal N^n for $n \geq 3$. The authors prove the following results: Theorem: Δ_f contains no closed subset of dimension n - 1. Theorem. If f is discrete (i.e. each $f^{-1}(y)$ is discrete), then dim $\bar{\Delta}_f \leq n - 2$. (Received January 29, 1979.)

*765-G4 H.D. JUNGHENN and BAO T. LERNER, The George Washington University, Wash. D.C 20052. Algebras of functions on semidirect products of semigroups.

Let S and T be semitopological semigroups with identities and $X = S \textcircled{\rtimes} T$ a semidirect product. In this report we determine the structure of semigroup compactifications X^F of X for translation invariant left m-introverted sub-C* algebras F of C(X) with identity. Our results are partial generalizations of work (to appear in Rocky Mountain J. of Math.) of the first author on compactifications of direct products of semigroups.

Theorem. Let $G = \{f(\cdot,1) : f \in F\} \subset AP(S)$ and $H = \{f(1,\cdot) : f \in F\}$. Then X^F is a semidirect product $S^G \textcircled{\rtimes} T^H$ if and only if for each $f \in F$ the functions $(s,t) \to f(s,1)$, $f(1,t)$ are in F and either $f(S,\cdot)$ or $f(\cdot,T)$ is relatively norm compact.

Corollary 1. If T contains a dense subgroup then there exist continuous homomorphic images S' and S* of S^{AP} and S^{SAP}, respectively, such that $X^{AP} = S' \textcircled{\rtimes} T^{AP}$, $X^{SAP} = S^* \textcircled{\rtimes} T^{AP}$, $K(X^{AP}) = K(S') \textcircled{\rtimes} T^{AP}$, and each minimal right ideal of X^{AP} is of the form $eS' \textcircled{\rtimes} T^{AP}$, where $e^2 = e \in K(S')$.

Corollary 2. If S is compact and if τ and multiplication in S are both jointly continuous, then $X^{LUC} = S \textcircled{\rtimes} T^{LUC}$.

An example is given to show that Corollary 1 is false without the subgroup hypothesis. Applications are made to wreath products. (Received February 2, 1979.)

*765-G5 Michael Mihalik, State University of New York at Binghamton, Binghamton, New York 13901, Ends of Fundamental Groups in Shape and Proper Homotopy.

We examine Mittag-Leffler inverse sequences of finitely generated groups such that each bonding homomorphism has finite kernel (termed M-L-F sequences) and their inverse limits (M-L-F groups). We define the number of ends of M-L-F sequences and M-L-F groups (either

0, 1, 2 or ∞) and derive classifications for the 0, 2 and ∞-ended cases. The ∞-ended case generalizes J. Stallings famous theorem on ∞-ended groups. An example of a 2-ended M-L-F group with no normal infinite cyclic subgroup is given. A shape invariant number, either 0, 1, 2 or ∞, is assigned to any compactum whose pro-π_1 sequence is M-L-F.
(Received February 5, 1979.)

*765-G6 JOHN MCCLEARY, Bates College, Lewiston, Maine 04240. On the mod p decompositions of certain spaces.

In these Notices 26 (1979), A-126, the author introduced an obstruction theory which provides a procedure to decide when a homomorphism between mod p cohomology algebras is realizable by a mapping between spaces of the kind Y, where $H^*(Y;Z_p) = U(M)$. (M here is an unstable module over the Steenrod algebra and U() is the free unstable algebra functor.) This method can be applied to obtain conditions on a space under which the mod p homotopy type of the space is determined by its cohomology. Examples of such spaces include simply-connected Lie groups, many mod p H-spaces and a few homogeneous spaces. (Received February 5, 1979.)

765-G7 C. A. McGibbon, University of Pennsylvania, Philadelphia, PA 19104
Multiplicative Properties of Power Maps. Preliminary Report.

Let (X,μ) be a connected, finite, homotopy associative H-complex. A theorem of Arkowitz and Curjel [Topology 6(1967), 137-148] states that there is an integer N such that the power map: $x \to x^\lambda$, $x \in X$, $\lambda \in \mathbb{Z}$ is an H-map if $\lambda \equiv 0 \bmod N$. We improve this result by showing

Theorem. There is a number $N = N(X,\mu)$ such that the power map $x \to x^\lambda$ is an H-map iff $\lambda(\lambda-1) \equiv 0 \bmod N$.

This characterization was previously known to Arkowitz and Curjel (Ibid) in the case when X is a sphere.

We then investigate these numbers N for loop multiplications on the spaces $S^3 \times S^p$, $S^3 \times S^{2p-3}$, $B_1(p)$, SU(3) and Sp(2) localized at various odd primes.
(Received February 5, 1979.)

WITHDRAWN

*765-G9 PAUL MILNES, The University of Western Ontario, London, Canada N6A 5B9. Continuity properties of compact right topological groups.

If one takes a distal function f on a group G, the associated enveloping semigroup G_f of G is a compact right topological group containing a continuous homomorphic image G' of G as a dense subset. Theorem. The following are equivalent: (i) f is almost periodic. (ii) G_f is metrizable. (iii) G' is a totally bounded topological group. (iv) The right translations $\{R_A \mid A \in G_f\}$ form an equicontinuous family of maps from G_f into G_f. (v) Inversion in G_f is continuous.

Examples and related material are discussed. (Received February 5, 1979.)

*765-G10 Ross Geoghegan, Institute for Advanced Study, Princeton, New Jersey 08540. Splitting homotopy idempotents which have essential fixed points.

Let X be a finite connected complex and $f : X \to X$ a homotopy idempotent, i.e. $f \simeq f^2$. An open question of geometrical interest is: must f split?, i.e. are there a (possibly infinite) complex K and maps $X \underset{u}{\overset{d}{\rightleftarrows}} K$ such that $d \circ u \simeq 1$ and $u \circ d \simeq f$? The problem is known to lie in the fundamental group: f splits iff $\varprojlim^1 \{\pi_1(X, *) \xleftarrow{f_\#} \pi_1(X, *) \xleftarrow{f_\#} \ldots\}$ is trivial; f splits iff π_1 (mapping torus of f) is a semi-direct product $[f_\#\pi_1(X)] \times_{f_\#} \mathbb{Z}$. It is known that f need not split when X is allowed to be infinite-dimensional, and that for any unsplittable f some very precise conditions must hold on the homomorphism $f_\# : \pi_1(X, *) \to \pi_1(X, *)$. In this "special session" talk, I will discuss the fixed point theory of a homotopy idempotent for a finite complex X. When f has non-zero Nielsen number (this includes the case of non-zero Lefschetz number) we can derive other fundamental group information, and thereby (in certain cases) rule out unsplittability - i.e. show that f splits. (Received February 5, 1979.)

765-G11 GEORGE GRAHAM, University of Houston, Houston, Texas 77004. The Local Lie Group Embeddability of Certain Local C^∞ Monoids. Preliminary Report.

C^∞ differentiability is defined intrinsically for functions with domain a subset of R^n having dense interior, i.e. without presuming the existence of a differentiable extension of the function. Theorem Let S be a local monoid with underlying space a subset of R^n having dense interior such that the operation is C^∞. Then S is locally embeddable in a local Lie group. Some consequences of the theorem and a sketch of its proof will be given. (Received February 5, 1979.)

*765-G12 Steven C. Ferry, Institute for Advanced Study, Princeton, New Jersey 08540. The converse of the Vietoris-Smale theorem and strong shape theory.

Theorem 1. If $f : K \to L$ is an r-connected map between finite polyhedra, then there exists a regular neighborhood N(K) of K in some high-dimensional Euclidean space and a surjection $f' : N(K) \to L$ with (r-1)-connected point inverses so that $f' | K \simeq f$. (This is the converse of a theorem of Smale.)

Theorem 2. If X is a UV' compactum, then there is a compactum X' shape equivalent to X such that for any finite polyhedron K there is a one-to-one correspondence between strong shape morphisms $K \to X'$ and homotopy classes of maps $K \to K'$.

Theorem 2 is proved by applying a generalization of Theorem 1 to the bonding maps of an inverse system with inverse limit X. (Received February 5, 1979.)

*765-G13 Gerianne M. Krause, Illinois Institute of Technology, Chicago, Illinois 60616. On a theorem of Ling concerning representation of associative functions. Preliminary report.

Theorem: Let $F: A \times A \to A$, where $A = [a,d]$ is a closed interval of the extended real line, such that

(i) $F(x,y)$ is associative; i.e. $F(F(x,y),z) = F(x,F(y,z))$

(ii) $F(a,x) = a$ for all $x \in A$; $F(d,x) = x$ for all $x \in A$

(iii) $\delta(x) < x$ for all $x \in (a,d)$ where $\delta(x) \equiv F(x,x)$

(iv) $F(x,y)$ in non-decreasing in each place

(v) $\delta(x)$ is continuous on $[a,d)$

(vi) $F(x,y)$ is uniformly continuous in some ϵ-neighborhood of $(a,d) \times \{d\}$

Then $F(x,y)=g(f(x)+f(y))$ where f is some increasing continuous function and g is its pseudo-inverse.

This result improves on a theorem of C.H. Ling [Publicationes Mathematicae Debrecen 12 (1965) pp. 181-212] which assumed $F(x,y)$ to be continuous on the entire domain of F. (Received February 6,1979.)

765-G14 RUSSELL REMAGE, University of Delaware, Newark, DE 19711
On pointwise recurrent locally compact totally disconnected semigroups.

If A is a subset of a topological semigroup S, $\theta(A) = A \cup A^2 \cup \ldots$, $\Gamma(A) = \theta(A)^*$, if $s \in S$, $\Gamma(x) = \{x, x^2, \ldots\}^*$. S is recurrent at $s \in S$ if $s \in \{s^2, s^3, \ldots\}^*$, and pointwise recurrent if S is recurrent at each $s \in S$. Concerning questions raised by Day (Semigroup Forum 10), we have the following results: (1) If S is a locally compact totally disconnected semigroup recurrent at s, then $\Gamma(s)$ is compact, hence a group. (2) If A is a compact open subset of a locally compact totally disconnected pointwise recurrent abelian semigroup S, then for some positive integer m, $\theta(A) = A \cup A^2 \cup \ldots \cup A^m$. (Received February 7, 1979.)

*765-G15 Wayne Lewis, Texas Tech University, Lubbock, Texas 79409. Dimension of Hyperspaces of Hereditarily Indecomposable Continua.

Eberhart and Nadler have shown that every hereditarily indecomposable continuum has a hyperspace of dimension either two or infinity. Every planar hereditarily indecomposable continuum (as well as every other standard one-dimensional example) has a two-dimensional hyperspace.

We prove that every hereditarily indecomposable continuum is the image under an open, monotone map of a one-dimensional hereditarily indecomposable continuum. Thus there also exist one-dimensional hereditarily indecomposable continua with infinite-dimensional hyperspaces. (Received February 8, 1979.)

*765-G16 Winston Crawley, Shippensburg State College, Shippensburg, Pennsylvania 17257. Epimorphisms and semilattices of semigroups.

Given a category D of [compact] semilattices and a category C of [compact] semigroups, one can form a category A whose objects are certain functors on D-objects into C. We establish conditions under which A inherits certain separation properties (relating to the epimorphism question) from D and C. For appropriate choices of D and C, the category A becomes equivalent to known categories of [compact] semigroups. In these cases we are able to settle the epimorphism question for the equivalent category. Some examples are given, including the category of compact inverse Clifford semigroups with Lawson idempotents and a certain category of compact normal bands of groups. (Received February 8, 1979.)

*765-G17 R. Venkataraman, University of Manitoba, Winnipeg, Canada, R3T 2N2. Pontryagin duality of topological semigroups.

Let S be an abelian Hausdorff topological semigroup with identity and $S^\wedge$ the topological semigroup of all semicharacters of S endowed with pointwise multiplication and the compact open topology. Let ϵ be a fixed real number such that $0 < \epsilon < 1$. Let e be an idempotent of S. If U is a subset of S, let $P(U, \epsilon) = \{f \in S^\wedge \mid \forall\, u \in U, \ |f(u) - f(e)| < \epsilon\}$.
The set U is said to be e-polar if

$$U = \{x \in S \mid |f(x) - f(e)| < \epsilon \ \forall\ f \in P(U, e)\}.$$

It is well known that in order that S satisfy Pontryagin duality the following conditions are necessary:
1) S must have sufficiently many semicharacters
2) S must be a continuous-inverse semigroup. We prove that S must also satisfy:
3) Let e be an idempotent and U a e-polar set such that for every compact set K containing e, $U \cap K$ is a neighbourhood of e relative to K. Then U is a neighbourhood of e in S.
We further show that when S satisfies 1), 2), 3) above, the canonical map from S to $S^{\wedge\wedge}$ is a continuous monomorphism. (Received February 8, 1979.)

765-G18 KARL.H.HOFMANN and JIMMIE D.LAWSON, Tulane University,New Orleans,La.70118 and LSU,Baton Rouge La.70803. Lie semigroups in Lie groups. Preliminary report.

A Lie subsemigroup of a Lie group is a subsemigroup generated by its one parameter subsemigroups, and which are closed in the Lie group topology of the analytic subgroup they generate.We develop a local theory by associating with a Lie semigroup the convex cone of its infinitesimal generators and study its algebraic properties inside the Lie algebra.The maximal subgroups of a Lie semigroup and the subgroup generated by it are characterized by the maximal subvector space contained in the infinitesimal cone and by the subalgebra generated by it, respectively. If the latter is nilpotent, then the former is an ideal, and so the maximal subgroup is normal in this case.Counterexamples are given for the solvable case. Various examples illustrate the pathologies which may occur. Some of these examples occur in semisimple Lie groups. (Received February 8, 1979.)

*765-G19 S. J. LOMONACO, JR., State University of New York at Albany, Albany, New York 12222. How to compute the algebraic 3-type of 2-knots.

Let X be the complement of a smooth (or locally flat PL) 2-knot. A method is given for computing the algebraic 3-type of X, i.e., the fundamental group $\pi_1 X$, the second homotopy group $\pi_2 X$ as a $\pi_1 X$-module, and the k-invariant lying in the third cohomology group $H^3(\pi_1 X, \pi_2 X)$. Various examples and theorems are given.(Received February 9, 1979.)

765-G20 DAVID C. WILSON, University of Florida, Gainesville, Florida 32611. Spaces which are not hereditarily indecomposable. Preliminary report.

A metric continuum X is said to be hereditarily indecomposable if every subcontinuum Y has the property that if $Y = A \cup B$, where A and B are continua, then A or B is equal to Y. A continuum K is unicoherent if however K is written as the union of two subcontinua A and B, then $A \cap B$ is connected.

Theorem 1. Let M_i be a closed connected triangulated and orientable n-manifold for $i = 1,2,\ldots$. Let $f_i : M_i \to M_{i-1}$ be continuous with non-zero degree. If each M_i is unicoherent and $X = \lim_{\leftarrow i} \{M_i, f_i\}$, then X is not hereditarily indecomposable.

Theorem 2. Let S be a closed connected orientable surface. If $X = \lim_{\leftarrow i} \{S_i, f_i\}$ where $S_i = S$ and deg $f_i \neq 0$ for all i, then X is not hereditarily indecomposable.

(Received February 16, 1979.)

765-G21 David C. Royster, University of Virginia, Charlottesville, Va. 22903.

Involutions fixing the disjoint union of a point and a real projective space. Preliminary report.

Let T be a smooth involution on the smooth closed manifold V^k and let $F_T(V^k)$ be its fixed point set. Let τ_0 be the involution on $RP(m)$ given by multiplying by -1 in one

of the homogeneous coordinates. THEOREM: (i) If $F_T(V^k) = pt \cup RP(n)$ (disjoint union) with n odd, then $k = n + 1$ and (T,V^k) is equivariantly cobordant to $(\tau_0, RP(n+1))$ in $\mathfrak{N}_*^{\mathbb{Z}_2}$. (In fact, if $F_T(V^k) = pt \cup M^n$, n odd, then $\{T,V^k\}_2 = \tau_0, RP(n+1)\}_2 \mathfrak{N}_{n+1}^{\mathbb{Z}_2}$.) (ii) If $F_T(V^k) = pt \cup RP(n)$, n even, then $\{T,V^k\}_2 = \Gamma^m(\{\tau_0, RP(n+1)\}_2)$ in $\mathfrak{N}_*^{\mathbb{Z}_2}$ where $m \geq 0$, and at least $m = 0$ and $m = 1$ occur. (Received February 16, 1979.)

*765-G22 Douglas S. Meadows, University of Rochester, Rochester, NY 14627. Some Groups of PL Self-Knottings.

In any of the categories TOP, PL, or DIFF an isomorphism $\phi: M \to M$ on a manifold is called a self-knotting if ϕ is homotopic to but not isotopic (in the category) to the identity on M. Using the coarser (but in some respects more relevant) equivalence relation of concordance (pseudo-isotopy) we define the self-knotting group of the manifold $SK_{CAT}(M)$. Our results in the PL category are a complete determination of $SK_{PL}(\partial V)$ where V is a disc bundle over a low (≤ 6) dimensional sphere with explicit constructions when the base sphere is S^2. We relate these groups to the classification of PL manifolds within a given homotopy type. (Received February 19, 1979.) (Author introduced by Professor David Prill).

765-G23 STEWART M. ROBINSON, The Cleveland State University, Cleveland, Ohio 44115. A theorem on separation is equivalent to the Axiom of Choice. Preliminary Report.

In their paper, Separation axioms between t_0 and t_i, [Indag. Math 23(1962)] Aull and Thron asked if there is a separation axiom weaker than t_1 which when combined with normality implies t_4. Robinson and Wu [Journal of the Australian Math. Society, Vol IX, 1969] defined a strong to point to be a point, x, whose derived set is either empty or is the union of non-empty closed sets, such that the intersection of these closed sets is empty and at least one of them is compact. They proved (assuming the Axiom of Choice) that in a normal space, every strong to point has an empty derived set.

In this note we prove that the assumption that normality implies each strong to point has an empty derived set implies the Axiom of Choice. (Received February 19, 1979.)

765-G24 RICHARD F. GUSTAFSON, SUNY College at Oneonta, Oneonta, New York 13820. A Simple Genus One Knot with Incompressible Spanning Surfaces of Arbitrarily High Genus. Preliminary report.

It has been shown by H. C. Lyon that there exists a genus one knot which has incompressible surfaces of arbitrarily high genus. Lyon's knot has companions and the companions are essential to his discussion. Presented in this paper is a knot of genus one which is shown to have no companions (is simple) but which has incompressible spanning surfaces of arbitrarily high genus. (Received February 20, 1979.)

*765-G25 D. G. Hartig, U. S. Naval Academy, Annapolis, Maryland, 21402. A Banach space characterization of local connectedness. Preliminary report.

The property of local connectedness in a topological space X has been characterized using the algebraic and/or order properties of the space C(X) of continuous scalar-valued functions on X (Proc. AMS 68, 1978). In this paper we discuss a Banach space characterization of this topological property. (Received February 20, 1979.)

*765-G26 JOHN J. WALSH, University of Tennessee, Knoxville, Tennessee 37916. A disjoint 2-disk characterization of Q-manifolds. Preliminary report.

Consider the following conditions on a locally compact space X: 1) X has the disjoint 2-disk property; 2) finite dimensional 1-LCC closed subsets of X are Z-sets; 3) for each n, there is a k so that each $f:I^n \to X$ can be approximated by $f':I^n \to X$ with $\dim f'(I^n) \leq k$. Theorem. An ANR which satisfies 1, 2, and 3 is a Q-manifold. It is hoped that 1 and 2 suffice to insure that an ANR is a Q-manifold; however, if there exists certain types of light mappings from Q onto Q, then there are ANR's which satisfy 1 and 2 but not 3. The precise nature of these mappings will be discussed. (Received February 22, 1979.)

765-G27 T. BENNY RUSHING, University of Utah, Salt Lake City, Utah 84112, A characterization of inverse limits of n-disk bundle maps. Preliminary report.

Theorem. A map $p: E \to B$ between finite dimensional metric compacta is a CE-map if and only if for some n it is the inverse limit of n-disk bundle maps.

The theorem fails in infinite dimensions, i.e., not every CE-map is the inverse limit of Q bundle maps (Q = Hilbert cube). The following are the key steps in the proof: First, p is shown to be the inverse limit of (particularly nice) microbundle projections. Then, a technique of J. M. Kister (Microbundles are Fibre Bundles) is applied to this setting to show that p is the inverse limit of n-euclidean bundles. Finally, the n-euclidean bundles are adjusted so as to contain 'large' n-disk bundles and the theorem results. (Received February 23, 1979.)

765-G28 AVNER ASH, Columbia University, New York, New York, 10027. Cohomology of congruence subgroups of $SL(3,\mathbb{Z})$. Preliminary Report.

Two geometric methods are presented for computing the cohomology of a subgroup Γ of finite index in $SL(3,\mathbb{Z})$. The first, originally due to Soule, constructs a finite cell complex whose cohomology equals that of Γ. The second generalizes the modular symbol for groups acting on the upper half-plane to our case. The connection between the two is shown. This approach can be applied to finding a Hecke-invariant complement in $H^3(\Gamma,\mathbb{R})$ to the subspace of cohomology classes representable by differential forms with compact support on $\Gamma \backslash SL(3,\mathbb{R})/SO(3,\mathbb{R})$. Application to the study of the symmetric-squares map of Jacquet-Gelbart is envisioned. (Received February 23, 1979.)

765-G29 LOUIS F. McAULEY, Institute for Advanced Study, Princeton, NJ 08540, and EDYTHE P. WOODRUFF, Trenton State College, Trenton, NJ. Certain point-like decompositions of E^3 with 1-dimensional images of non-degenerate elements.

We answer the following questions in the affirmative:

1. (Starbird) Does there exist a point-like usc decomposition G of E^3 such that (1) P(H) has dimension 1, (2) $E^3/G \not\cong E^3$, and (3) if $H' \subset H$, P(H') has dimension 0, and G is an usc decomposition of E^3 whose collection of non-degenerate elements is H', then $E^3/G' \cong E^3$?

2. (Daverman) Does there exist an usc decomposition G of E^3 such that (a) each element of H is a simple arc, (b) H* is a 2-cell, (c) H is a continuous collection, (d) $E^3/G \not\cong E^3$, (e) P(H) has dimension 1, and (f) if $H' \subset H$ and P(H') has dimension 0, then $E^3/G' \cong E^3$ where H' is the collection of non-degenerate elements of the usc decomposition G'? (Received February 26, 1979.)

*765-G30 ERIC E. ROBINSON, Ithaca College, Ithaca, New York 14850. Inverse systems for light-open mappings onto polyhedra.

A characterization of light-open mappings from Peano spaces to polyhedra is given in terms of inverse systems. This is used to prove that under certain conditions the action of a compact totally-disconnected transformation group on a Peano space reduces to the study of inverse systems of finite

group actions with the same orbit space. Using this characterization, it is shown that if a compact infinite totally-disconnected transformation group acts freely on a Peano space, then the orbit space is not a polyhedron. A theorem of Armstrong relating the structure of a discontinuous group action to the fundamental group of the orbit is also generalized. (Received February 26, 1979.)

765-G31 MICHAEL STARBIRD, The Institute for Advanced Study, Princeton, New Jersey 08540. Pushing shrinkable decompositions into non-shrinkable ones. Preliminary report.

There exist decompositions G of S^3 with a null sequence of cellular non-degenerate elements so that (i) S^3/G is homeomorphic to S^3; (ii) there is a pseudo-isotopy h_t ($t \in [0,1]$) of S^3 so that $h_0 = id$ and h_1 is a homeomorphism on the union of the non-degenerate elements of G; (iii) for each non-degenerate element g of G, $h_1(g)$ is cellular; (iv) if G' is the decomposition of S^3 the set of whose non-degenerate elements is $\{h_1(g) | g$ is a non-degenerate element of $G\}$, then S^3/G' is not homeomorphic to S^3. For what cellular shrinkable decompositions G do there exist such pseudo-isotopies h_t ($t \in [0,1]$)? (Received February 26, 1979.)

765-G32 Joseph Martin, University of Wyoming, Laramie, Wyoming 82070, and The Pennsylvania State University, University Park, Pa. 16802. Monotone mappings onto manifolds. Preliminary report.

Let B^3 be a 3-cell. There is a subset U of Bd B, so that if M^n is a connected, triangulated, n-manifold, $n \geq 2$, then there is a monotone mapping f of $B^3 - U$ onto M^n. In particular, if $p \in M^n$, then $f^{-1}(p)$ is a point or a collapsible 2-complex. (Received February 26, 1979.)

765-G33 John Hollingsworth, University of Georgia, Athens, Georgia 30602. Simple shape theory. Preliminary report.

We report on joint work with Harold M. Hastings. J. H. C. Whitehead's simple homotopy theory was recently extended algebraically by A. Hatcher (higher Whitehead groups) and geometrically by S. Ferry (homotopy equivalent spaces are CE-equivalent). We consider CE-equivalence (in fact, hereditary strong shape equivalence) of strongly shape equivalent compacta, and related questions about higher Whitehead groups of towers of polyhedra.

Proposition 1. Let $f: X \to Y$ be an inclusion and strong shape equivalence. Then f is the limit of a tower of PL expansions. Proposition 2. Let f be as above. Then Σf is simple (factors through hereditary strong shape equivalences and their inverses up to strong shape). Proposition 3. Let $f: S^n \to Y$, $n \neq 1$ be as above. Assume also a retraction $r: Y \to S^n$ which is CE over a point. Then r is simple. An example of Ferry shows that the above hypothesis on r is necessary. (Received February 26, 1979.)

*765-G34 H.H. WICKE and J. M. WORRELL,JR., Ohio University, Athens, Ohio 45701. A covering property which implies isocompactness II.

The authors formulate and study analogues of some covering properties studied in Part I [Abstract 763-54-17, these Notices 26(1979),A-124]. The following theorem is a special case of the main result. Theorem . Suppose X is a space such that for every open cover $\mathcal{H}$ of X there exists a sequence $\langle \mathcal{V}_n : n \in N \rangle$ of open collections such that for each $p \in X$ there exist $n \in N$ and a countable subcollection $\mathcal{K}$ of $\mathcal{H}$ such that p belongs to some element of $\mathcal{V}_n$ and $\{V \in \mathcal{V}_n : p \in V\}$ refines $\mathcal{K}$. Then if X is countably compact, then X is compact. The main result of the paper involves a more generally formulated covering property and is expressed in terms of closed ultrafilters. (Received February 27, 1979.)

765-G35 LOUIS F. MCAULEY, The Institute for Advanced Study, Princeton, New Jersey 08540. Decompositions of E^3.

Suppose that G is an upper semicontinuous decomposition of E^3 and that H is the collection of the nondegenerate elements of G. If H is a countable number of starlike equivalent continua, then E^3/G is homeomorphic to E^3. This answers in the affirmative a question raised by Bean in 1967.) (Received February 27, 1979.)

*765-G36 GERARD A VENEMA, Institute for Advanced Study, Princeton, New Jersey 08540. A new proof of Štanko's approximation theorem.

A new proof is given of the following theorem of M. A. Štanko.

THEOREM. Let X be a compactum in the PL n-manifold M with $\dim X \leq n-3$. For every $\varepsilon > 0$ there exists an embedding $h : X \to M$ such that $d(x,h(x)) < \varepsilon$ for all $x \in X$ and h(X) is a tame compactum.

["h(X) is tame" means that the embedding dimension of h(X) equals the dimension of h(X), or (equivalently for $n \neq 4$) that M-h(X) is uniformly locally simply connected.]

The present proof uses the fact that if $k = \dim X$, then X can be mapped onto k-dimensional polyhedra in M with arbitrarily small maps. Radial engulfing is used to push the polyhedra around. (Received February 27, 1979.)

*765-G37 Joseph A. Neisendorfer, Fordham University, Bronx, New York, 10458. A periodicity map for the homotopy of the 3-sphere. Preliminary report.

Let $S^3\langle 3\rangle$ denote the 3-connected cover of the 3-sphere and suppose that all spaces have been localized at a prime $p > 3$. Then there exists a map $\theta : \Omega^2 S^3\langle 3\rangle \to \Omega^{2p} S^3\langle 3\rangle$ which is a factor of the "2p-2 fold suspension" map $\Omega^2 S^3\langle 3\rangle \to \Omega^2 S^3 \to \Omega^{2p} S^{2p+1}$. The map θ is a periodicity map in the sense that $\theta_*(\alpha_t) = \alpha_{t+1}$ where α_t indicates the well known family of homotopy classes in $\pi_*(S^3)$. (Received February 16, 1979.)

765-G38 PETER FREYD, University of Pennsylvania, Philadelphia, Pennsylvania 19174 and ALEX HELLER, City University of New York, New York, New York 10036. Free-homotopy idempotents.

Suppose X is a connected, pointed CW-complex and f a continuous endomorphism such that f^2 is homotopic to f. Then f splits in the homotopy category: there exist maps g, h such that $f = gh$ and hg is an identity map. If "homotopy" is replaced with "free homotopy" (that is, ignore the base-point) then such is not the case. We construct a group G which must appear as a subgroup of $\pi_1(X)$ whenever X is a counterexample. The class $\mathcal{C}$ of groups that do not contain a copy of G is shown to be large using certain facts about G: G is finitely presented and torsion-free; its commutator subgroup is simple and contains a copy of G; G contains a copy of its own infinite wreath-product. Among the consequences: $\mathcal{C}$ is closed under infinite cartesian product; it contains all residually-torsion groups; it contains all groups whose linear representations are collectively faithful; it contains the extension of any two of its members; it contains all proper group-varieties. As a sample application, the last says that any nontrivial equation $\pi_1(X)$ forces all free-homotopy idempotents on X to split. (Received February 27, 1979.)

Miscellaneous Fields (00, 01, 96–99)

765-H1 Heang Tuy, SUNY at Buffalo, Amherst, N.Y. 14226. A mathematical model in computerized transmission tomography. Preliminary report.

The main mathematical problem in "Computerized Transmission Tomography" is to estimate the density function f reflecting the internal structure of a three-dimensional object from the knowledge of its X-ray projections along a finite number of rays. Essentially the problem is to solve a system of line integral equations $\int_L f = g(L)$ where g(L) can be calculated from the projection data along

the ray L. There are two different approaches: continuous approach and discrete approach. In both approaches, finding f satisfying the projection data and some a-priori knowledge can be reduced to find a common point of convex sets. This point of view allows the derivations of various iterative algorithms estimating f. Some algorithms using Fourier transform,convolution,orthogonal projection on convex sets,quadratic optimization,analytic extension of entire functions,curve fitting methods to estimate f from a full range of views,an incomplete range of views and an incomplete field of views are given. (Received February 26, 1979.)

765-H2 NICHOLAS D. KAZARINOFF, S.U.N.Y. at Buffalo, Buffalo, New York 14214. What Hopf bifurcation analyses may suggest to experimental scientists.

Bifurcation from stable (unstable) steady states to stable (unstable), small amplitude periodic solutions can be analyzed by means of Hopf bifurcation formulae for systems of ordinary, delay, and partial differential equations. Predictions of existence of these solutions may be interesting in themselves. Nonlinear stability analysis can indicate the case of experimental observability of the oscillations and possibly existence of large amplitude oscillations. Where periodic phenomena are symptoms of malfunction, the bifurcation formulae can suggest parameter changes that will suppress the oscillations. Examples will be presented. (Received February 26, 1979.)

*765-H3 F. ALBERTO GRÜNBAUM, University of California, Berkeley, California 94720. Tomographic reconstruction with limited angles of view.

We consider the problem of estimating $f(x,y)$ from its projections $P_\theta f(t)$ for $0 \leq \theta \leq \alpha$. We give an analysis of the performance of some iteration algorithms. We obtain estimates on the number of iterations $N(n,\alpha)$ needed to reconstruct the "first n components of f", and conclude that for a given α only a fixed number of components $n(\alpha)$ can be obtained in practice regardless of the number of iterations and of $f(x,y)$. However for not too small an angle α results appear promising. (Received February 26, 1979.) (Author introduced by Professor J. Feldman).

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

*766-A1 Ira J. Papick, University of Missouri, Columbia, Missouri 65211. When coherent pairs are Noetherian pairs.

For commutative integral domains $R \subseteq T$ (where R is not a field), (R,T) is called a coherent pair (resp. Noetherian pair) if each intermediate domain S, $R \subseteq S \subseteq T$, is coherent (resp. Noetherian). It is proved that if (R,T) is a coherent pair with R Noetherian, then (R,T) is a Noetherian pair. Several corollaries are given, some of which generalize results of Gilmer, Wadsworth, and this author. An especially useful consequence is that if (R,T) is a coherent pair and the quotient fields of R and T are different, then (R,T) is a Noetherian pair. (Received December 7, 1978.)

766-A2 JONATHAN S. GOLAN, Indiana University, Bloomington, Indiana 47401. Pierce sheaves and torsion-theoretic monopresheaves.

R. S. Pierce defined a sheaf of rings over the boolean lattice of all central idempotents of an arbitrary ring and used this construction in his study of commutative regular rings. This construction has since been used by Burgess and Stephenson to study noncommutative rings. We show that for a large class of rings R the Pierce sheaf is the direct image of the monopresheaf of localizations of R at prime torsion theories defined on the category of left R-modules. (Received January 5, 1979.)

*766-A3 JAMES A. HUCKABA, University of Missouri-Columbia, Columbia, Missouri 65211 and
JAMES M. KELLER, University of Missouri-Columbia, Columbia, Missouri 65211. Annihilation of ideals in commutative rings.

A commutative ring R has Property (A) if every finitely generated ideal of R consisting entirely of zero divisors has nonzero annihilator. Theorem 1 shows that all non-trivial graded rings have Property (A). Theorem 2 completely characterizes those reduced rings with Property (A).

Property (A) is closely connected with two other conditions on a reduced ring. One is the annihilator condition (a.c.): If (a,b) is an ideal of R, then there exists $c \in R$ such that $\mathrm{Ann}(a,b) = \mathrm{Ann}(c)$. The other condition is that $\mathrm{MIN}(R)$, the space of minimal prime ideals of R, is compact. Theorem 3 proves that for a reduced coherent ring R Property (A), (a.c.), and the total quotient ring of R being a von Neumann regular ring are equivalent conditions; and that each of these conditions imply that $\mathrm{MIN}(R)$ is compact. (Received January 8, 1979.)

*766-A4 DAVID F. ANDERSON, University of Tennessee, Knoxville, Tennessee 37916 and JACK OHM, Louisiana State University, Baton Rouge, Louisiana 70803. Valuations and semi-valuations of graded domains.

We show how one can define valuations by means of gradings and describe the residue fields of these valuations. These ideas may also be used to construct extensions of a given valuation or semi-valuation. For example, these methods yield the usual constructions for showing that every totally ordered group is a value group and the Kaplansky-Jaffard theorem that every lattice ordered group is the group of divisibility of a Bezout domain. Our main result is that every lexicographic extension of a semi-value group by a totally ordered group is a group of divisibility. (Received January 31, 1979.)

*766-A5 GARY F. BIRKENMEIER, Southeast Missouri State University, Cape Girardeau, Missouri 63701 Baer rings and rings with a minimal direct summand containing the nilpotents.

R denotes an associatative ring with unity. A rt. ideal is reduced if it contains no nonzero nilpotent elements. A rt. ideal X is densely nil (DN) if either X=0, or if X≠0 then for every nonzero $x \in X$ there is some $r \in R$ such that $xr \neq 0$ but $(xr)^2=0$. N is the set of nilpotent elements of R and $\bar{N}$ is the ideal generated by N. THM. Let R be a ring in which the rt. annih. of a reduced rt. ideal is generated by an idempotent. Then $R = A \oplus B$ where B=MDSN and $\bar{N}$ is essential in B. Furthermore, every nonzero ideal $X \subseteq B$ contains nonzero nilpotent elements. CORO. If R is a Baer ring, then $R = A \oplus B$ where B=MDSN and $\bar{N}$ is essential in B. Furthermore, every nonzero ideal $X \subseteq B$ contains nonzero nilpotent elements. This corollary generalizes Prop. 5.7 p. 255 (B. Stenstrom, Rings of Quotients, Springer-Verlag, 1975). THM. Let R be a ring such that each reduced rt. ideal is essential in an idempotent generated rt. ideal. Then $R = A \oplus B$ where B is DN and the MDSN of R, and A is a ring with unity such that each of its reduced rt. ideals is essential in a direct summand of A. This theorem generalizes results of L. Jeremy (Canad. Math. Bull. 17 (1974), 217-228). (Received February 5, 1979.)

766-A6 JOHN HEDSTROM and EVAN HOUSTON*, University of North Carolina at Charlotte, Charlotte, N. C. 28223. Some remarks on *-operations. Preliminary report.

The terminology follows Multiplicative Ideal Theory by Robert Gilmer. We study several examples of *-operations on a domain D, including the well-known v-operation, the t-operation, and the F-operation recently introduced by H. Adams. We introduce a *-operation $I \to I_{F_1}$ of finite type closely related to Adams' F-operation: for each integral ideal I of D define I_{F_1} to consist of those elements $d \in D$ with $dJ \subset I$ for some finitely generated integral ideal J of D with $Jv = D$. We ask whether this F_1-operation is the same as the F-operation, and we provide an affirmative answer in case D is Noetherian. Also, if $D = A[x]$ then a prime ideal is F_1 if and only if it is F. In a similar vein we ask whether, for a prime ideal P of D, $(a,b)v \subset P$ for every $a, b \in P$ is sufficient to insure that P be a t-ideal. We give an affirmative answer in case $D = A[x]$, with A integrally closed. (Received February 5, 1979.)

766-A7 DAVID E. DOBBS, University of Tennessee, Knoxville, Tennessee 37916. Lying-over pairs of commutative rings. Preliminary report.

Let R be a subring of a commutative ring T, with the same identity element. After sharpening a characterization of P-domains in abstract 78T-A114, these Notices 25(1978), we obtain Corollary. T is integral over R iff $R \subset T$ is a P-extension such that, for each intermediate ring A and prime Q of A, $QT \neq T$. Definition. (R,T) is a lying-over pair (LO-pair) if $A \subset B$ satisfies LO for each intermediates $A \subset B$. There exist nonintegral LO-pairs with the base ring having arbitrary Krull dimension. Proposition. If (R,T) is a LO-pair of overrings with each intermediate a finite-conductor domain, then T is integral over R. Theorem. If T is a domain, then (R,T) is a LO-pair iff, for each intermediate A and prime Q of A, $QT \neq T$. Key Lemma. (R,T) is a LO-pair iff $A \subset B$ satisfies going-up for each intermediates $A \subset B$. Corollary 1 of the above-cited abstract is thereby extended. By considering going-up for polynomial rings, we then have: Corollary. (a) If T=R[X] with X transcendental over R, then (R,T) is a LO-pair iff R is a field. (b) If (R,T) is a LO-pair, then $\dim(T) \leq \dim(R)+1$; moreover, given intermediates $A \subset B$ and distinct primes $P_1 \subset P_2$ of B such that $P_1 \cap A = P_2 \cap A = Q$, then Q is a maximal ideal of A. Proposition. Let R be a field and T a domain. Then: (a) (R,T) is a LO-pair iff T is integral over each intermediate nonfield. (b) If (R,T) is a LO-pair, either T is integral over R or R[X]. (Received February 5, 1979.)

766-A8 SARAH GLAZ, Case Western Reserve University, Cleveland, Ohio, 44106 and WOLMER V. VASCONCELOS, Rutgers University, New Brunswick, New Jersey, 08903. Uppers of 0 over coherent rings. Preliminary report.

Let A be a commutative ring. A prime ideal P in the polynomial ring in one variable over A is called an upper of 0 if $P \cap A = 0$ and PK is principal, where K denotes the total ring of quotients of A. Finiteness properties of uppers of 0 are investigated over coherent domains. Two types of results are obtained:

1. Uppers of 0 with certain restrictions on their content ideal, are finitely generated over coherent domains.

2. Additional properties of the ring itself result in the finiteness of uppers of 0 with no restriction on their content. For example: over a coherent domain with Prüfer integral closure all uppers of 0 are finitely generated. The results obtained yield some insight in the nature of the integral closure of a coherent domain, and are applicable to the question of completeness of flat ideals over integrally closed domains. (Received February 8, 1979.)

766-A9 I.N. Herstein, University of Chicago, Chicago, Ill. 60637. Center-like elements in prime rings.

Let R be a prime ring with center Z and suppose that $a \in R$, $a \notin Z$ is such that $(ax - xa)^n \in Z$ for all $x \in R$ where $n \geq 1$ is a fixed integer. Then it is shown that R is an order in a 4-dimensional simple algebra. En route to proving the result, one needs to study subrings invariant re a certain class of automorphisms. One also shows that if $(ax - xa)^n = 0$ for all $x \in R$, R prime, and $n \geq 1$ fixed, then $a \in Z$. (Received February 19, 1979.)

*766-A10 CARL FAITH, Rutgers, The State University, New Brunswick, New Jersey 08903. Injective quotient rings of commutative rings II.

R is FPF if every finitely generated (f.g.) faithful R-module generates mod-R. CFPF denotes that every factor ring of R is FPF. FPF rings include Prufer rings, self-injective rings; QF rings, Dedekind rings and almost maximal valuation rings (AMVR's) are CFPF. A reduced FPF ring is semihereditary with injective $Q_{c\ell}(R)$, and conversely for semihereditary rings. A local ring R is FPF iff the zero divisors are a waist P such that R/P is a VR and R_P (= $Q_{c\ell}(R)$) is self-injective. (See "I" in Module Theory, Springer LNM vol. 700.) We say R is essentially upper FPF if every f.g. module between the injective hull E(R) of R and R generates mod-R. THEOREM. If R is ess. upper FPF, then R is quotient-injective, that is, $Q_{c\ell}(R) = Q_{max}(R) = E(R)$. COROLLARY. Every CFPF ring fractionally self-injective (FSI) in the sense of Vámos. These results verify conjectures of "I". Moreover, using the structure theorems of Vámos, one shows that every FSI ring is CFPF. Thus, the CFPF rings are finite products of indecomposable rings of the 3 types: (1) AMVR; (2) Almost maximal h-local domains; (3) Almost maximal torch rings. (Almost maximal means that R_P is an AMVR for every prime ideal P. See Theorem B of Vámos' s paper, J. London Math. Soc. (2), 16 (1977), 209-220.) Any product of FPF (commutative) rings is FPF by a result of the author in the 1978 Antwerp Ring Theory Conference, Dekker Lecture Notes (to appear), and Vámos' theorem shows that an infinite product of CFPF rings cannot be CFPF. A lemma in the proof of Theorem states that E(R) and $Q_{c\ell}(R)$ have the same singular submodule; also R is integrally-closed in Q_{max}. (Received February 20, 1979.)

766-A11 Richard Resco, University of Southern California, Los Angeles, CA. 90007. Primitive Polynomial Rings. Preliminary Report.

Let D be a division ring with center the field k. An old result of Jacobson ("Structure of Rings", p. 241) asserts that the polynomial ring D[x] is primitive iff there exists an integer $n \geq 1$ such that the matrix ring $M_n(D)$ is not algebraic over k. This theorem has recently been extended to polynomials in several variables over a division ring by Amitsur and Small.

The above results lead one to ask when polynomials over an arbitrary ring are primitive. Some partial answers to this question are given by the following two theorems. Theorem 1. Let A be a primitive ring and let E be the extended center (in the sense of Martindale) of A. If there exists a simple, faithful A-module M such that $D = End_A(M)$ is transcendental over E, then A[x] is primitive. Theorem 2. Let A be a primitive ring, M a simple, faithful A-module, and $D = End_A(M)$. If D[x] is primitive then A[x] is primitive.

In rather sharp contrast to the case for division rings, the converse of Theorem 1 fails in general. Theorem 2, on the other hand, can easily be extended to tensor products of algebras and leads to a generalization of some classical results of Azumaya-Nakayama ("Structure of Rings", p. 113). (Received February 19, 1979.)

*766-A12 LAWRENCE S. LEVY, Mathematics Department, University of Wisconsin, Madison, Wisconsin 53706, Modules over Pullbacks and Subdirect Sums.

Let $f_i: R_i \twoheadrightarrow \bar{R}$ be homomorphisms of rings: R_1 and R_2 onto $\bar{R}$ = semisimple artinian, and R = the pullback $\{(r_1,r_2) \in R_1 \oplus R_2 \mid f_1(r_1)=f_2(r_2)\}$. Can all R-modules be described as some kind of combination of modules over the rings R_1, R_2, and $\bar{R}$? It is not true that every R-module is a pullback of modules over R_1, R_2, and $\bar{R}$, so we call an R-module S separated if it is such a pullback.

THEOREM 1. Every R-module M has a separated representation, i. e., an R-homomorphism $g: S \twoheadrightarrow M$, with S separated and "as close as possible to M" in the following sense: In any factorization $g: S \to S' \twoheadrightarrow M$, with S' separated, $S \to S'$ must be one-to-one. The S in this theorem is unique up to isomorphism over M. This is a special case of: THEOREM 2. ("Almost Functorial Property") Any homomorphism of R-modules can be lifted to a homomorphism of their separated representations.

In a subsequent paper, these results will be used to determine all finitely generated modules over the integral group ring R=ZG of the cyclic group G of prime order, and over any ring R of prime index in $Z \oplus Z$. This will extend some results of Nazarova and Roiter from finite to finitely generated modules. (Received February 21, 1979.)

766-A13 JUDITH D. SALLY, Northwestern University, Evanston, Illinois 60201. The Hilbert function of a local ring.

• The Hilbert function of a local ring (R, m) is a good measure of the singularity at (R, m). We survey known results and open problems concerned with the computation of the Hilbert function including those which arise from changing the ring. (Received February 22, 1979.)

766-A14 SAMUEL S. WAGSTAFF, JR., Northern Illinois University, DeKalb, Illinois 60115. Proof of a formula of Ramanujan concerning Bernoulli numbers. Preliminary report.

We interpret and prove an equation which Ramanujan stated without proof and from which he deduced the von Staudt-Clausen theorem concerning the fractional parts of the Bernoulli numbers. The equation is formula (28) of "Some properties of Bernoulli's numbers," J. Indian Math. Soc. 3(1911), 219-234. (Received February 22, 1979.) (Received February 22, 1979.)

766-A15 JOHN A. BEACHY, Northern Illinois University, DeKalb, Illinois 60115. Essentially Artinian modules. Preliminary report.

A left R-module M will be called essentially Artinian if it contains an essential Artinian submodule; it will be called finitely annihilated if $\mathrm{Ann}(M) = \mathrm{Ann}(m_1,m_2,\ldots,m_k)$ for elements $m_1,m_2,\ldots,m_k \in M$. The theorem below extends several known results on essentially Artinian modules.

Theorem. Let R be a left Noetherian ring, and let M be a finitely generated, essentially Artinian left R-module. Assume that if I is an ideal of R such that R/I is right Artinian, then for any ideal K, K/IK has finite length as a right R-module. Then M is Artinian if and only if every submodule of M is finitely annihilated.

Corollary. If a left FBN ring satisfies the hypothesis of the theorem, then the intersection of powers of its Jacobson radical is zero. (Received February 23, 1979.)

*766-A16 ROBERT B. WARFIELD, University of Washington, Seattle, WA 98195. The spectrum of a fully bounded Noetherian ring. Preliminary report.

Let R be a right Noetherian, right fully bounded ring, and Spec(R) the usual spectrum consisting of prime ideals. If Spec(R) is given the Zariski topology, then some natural functions on Spec(R) which are continuous or semicontinuous for commutative R fail to have these properties in general. An example is the function defined by a finitely generated module A associating to each prime P the number of generators of A at P. (In the commutative case this number is the number of generators of A_P; in the noncommutative case we pass to A/AP and use the Goldie localization.)

We show that if Spec(R) is given Hochster's patch topology, these functions become continuous or semicontinuous, and we give some applications. The first application is to a finiteness theorem useful in proving a variety of K-theoretic results. The second is contained in joint work of the author and K.R. Goodearl, and concerns the structure of the state space of $K_0(R)$--a compact convex set. (Received February 23, 1979.)

766-A17 BARBARA ANN BENANDER, Kent State University, Kent, Ohio 44242. Finite Length in Torsion Theories. Preliminary report.

O.Goldman [Elements of Noncommutative Arithmetic I, Journal of Algebra 35, 308-341 (1975)] introduced the following concepts. If σ is an idempotent kernel functor, a σ-chain in an R-module M is a sequence of submodules $0=M_0\leq M_1\leq\ldots\leq M_n=M$ having the property that M_{i+1}/M_i is a supporting module for $0\leq i\leq n-1$. If such a σ-chain exists we say M has finite σ-length.

Let σ be an idempotent kernel functor, E an injective module which cogenerates the torsion theory associated with σ, and S the endomorphism ring of E. Goldman's concept of finite σ-length is shown to be equivalent to finite length over S. The following are shown: 1.If M_R is σ-torsion free, then M_R has finite σ-length if and only if ${}_SM^*={}_S\mathrm{Hom}(M_R,{}_{(S)}E_R)$ has finite length. In particular, if M has finite σ-length and $0=M_0\leq M_1\leq\ldots\leq M_n=M$ is a σ-chain, then ${}_SM^*=\mathrm{Ann}_{M^*}(M_0)\geq\ldots\geq\mathrm{Ann}_{M^*}(M_n)=0$ is a composition series of ${}_SM^*$. Conversely, if ${}_SM^*=X_0\geq X_1\geq\ldots\geq X_n=0$ is a composition series of ${}_SM^*$, then $0=\mathrm{Ann}_M(X_0)\leq\ldots\leq\mathrm{Ann}_M(X_n)=M$ is a σ-chain in M_R.
2. If $\P$ is a prime kernel functor and X_R is a $\P$-supporting module then $\delta(\P)$, Goldman's primadic multiplicity function, is the number of factors of a composition series of ${}_SM^*$ isomorphic to ${}_SX^*$ (a simple S-module). (Received February 26, 1979.)

(Author introduced by Professor Kent R. Fuller.)

766-A18 ALAN BENANDER, Kent State University, Kent, Ohio 44242. On Prime Kernel Functors. Preliminary report.

The concept of a prime kernel functor was introduced by O.Goldman[Rings and Modules of Quotients, Journal of Algebra 13, 10-47(1969)]. In the following, for a module A, τ_A will denote the kernel functor associated with the torsion theory cogenerated by E(A), the injective hull of A. The study of prime kernel functors is undertaken with the goal of classifying those rings R for which τ_R is a prime. For example, if R is a right Noetherian prime ring, then τ_R is a prime. Also, if R is a right Noetherian, non-singular ring and the endomorphism ring of E(R) is simple Artinian, then τ_R is a prime. Some related results are: 1. If E_R is uniform and injective, then τ_E is a prime if and only if $\mathrm{Soc}({}_\Sigma E)\neq 0$, where Σ is the endomorphism ring of E. 2. If E_R is injective and τ_E is a prime, then $\mathrm{Soc}({}_\Sigma E)$ is nonzero and homogeneous. 3. If $\tau_R=\tau_S$ for some simple R-module S, then every faithful module M_R contains a simple R-module isomorphic to S_R. 4. If $\P$ is a prime kernel functor, X_R is a $\P$-supporting module, E_R is the injective hull of X_R, and Q is the ring of quotients of R with respect to $\P$, then τ_{E_Q} is a prime kernel functor. (Received February 26, 1979.)

(Author introduced by Professor Kent R. Fuller).

*766-A19 ROBERT W. SHEETS, Southeast Missouri State University, Cape Girardeau, Missouri 63701 Partial Henselizations.

A denotes a commutative ring with identity and m denotes an ideal in A. A pair (A,m) is a k H-pair (a k-Henselian pair) in case m is contained in the Jacobson Radical and for every monic polynomial f(X) of degree k in A[X] such that $\bar{f}(X)\in A/m[X]$ factors into $\bar{f}(X)=\bar{g}_o(X)\bar{h}_o(X)$ where $\bar{g}_o$ and $\bar{h}_o$ are monic and coprime, there exists monic polynomials g(X), h(X) $\in$ A[X] such that f(X) = g(X)h(X), $\bar{g}(X)=\bar{g}_o(X)$ and $\bar{h}(X)=\bar{h}_o(X)$. It is shown that the 2-Henselization and the 3-Henselization exist. Several properties of k H-pairs are noted. And an equivalence to the chain conjecture is also given. (Received February 26, 1979.)

766-A20 J.R. Matijevic, University of Southern California, Los Angeles, California 90007. Matrix Factorization And Towber Rings.

Let R be a commutative ring with unit and let R_n denote the ring of nxn matrices with entries in R. If $\mathcal{A}$ is a left ideal of R_n, denote by $N(\mathcal{A})=\sum_{A\in\mathcal{A}}(\det A)R$. We say R_n admits norm-induced factorization if for each left ideal $\mathcal{A}\subset R_n$, $\mathcal{A}\subset R_nC$ where det C = c, a non-zero divisor in R, whenever $N(\mathcal{A})\subset cR$.

This talk will center around the relationships between the norm-induced factorization condition and the solution of problems concerning the structure of projective modules, the number of generator of ideals, the decomposibility of vectors in exterior algebras and the unique factorization of matrices. (Received February 26, 1979.)

*766-A21 GORO AZUMAYA, Indiana University, Bloomington, Indiana 47401. Exact rings. Preliminary report.

Let R be a left Artinian ring with radical N. Then R has a two-sided composition series, say $R=I_0\supset I_1\supset\dots\supset I_r=0$. R is called exact if every endomorphism of each left R-module I_{i-1}/I_i is given by the right multiplication of an element of R. This concept is left-right symmetric. It is proved that every finite-dimensional split algebra over a field as well as every serial ring (= generalized uniserial ring) is exact. Let R be an exact ring, and let e be a primitive idempotent of R. Then the injective envelope E of the simple left R-module Re/Ne has a composition series, and moreover the composition length of E is equal to the composition length of the right ideal eR. The following conjecture is proposed: If R is exact, then R is self-dual, i.e. there exists a finitely generated left injective R-cogenerator Q such that R is isomorphic to the endomorphism ring of Q. (Received February 26, 1979.)

*766-A22 JOEL K. HAACK, University of Iowa, Iowa City, Iowa 52242. On rings with self-duality.

An artinian ring R is said to have self-duality if there is a Morita duality between the categories of left and right finitely generated R-modules. Associated with each indecomposable serial ring is a sequence of numbers called the admissible sequence. (See K. R. Fuller, Math. Z. 106 (1968), 248-260.) Theorem: Any factor ring of a serial ring with a strictly increasing or a constant admissible sequence has self-duality. In the course of the proof, it is shown that if an artinian ring R has a weakly symmetric self-duality (in the sense of W. Müller, Math. Z. 137 (1974), 197-226) and if every primitive left ideal of R has a distributive lattice of submodules, then any factor ring of R also has self-duality. Using similar techniques, it is proven that factor rings of incidence rings of finite pre-ordered sets over division rings also have self-duality. (Received February 27, 1979.)

766-A23 POOBHALAN PILLAY, University of Durban-Westville, Private Bag X54001, Durban 4001, South Africa. Polynomial rings and orders. Preliminary report.

Let R be an associative, not necessarily commutative, ring with identity. Let $S = R[x_\alpha]_{\alpha\in I}$ be a polynomial ring over R, where the x_α's are central indeterminates. It is shown that R is a right order in a P-ring $\Leftrightarrow$ S is a right order in a P-ring where P is any one of semisimple, right Artinian, quasi-Frobenius. (Received February 26, 1979.) (Author introduced by Professor Carl Faith).

Analysis (26, 28, 30–35, 39–47, 49)

*766-B1 Palle E.T. Jorgensen, Stanford University, Stanford, CA 94305. Discrete subgroups and invariant vector fields. Preliminary report.

Let G be a unimodular connected Lie group with Lie algebra $\mathfrak{G}$, the elements of $\mathfrak{G}$ being identified with left-invariant analytic vector fields on G. Let Γ be a discrete subgroup with projection $\pi: G\to\Gamma\backslash G = M$, $\pi(a)=\Gamma\cdot a$, and let $C_0^\infty(M)$ denote the space of C^∞ functions on M which are compactly supported away from the boundary. Then $\mathfrak{G}$ induces a skew-symmetric Lie algebra of vector fields of $C_0^\infty(M)$ via a familiar representation $\rho: \rho(X)f = X(f\circ\pi)$, $X\in\mathfrak{G}$, $f\in C_0^\infty(M)$. Our results below generalize work of B. Fuglede in the special case $G=\mathbb{R}^n$. Theorem 1. Suppose U is a unitary repre-

sentation of G on the space $L^2(M)$, constructed from an invariant Haar measure ν on G, in such a way that the infinitesimal generator $dU(X)$ of $t \to U(\exp t X)$ is a skew-adjoint operator extension of $\rho(X)$ for all $X \in \mathfrak{G}$. Then there is a one-dimensional representation L of Γ such that U is unitarily equivalent to the representation induced by L. Theorem 2. Suppose G is also simply connected, $\Omega \subset G$ an open connected subset, $\nu(\Omega) < \infty$. Assume that $X|C_o^\infty(\Omega) \subset dU(X)$ for all $X \in \mathfrak{G}$ in the sense of operator graphs where dU is the infinitesimal of a unitary automorphic representation U (i.e. $U_a(fg)=(U_a f)(U_a g)$ whenever $a \in G, f, g$, and the product $fg \in L^2(\Omega)$). Then there is a discrete subgroup Γ of G and a particular fundamental domain F of $\Gamma \backslash G$ such that $\nu(\Omega \Delta F)=0$, Δ denoting the symmetric difference. (Received October 23, 1978.)

*766-B2 Rainald Schöneberg, University of Iowa, Iowa City, Iowa 52242. Asymptotic normal structure and fixed points of nonexpansive mappings.

The concept of asymptotic normal structure is introduced, and it is shown that all nonempty, closed, bounded and convex subsets of reflexive Banach spaces with asymptotic normal structure have the fixed point property for nonexpansive self-mappings. While it is evident that normal structure implies asymptotic normal structure, the converse is not true. We prove that the reflexive Banach space X_J, defined to be ℓ_2 renormed according to $\|x\| = \max\{\|x\|_\infty, \|x\|_2/\sqrt{2}\}$, has asymptotic normal structure but not normal structure. It follows that our fixed point theorem is not only a proper generalization of Kirk's theorem, but it also includes a recent result due to Karlovitz for which only a more complicated proof is known. (Received January 11, 1979.) (Author introduced by W. A. Kirk).

766-B3 Philip Unell, Iowa State University, Ames, Iowa 50011. Self-adjointness of an elliptic operator on a Riemannian manifold.

In [J. Fnal. Anal. 25(77)] A. Devinatz announced a general result on the self-adjointness of $L = -\sum D_j a_{jk}(x) D_k + q(x)$ in $\mathbb{R}^n$, where $D_j = \partial_j - ib_j(x)$. His main hypothesis was that $q \in L^2_{loc}(\mathbb{R}^n)$ is bounded below locally with decay to minus infinity tied to the quantity $S(x) = |x|^{-2} \sum a_{jk}(x) x_j x_k$.

We generalize this theorem from $\mathbb{R}^n$ to any complete, non-compact Riemannian manifold. The function $S(x)$ is replaced by $\sigma(x; dr(x))$, where σ is the symbol of L and $dr(x)$ is the differential of a distance function on the manifold. For the proof properties of $r(x)$ are derived and a manifold version of a maximum principle of W. Littman is employed.

Our theorem may be compared to one of P. Chernoff [Pac. Jnal. M. 72(77)] in which the lower bound of the operator, rather than of q, decays to minus infinity in a prescribed manner. (Received January 11, 1979.)

*766-B4 B. A. TAYLOR, Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109. Algebras of entire functions. Some problems from harmonic analysis.

• Let A be a subalgebra of the space $A(\mathbb{C}^n)$ of all entire functions on $\mathbb{C}^n$, and let $\mathcal{J}$ be an ideal in A. We will discuss special cases of the two questions: (1) What is the structure of $\mathcal{J}$?; and (2) What is the structure of $A/\mathcal{J}$? In many interesting cases these questions are quite old, but the framework we consider and the problems we discuss derive from L. Schwartz's 1947 paper on mean-periodic functions where the question was raised: Is every closed, translation-invariant subspace V of the continuous functions on $\mathbb{R}^n$ the closure of the exponential polynomials it contains? When A is the algebra of all entire functions of exponential type on $\mathbb{C}^n$ of at most polynomial rate of growth on the real subspace, then Schwartz's problem is equivalent to the following case of question 1. If $\mathcal{J}$ is a closed ideal in A (in a natural topology on A which reflects the growth conditions defining A), and if $\mathcal{J}_{loc}$ is the ideal of all functions in A which belong to $\mathcal{J}$ locally, then is $\mathcal{J} = \mathcal{J}_{loc}$? That is, are closed ideals in A completely determined by the local structure of their zeros? Schwartz proved this to be true for functions of 1 variable. For functions of more than one variable, a counterexample was given in 1971 by D. I. Gurevich. The question (2) is related to the following harmonic analysis problem. Given that the function f belongs to a proper closed, translation-invariant subspace V of the continuous functions on $\mathbb{R}^n$, and given

that f is the limit of exponential polynomials in V, can f be represented in some natural way as a convergent series or integral of these special solutions? Various concrete descriptions of the spaces $A/\mathcal{I}$, where $\mathcal{I} = \mathcal{I}_{loc}$ yield results on this question. Since $A/\mathcal{I}$ can be viewed as a subspace of functions analytic on the variety of the ideal $\mathcal{I}$, descriptions of $A/\mathcal{I}$ amount to interpolation theorems for entire functions satisfying growth conditions. (Received January 12, 1979.)

JOHN W. BUNCE and WILLIAM PASCHKE, University of Kansas, Lawrence, Kansas 66045.

766-B5 Derivations on a C-algebra and its double dual.

Let A be a C*-algebra and X a Banach A-module. The module action of A on X gives rise to module actions of A** on X* and X**, and derivations of A into X (resp. X*) extend to derivations of A** into X** (resp. X*). If A is separable and nuclear, and X is a dual Banach A-module with X* weakly sequentially complete, then every derivation of A into X is inner. Under the same hypotheses on A, the extension to the finite part of A** of any derivation of A into any dual Banach A-module is inner, as are all derivations of A into A*. Every derivation of a semi-finite von Neumann algebra into its predual is inner. (Received January 17,1979.)

*766-B6 WILLIAM O. RAY, Iowa State University, Ames, Iowa 50011. The fixed point property and unbounded sets in Hilbert space.

It is shown that a closed convex subset K of a real Hilbert space H has the fixed point property for nonexpansive mappings if and only if K is bounded. (Received January 18, 1979.)

*766-B7 THEAGENIS ABATZOGLOU, Iowa State University, Ames, Iowa 50011. Smooth points and Norm derivatives in c_p and B(H).

Keeping in mind the equivalence of smooth points of balls and norm derivatives in Banach spaces we prove:

THEOREM 1. Let A be an operator in a Hilbert space H of class c_p, then for every B in c_p, $1 < p < \infty$, we have $\frac{d}{dt}||A + tB||\Big|_{t=0} = \mathrm{tr}\left(\frac{|A|^{p-1}U^*B}{||A||^{p-1}}\right)$ where $A = U|A|$

THEOREM 2. Let A be in B(H), then the norm of B(H) is Frechet differentiable at A if and only if A attains its norm at $\pm x$, $||x|| = 1$ and $\sup_{x \neq y, ||y|| = 1} ||Ay|| < ||A||$ in which case

$$\frac{d}{dt}||A + tB||\Big|_{t=0} = \left\langle \frac{Ax}{||A||}, Bx \right\rangle \quad \text{for any } B \text{ in } B(H).$$

(Received January 29, 1979.)

766-B8 Vadim Komkov, American Mathematical Society, 611 Church Street, Ann Arbor, Michigan 48109
Noether's theorem and invariants of non-conservative differential systems of continuum mechanics.

The well known proof of Noether's theorem is restated for dual variational systems in the $(H_1 \oplus H_2) \times (H_1^* \oplus H_2^*)$ setting (previously introduced by the author). Here H_1 is the normed space of generalized displacements of the physical system, H_2 -- of the displacements of the adjoint system, H_1^*, H_2^* are the spaces of the corresponding generalized momenta which can be regarded as the respective topological duals of H_1, H_2, but a more general interpretation suggested by I. Herrera is acceptable. In analogy with the classical use of Noether's theorem invariants of "motion" and a group of transformations invariant with respect to "a joint Lagrangian" of a physical and un-physical system is derived for a class of problems in continuum mechanics which do not have a variational formulation in the classical sense (i.e. according to Tonti's classification). (Received February 19, 1979.)

766-B9 JOHN P. D'ANGELO, UNIVERSITY OF ILLINOIS, URBANA, IL. 61801.
Order of Contact of Real and Complex Varieties.

Let r be a smooth real valued function on C^n. We discuss conditions on the Taylor series of r which determine when all complex analytic varieties in C^n have finite order of contact with the zero set of r. In particular we give a necessary and sufficient condition for the non-existence of q-dimensional varieties in the zero set of a real valued polynomial. Finally we discuss the relevance of this question to analytic objects on the boundaries of weakly pseudo-convex domains. (Received February 5, 1979.)

*766-B10 LAWRENCE FIALKOW, Western Michigan Univ., Kalamazoo, Mich. 49009.
On the range of the operator $T(X) = AX - XB$. Preliminary report.

Let A and B denote operators on a Hilbert space H. We investigate when the range of the operator $T(X) = AX - XB$ is norm closed in $L(H)$. For the case $A = B$, the solution is due to C. Apostol [Rev. Roum. Math. Pures Appl., 21 (1976), 249-265]. Among the results is the following. If A and B are hyponormal and $\sigma_1(A) \cap \sigma_1(B)$ contains a limit point of $\sigma_1(A) \cup \sigma_1(B)$, then $R(T)$ is not closed. If $\sigma_1(A) = \sigma(A)$ and $\sigma_1(B) = \sigma(B)$, including the case when A and B are quasitriangular, then the converse is valid. This extends a result of J.G. Stampfli for the case $A = B$ [Proc. Amer. Math. Soc., 52(1975), 117-120]. (Received February 6, 1979.)

*766-B11 ALAN HOPENWASSER, University of Alabama, University, AL 35486. The equation $Tx = y$ in a reflexive operator algebra.

Let L be a commutative subspace lattice and let $A = Alg\ L$. Let x and y be vectors in the Hilbert space on which A acts. Questions: Does there exist an operator in A such that $Tx = y$? If so, how small can its norm be? The answers, previously known when A is a nest algebra, are the following: Let K be the supremum of all the numbers $\|E^{\perp}y\| / \|E^{\perp}x\|$ where E runs through all projections in L and $E^{\perp} = I - E$. (Declare $0/0 = 0$). If K is finite, there is an operator T in A of norm K such that $Tx = y$. Any other operator in A which maps x to y has norm at least as great as K. (Received February 12, 1979.)

*766-B12 DOMINGO HERRERO, Instituto Venezolano de Investigaciones Cientificas, (AP1827) Caracus (101), VENEZUELA. Characterization of operators with local similarity cross sections. Preliminary report.

We report on joint work with Larry Fialkow concerning the similarity orbits of various types of operators. (Received February 12, 1979.)

*766-B13 HUGO ROSSI, University of Utah, Salt Lake City, Utah 84112. Certain $Sp(n,R)$-homogeneous domains.

Let $L \subset G_{\mathbb{C}}(2n,n)$ be the set of Lagrangian subspaces of $\mathbb{C}^{2n}$ for the symplectic form $J = \begin{pmatrix} 0 & I \\ -I & 0 \end{pmatrix}$. There is a smooth real-valued function φ defined on L such that a) $\varphi(V) = 0$ if and only if $V \cap \overline{V} = \{0\}$. Associated to each V with $\varphi(V) \neq 0$ ia a non-degenerate hermitian form H_V on $\mathbb{C}^n$. Let $B_q = \{V \in L\ ;\ H_V$ has signature $(n - q,q)\}$. Then the Hessian of $-\ln|\varphi|$ is non-degenerate with at most $(n - q)q$ negative eigenvalues. $Sp(n,R)$ acts transitively on each B_q and to each there are naturally associated representations of $Sp(n,R)$ which hopefully can be unitarized. (Received February 12, 1979.)

*766-B14 M. ANN PIECH, State University of New York at Buffalo, Buffalo, New York 14214. Differentiability of measures associated with parabolic equations on infinite dimensional spaces.

The transition measures of the Brownian motion on manifolds modelled on abstract Wiener spaces locally correspond to fundamental solutions of certain infinite dimensional parabolic equations. We establish that the fundamental solutions are comprised of differentiable measures. This result provides strong evidence in support of the conjecture that the transition measures of the Brownian motion are differentiable, and hence is of importance to the construction of infinite-dimensional Laplace-Beltrami operators. (Received February 14, 1979.)

766-B15 N. J. Kalton, Barry Turett, and J. J. Uhl. Jr. University of Illinois, Urbana, IL 61801 Basically scattered vector measures.

Let X be a Banach space and $\sum$ be a σ-field of sets. A vector measure $F : \sum \longrightarrow X$ is basically scattered if it takes disjoint sequences of non-null sets into basic sequences. The notation extends related notions of Masani (orthogonally scattered measures), Sundaresan-Woyczynski (L-scattered measures) and Urbanik-Woyczynski (symmetric random measures). It is shown that no non-atomic a basically scattered vector measure has a weak (or a strong derivative) and that if X is a Banach space containing no copy of $L_1[0.1]$, then non-atomic basically scattered vector measures with range in X are of infinite variation. (Received February 15, 1979.)

*766-B16 WARREN R. WOGEN, University of North Carolina, Chapel Hill, N.C. 27514. On direct sums of reflexive operators.

We consider bounded operators on a Hilbert space H with the following property.

(*) Whenever M is a cyclic invariant subspace for $T \oplus T$, then there is an invariant subspace N for T so that $T \oplus T|_M$ is similar to $T|_N$.

Property (*) is related to reflexivity of operators.

Theorem. If T_1 and T_2 are reflexive and have property (*), then $T_1 \oplus T_2$ is reflexive and has property (*). Some corollaries, examples, and open questions will be discussed. (Received February 15, 1979.)

*766-B17 Al Boggess, Rice University, Houston, Texas 77001. Kernels for the tangential Cauchy Riemann equations in codimensions one and two. Preliminary report.

Two theorems are discussed. Let $M = \partial\Omega$ be the smooth boundary of a bounded strictly pseudo convex domain. Let ω be an open set in M with smooth boundary. The first theorem gives sufficient conditions on ω to solve the tangential Cauchy Riemann equations on ω with a solution that is smooth across the boundary of $\omega = \partial\omega$, except at characteristic points on ω ; i.e. those points where the tangent space becomes complex linear. An explicit kernel is used to represent the solution. The second theorem gives sufficient conditions on $\partial\omega$ to globally solve the tangential Cauchy Riemann equations on $\partial\omega$ (except near characteristic points.) The solution is represented by the boundary value jump across $\partial\omega$ of an explicit kernel. A-priori L^p estimates on the solution are also given. (Received February 19, 1979.) (Author introduced by Professor John C. Polking).

766-B18 JEAN N. RENAULT, University of Iowa, Iowa City, Iowa 52242. On the structure of groupoid C-algebras. Preliminary report.

The classical construction of the C*-algebra of a transformation group can be extended to locally compact groupoids endowed with a Haar system. We will present some results about the ideal structure and the type of groupoid C*-algebras which generalize and enlighten the case of a transformation group. (Received February 19, 1979.)

*766-B19 Gregory A. Fredricks, Texas Tech University, Lubbock, Texas 79409. Complexifications of C-R manifolds. Preliminary report.

A complexification of the C-R manifold (M,A) is a pair (X,τ), where X is a complex manifold and $\tau: M \to X$ is an embedding for which τM is a generic submanifold of X and $\tau_* A = HT(\tau M)$.

Theorem: Complexifications of real analytic C-R manifolds exist.

Other results and questions concerning the existence of complexifications are discussed. (Received February 22, 1979.)

766-B20 JAMES MURDOCK, Iowa State University, Ames, Iowa 50011. A mathematical approach to spin/orbit resonance.

A survey of the author's work on spin/orbit resonance (as for instance that of Mercury) will be given; part of this is joint work with R. Clark Robinson. The basic model is $\ddot{\theta} = \varepsilon f(t,\theta,\dot{\theta})$. Solutions for which $\dot{\theta}$ exhibits a steady-state behavior can occur only in "ground states" or "active resonances," and the qualitative features of motion in different cases are studied by the method of second-order averaging together with structural stability theory. (Received February 22, 1979.)

*766-B21 EDWARD A. BELBRUNO, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012. A canonical regularization of the three-dimensional restricted three-body problem and a class of periodic collision orbits. Preliminary report.

The flow for the Kepler problem for positive energy is shown to be topologically equivalent to the geodesic flow of the Lobachevsky space by a simple rational transformation. This approach allows the unified treatment of the three cases of zero, positive and negative energy. (The last case was solved by Moser(1970).)

This technique is applied to the study of a class of periodic solutions to the three-dimensional restricted three-body problem which bifurcate off from collision orbits. These collision orbits are studied with the aid of a new regularizing canonical map. This map corresponds to a rotation of S^3 and yields a regularization in the three-dimensional case without the raising of dimension as in the Kustaanheimo-Stiefel procedure. (Received February 22, 1979.)

*766-B22 DAVID S. TARTAKOFF, University of Illinois at Chicago Circle, P.O.Box 4348, Chicago, Ill., 60680. Analytic regularity of solutions to $\Box_b$ and the $\bar{\partial}$-Neumann problem near isolated degeneracies of the Levi form.

In a neighborhood U of x_0 in R^m we consider systems $P = \sum a_{jk}(x) Z_j Z_k + \sum a_j(x) Z_j + a(x)$ of partial differential operators, with real analytic coefficients, where the Z_j and T $(j=1,\ldots,m-1)$ are analytic vector fields spanning the tangent space whose associated Levi form $c_{jk}(x)$ = coeff. of T in $Z_j Z_k - Z_k Z_j$ has non-zero determinant outside a compact subset K of U. We assume that in U, $TZ_j - Z_j T$ is zero modulo the Z_k and that P satisfies the a priori estimate $\sum \| Z_j v\|_0^2 + \| v\|_0^2 \leq C(|\mathrm{Re}(Pv,v)| + \| v\|_{-1}^2)$, $v \in C_0^\infty(U)$. Then Pu real analytic in U implies the same of u.

The idea of proof is to show that any singularities in K would propagate to $U \setminus K$, and from the author's (and F.Trèves') earlier work, such operators are analytically hypoelliptic where the Levi form inverts. (Received February 23, 1979.)

766-B23 FRANK GILFEATHER and DAVID R. LARSON, University of Nebraska, Lincoln, NE 68588. Nest-subalgebras of von Neumann algebras.

Suppose $\mathcal{N}$ is a nest of projections contained in a von Neumann algebra $\mathcal{B}$ and let $\mathcal{A}$ be the algebra of operators in $\mathcal{B}$ leaving every member of $\mathcal{N}$ invariant. Then $\mathcal{A}$ is a nest subalgebra of $\mathcal{B}$. Such algebras prove amenable to computational techniques and many of the structure results for the nest algebras of J. Ringrose extend to this class.

In particular, the commutant of the core of the nest modulo the radical of $\mathcal{A}$ has been characterized. Also, the commutant of $\mathcal{A}$ modulo the compacts has been identified whenever the von Neumann algebra does not contain a type II factor as a direct summand. Related results in the class of reflexive operator algebras with commutative subspace lattices have been obtained. (Received February 26, 1979.)

766-B24 MICHAEL FREEMAN, University of Kentucky, Lexington, Kentucky 40506. Fully integrable Pfaffian Systems, Preliminary report.

The real hypersurface $z_2 + \bar{z}_2 + (z_1 - \bar{z}_1)(z_2 - \bar{z}_2) = 0$ in C^2 has the complex submanifold $z_2 = 0$ but no others. A complex submanifold M of a real submanifold $\rho_1 = \ldots = \rho_m = 0$ satisfies $j^*D = 0$, where $D = D_\rho = sp\{\partial\rho_i, \bar{\partial}\rho_i\}$ is the indicated Pfaffian system and j is the inclusion of M. An arbitrary Pfaffian system D (module of one-forms) is fully integrable at p by a submanifold M if p lies on M, $j^*D = 0$, and codim M = rank of D at p. For D_ρ such an M is automatically complex. Full integrability at p is governed by an ascending chain $\{E_p^k D\}$ beginning at $D = E_p^0 D$ and defined recursively by an invariant differentiation process: Theorem. A real-analytic module D is fully integrable at p if and only if $D(p) = (UE_p^k D)(p)$. This subsumes most known methods for the detection of complex manifolds, and since D need not have constant rank it works equally well in the non-CR case. It is a corollary that $UE_p^k D$ is always fully integrable at p. Since this module contains D, the latter always has an integral manifold through p, which will be complex in the case of D_ρ. (Received February 26, 1979.)

766-B25 T. C. LIM, University of Chicago, Chicago, Illinois 60637. On asymptotic centers and fixed point theorems in conjugate Banach spaces.

Properties of asymptotic centers and nonreflexive spaces in which every bounded regnence has an asymptotic center are investigated. Applications are given to fixed point theorems in some conjugate Banach spaces. An example shows that there exist a weak* compact convex subset K of a conjugate Banach space and an affine isometry $T : K \to K$ such that T does not possess a fixed point. (Received February 26, 1979.)

*766-B26 RONALD A. KNIGHT, Northeast Missouri State University, Kirksville, Missouri 63501. Central Motions.

The following well known theorem on central motions has been generalized: If the phase space X of a flow is metric and either locally compact or complete and if every point is nonwandering, then the set of bilaterally Poisson stable points is dense in X. We show that the theorem is valid for locally compact Hausdorff phase spaces and we show that the extension is sharp by giving an example of a nonwandering flow on a nonlocally compact Hausdorff phase space with no Poisson stable points. (Received February 26, 1979.)

766-B27 RICHARD I. LOEBL, Wayne State University, Detroit, Michigan 48202. Group actions on C*-algebras.

Let G be a locally compact group represented as *-automorphisms of a C*-algebra $\mathfrak{A}$. We consider the sub C*-algebra $\mathfrak{A}_G = \{A \in \mathfrak{A} : g \to g \cdot A$ is norm-continuous$\}$. If G is compact abelian, acting via the regular representation on $H = L^2(G) \otimes \ell_2$, then $L(H)_G$ is isomorphic to the crossed product of operators fixed by G by a canonical action of the

dual group $\hat{G}$. In this case we can also classify the G-invariant ideals in $L(H)_G$. Many of the above results hold for G-actions on the Calkin algebra $L(H)/K(H)$, and some G-Fredholm results can be proved. We will be discussing results of C. Schochet, Loebl, and others. (Received February 26, 1979.)

766-B28 CHARLES G. CONLEY, University of Wisconsin, Madison, Wisconsin 53706. On the structure of the set of solutions of a differential equation.

• To an isolated invariant set of a differential equation there is associated a directed graph. The vertices represent pointed spaces and the edges map from one space to the suspension of the next. This structure is stable under perturbation. The existence of special kinds of solutions (in particular those whose existence is stable) can frequently be concluded from compatibility conditions which the graph must satisfy. (Received February 26, 1979.)

766-B29 Mark S. Ephron, University of Michigan, Ann Arbor, Michigan 48109. Indicators of Products and Surjective Convolution Maps of Analytic Functions. Preliminary report.

Let f(z) be an entire function of order one and finite type. Let $h_f(\theta)=\limsup \frac{\log|f(re^{i\theta})|}{r}$ be the Lindelof indicator function of f(z). We say f(z) is of completely regular growth if there exists some "thin" set of disks E with the property that $\frac{\log|f(re^{i\theta})|}{r}$ converges uniformly to $h_f(\theta)$ as r approaches infinity avoiding those values for which $re^{i\theta}$ lie in E. Given f(z) and a bounded convex set R, one can define a convolution map $*_f$ between two appropriately chosen spaces of analytic functions. We show the equivalence between this map being onto for all R, the function f(z) having the property that $h_{fg}(\theta)=h_f(\theta)+h_g(\theta)$ for all entire functions g(z) of exponential type, and f(z) being of completely regular growth. We also describe another equivalent condition that seems to be easier to work with than the original definition of completely regular growth.
(Received February 27, 1979.)

766-B30 DANIEL M. BURNS,JR., Univ. of Michigan, Ann Arbor, Mich. 48109. Curvatures of foliations and Monge-Ampere equations. Preliminary Report.

Theorem: Let $\tau: M \to R^+$ be a C^5 strictly plurisubharmonic exhaustion function, and $u = \log \tau$. If $(dd^c u)^n = 0$, $n = \dim M$, then $M = \mathbb{C}^n$ and $\tau = |z|^2$.
We describe the relation of this result to curvatures associated with Monge-Ampere foliations, and partial results towards a more general conjecture. A proof of the theorem has also been given by W. Stoll.(Received February 27, 1979.)

766-B31 WILLIAM O. RAY, Iowa State University, Ames IA 50011 and STANLEY E. SELTZER, Illinois State University, Normal, IL 61761. Stability and Chaos in a discrete predator-prey model. Preliminary report.

We are concerned with the system of difference equations

$$x_{n+1} = x_n (a - \delta x_n - b y_n)$$

$$y_{n+1} = y_n (c - \epsilon y_n + d x_n).$$

This is a variation of the classical Lotka-Volterra model; here each species exhibits logistic growth in the absence of the other. Assume $a > 1$ and $b,c,d,\delta,\epsilon,x, y, \geq 0$.

We call a critical point P a locally stable solution if there is an open neighborhood $U \subseteq [\,0,\infty\,) \times [\,0, \infty\,)$ of P such that all initial conditions in U give rise to non-negative solutions which approach P. In this paper we obtain stability and non-stability results and investigate chaos (in the sense of Li and Yorke, Am. Math. Monthly, 82 (1975),985-992).(Received February 27,1979.)

Applied Mathematics
(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

*766-C1 Robert O. Shelton, University of Tennessee, Knoxville, Tennessee 37916. Noncollision Singularities in the Four-Body Problem.

A description of the behavior of the 4-body problem near a noncollision singularity is given. This description includes a careful treatment of the clustering process first described by von Zeipel and later used by Sperling. It is shown that the angular momentum of each cluster with respect to its center of mass tends to 0 at the time of a noncollision singularity. This result implies that the positions of the particles must tend to some fixed line in space at such a singularity. (Received February 9, 1979.) (Author introduced by Professor Richard P. McGehee).

*766-C2 JOHN B. URENKO, Pennsylvania State University, Schuylkill Campus, Schuylkill Haven, Pennsylvania 17972. Improbability of Collisions in Newtonian Gravitational Systems of Specified Angular Momentum.

The angular momentum integral of the equations of motion of the n-body problem of celestial mechanics defines a family of lower dimensional analytic manifolds in the phase space. It is shown that if $n \geq 3$, then the intersection of each manifold with the set of initial conditions which lead to collision is of measure zero in the manifold. Thus, for a specified value of angular momentum, collisions are improbable. It follows as a corollary that the converse of Sundman's Theorem of Total Collapse is not true when $n \geq 3$. (Received February 22, 1979.)

*766-C3 NEAL D. HULKOWER, Jet Propulsion Laboratory, Pasadena, CA 91103 and DONALD G. SAARI, Northwestern University, Evanston, IL 60201. Toward a proof of a conjecture of Wintner. Preliminary report.

In his classic text on celestial mechanics, Wintner proved that n particles participating in total collapse asymptotically approach the vertices of a central configuration. Only for n=2 was it also shown that the particles did so along definite directions. Siegel extended this result to n=3. More recently an expanding universe version of this problem presented itself when Saari proved that n particles expanding parabolically must also approach vertices of a central configuration. Hulkower proved for the planar three-body problem that the particles did so along fixed asymptotes. Limited results were also obtained for the spatial situation. We report on our progress toward extending these results for both versions of the conjecture for certain n body systems and "nondegenerate" central configurations. The primary tool remains the stable manifold theorem. We also obtain structural and dimensional information about the sets of initial conditions leading to each type of behavior. (Received February 22, 1979.)

766-C4 Martin Kummer, University of Toledo, Ohio 43606. On the construction of the reduced phase space of a Hamiltonian System with Abelian symmetry group. Preliminary report.

Let $\pi: M \to N$ be a principal fiber bundle with Abelian structure group G, action ϕ and Weil homomorphism h. Let $\psi: T^*M \to g^*$ (g = lie algebra of G) be the moment of the exact symplectic lift of ϕ to the contangent bundle T^*M of M, so that $i_\lambda: \psi^{-1}(\lambda) \to T^*M$ for $\lambda \in g^*$ is a submanifold of T^*M. Theorem: π possesses an extension $\tilde{\pi}: T^*M \to T^*N$ such that $i_\lambda^* \tilde{\pi}^* d\theta_N = i_\lambda^* d\theta_M$ iff $\lambda \in \ker h$. (θ_M, θ_N = canonical one forms on T^*M, T^*N). $\tilde{\pi}$ is constructed explicitly and like Satzer (Ind. Univ. Math. J. 26, 951-76 (1977)) we apply our construction to the planar 3-body problem with the difference however, that all our transformations are canonical. (February 22, 1979.)

766-C5 Dieter Schmidt, University of Cincinnati, Cincinnati, Ohio 45221. The Lunar Theory of Hill and Brown. Preliminary report.

The solution of Hill and Brown to the motion of the moon was used until recently for the computation of the ephemerides of the moon. Despite corrections and improvements to this solution it is no longer accurate enough and its necessary to redo the computations of Brown in their

entirety. This is accomplished with the help of a computer program called POLYPAK, which can manipulate power series in several variables.

We show how to solve the differential equations of the main problem of lunar theory formally and report on our comparison with the results of Brown. (Received February 26, 1979.)

Geometry (50, 52, 53)

*766-D1 M. J. KALLAHER and T. G. OSTROM, Wash. State Univ. Pullman, Washington 99164
Collineation groups acting irreducibly on lines of a translation plane.

We consider a translation plane $\mathfrak{P}$ with a collineation group G such that the following hold: (i) $\mathfrak{P}$ has odd dimension d over its kernel $K = GF(p^s)$ and (ii) For every component ℓ of $\mathfrak{P}$, the group G_ℓ has order divisible by a p-primitive divisor u of $p^{sd}-1$. The following results are proven. Theorem 1: If G is solvable then $\mathfrak{P}$ is either a semi-field plane or a generalized André plane. Theorem 2: If G is non-solvable, then one of the following holds: (a) $\mathfrak{P}$ is desarguesian; (b) $p^s = d = 3$, $s = 1$, $u = 13$, $G = SL(2,13)$, and the group TG, where T is the translation group of $\mathfrak{P}$ is doubly transitive on $\mathfrak{P}$; (c) $u = 2d + 1$, $s = 1$, and $G = SL(2,u)$. Using these results we prove: Theorem 3: If $\mathfrak{P}$ is a finite translation plane of odd dimension over its kernel with a rank 3 collineation group, then $\mathfrak{P}$ is either a generalized André plane or a semi-field plane. Theorem 4: If $\mathfrak{P}$ is a finite translation plane of odd dimension over its kernel with a collineation group G that is doubly transitive on each affine line, then one of the following holds: (a) $\mathfrak{P}$ is a generalized André plane; (b) $\mathfrak{P}$ is a semi-field plane; (c) $\mathfrak{P}$ has order 3^3 and G contains a subgroup $G_1 \cong SL(2,13)$ such that the group TG_1, where T is the group of translations, is doubly transitive on the affine points of $\mathfrak{P}$. (Received November 20, 1978.)

Logic and Foundations (02, 04)

766-E1 Bruce I. Rose, University of Notre Dame, Notre Dame, Indiana 46556. A characterization of rings which admit elimination of quantifiers. Preliminary report.

All rings are associative with 1. Quantifier elimination is in the language $\{0,1,+,-,\cdot\}$. Results of Boffa, Berline, Rose, Macintyre and Rosenstein are used to obtain the following theorems.

THM 1 Let R be countable. Then R admits elimination of quantifiers if and only if either R is an algebraically closed field of characteristic 0 or $R \cong R_1 \oplus \ldots \oplus R_n$ where for distinct primes $p_1, \ldots, p_n$, $p_i^{n_i} R_i = 0$ and either R_i is an algebraically closed field or R_i is a uniformly locally finite ring with the property that any isomorphism of subrings of smaller cardinality can be extended to an automorphism.

THM 2 Let R have no nonzero nilpotent elements. Then R admits elimination of quantifiers if and only if R is either an algebraically closed field of characteristic 0, or $R \cong R_1 \oplus \ldots \oplus R_n$ where if $i \neq j$, then R_i and R_j have different prime characteristics and R_i is either
(a) an algebraically closed field,
(b) an atomless p_i-ring,
(c) a finite field,
or (d) a direct sum of two finite fields $GF(p_i^j)$ and $GF(p_i^k)$ where either $j=k$ or j and k are relatively prime.

(Received February 27, 1979.)

Statistics and Probability (60, 62)

766-F1 ANNIE MILLET and LOUIS SUCHESTON, Ohio State University, Columbus, Ohio 43210. Essential convergence of L_1-bounded martingales does not imply the Vitali condition V.

The result stated in the title answers a question which has remained open since in 1956 K.Krickeberg introduced V. Let (F_t) be an increasing family of σ-algebras indexed by a directed set J. $\mathbb{M}$ is the set of incomplete multivalued stopping times τ ; $e_\tau = \sum 1_{\{\tau=t\}} - 1_{U\{\tau=t\}}$. (C.R. Acad. Sc. Paris, t. 286, p. 1015). Let $m \in \mathbb{N}$; SV(m) holds iff $\forall \alpha > 0$, and for every adapted family of sets (A_t), $\exists \tau \in \mathbb{M}$ such that $P(e \overline{\lim} A_t \setminus A_\tau) < \alpha$, and $e_\tau \leq m$. $V(= V_\infty)$ is SV(0) ; SV is the logical

union of the SV(m). T1: Fix (F_t); TFAE : (i) SV(m) holds.(ii) For every adapted family of positive r.v.'s (X_t) , $\forall \beta > 0$, $\beta\, P(e \overline{\lim} X_t \geq \beta) \leq \overline{\lim}\{ E X_\tau : e_\tau \leq m\}$. (iii) $\exists K > 0$ such that for every adapted family of sets (A_t), $P(e \overline{\lim} A_t) \leq K \overline{\lim}\{ P(A_\tau) : e_\tau \leq m\}\}$. C1: If SV(m) holds, for every positive submartingale (X_t), $\forall \beta > 0$, $\beta\, P(e \overline{\lim} X_t \geq \beta) \leq (m+1) \lim E X_t$. T2: Let (F_t) satisfy SV , and let $\underline{E}$ be a Banach space. (i) If $X \in L_1^{\underline{E}}$, $E(X \mid F_t)$ converges essentially. (ii) If $\underline{E}$ has RNP , every $L_1^{\underline{E}}$-bounded martingale converges essentially. T3: The conditions SV(m), $m = 0, 1, \ldots$ are all different. (Received February 15, 1979.)

766-F2 WALTER PHILIPP, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801. Almost sure invariance principles for sums of B-valued random variables.

The main purpose of this paper is to give necessary and sufficient conditions for the almost sure approximation of the t-th partial sum of independent identically distributed random variables with values in a separable Banach space and having finite second moments by a suitable Brownian motion $\{X(t), t \geq 0\}$ with an error term $o((t \log\log t)^{\frac{1}{2}})$. (Received February 5, 1979.)

*766-F3 MARJORIE G. HAHN, Tufts University, Medford, MA 02155 and MICHAEL J. KLASS, UC Berkeley, Berkeley, CA 94720. The multidimensional central limit theorem for arrays normed by affine transformations and related asymptotic independence results.

Let $X_{n1}, \ldots, X_{nk_n}$ be independent random vectors. Necessary and sufficient conditions are found for the existence of linear operators $T_n : \mathbb{R}^d \to \mathbb{R}^d$ and vectors c_n such that $L(T_n(\sum X_{nj}) - c_n) \to N(\vec{0}, I)$, where I is the d × d identity covariance matrix. These results extend the authors' previous work on sums of i.i.d. random vectors and also the Lindeberg-Feller Theorem, even in 1-dimension. The centering for non-identically distributed random vectors is more complicated and requires injection of a new idea. The proof of the main theorem is constructive, yielding explicit centering constants and norming linear operators whose choice is motivated by the asymptotic independence of orthogonal directions which is required by the limit distribution. We then extend the notion of asymptotic independence of orthogonal components as defined by Hudson and Tucker. As a consequence, whenever the sample mean of i.i.d. random variables is in the domain of attraction of a normal law, it is asymptotically independent of a suitably normalized sample variance except when the third moment exists and is nonzero. (Received February 8, 1979.)

766-F4 Chi-Shang Soong, Villanova University, Villanova Pa., 19085. Exchangeable sequences in Banach spaces.

The previous exchangeable central limit theorem in the type 2 Branch space (Notices January 1979 763-60-16) is extended to the cases involving random sample size and/or triangular arrays. (Received February 12, 1979.)

*766-F5 HUI-HSIUNG KUO, Louisiana State University, Baton Rouge, LA 70803. An example of quasi-invariant cylindrical measure.

Let μ be the cylindrical measure on ℓ_1 defined by $\mu(\{(x_k) \in \ell_1; (x_1, \ldots, x_n) \in B\}) = 2^{-n} \int_B \exp\{-(|x_1| + \ldots + |x_n|)\}\, dx_1 \ldots dx_n$. It is proved that μ is quasi-invariant. This answers affirmatively a question raised by W. Linde (Z. Wahrscheinlichkeitstheorie 40 (1977), 91-99): Are there quasi-invariant cylindrical measures on Banach spaces which are not isomorphic to a Hilbert space? (Received February 12, 1979.)

*766-F6 EVARIST GINE-MASDEU, Instituto Venezolano de Investigaciones Científicas (IVIC), Apdo. 1827, Caracas 101, Venezuela.
Convergence of moments in the CLT in Banach spaces: applications.

A recent result of A. de Acosta and this author on convergence of moments in the general CLT in Banach spaces is applied to: centering of integrable shift compact triangular arrays, the i.i.d. Gaussian convergence case and the equivalence of the different cotype 2 properties (another simple proof of this), convergence of moments in the i.i.d. case (general domain of attraction), and the global CLT. This is a report on results obtained jointly with A. de Acosta. (Received February 12, 1979.)

766-F7 J. KUELBS, University of Wisconsin, Madison, Wisconsin 53706 and J. ZINN, Michigan State University, East Lansing, Michigan 48824. Some recent results on the Law of the Iterated Logarithm. Preliminary report.

If X is a mean zero random variable with values in the real separable Banach space we say X satisfies the bounded law of the iterated logarithm (LIL) if $\overline{\lim_n} \|S_n/a_n\|$ with probability one. Here $\{X_j\}$ are independent copies of X, $S_n = X_1 + \ldots + X_n$, and $a_n = \sqrt{2n \log\log n}$ for $n \geq 3$. We say X satisfies the compact LIL if there is a compact set K such that $\lim_n d(S_n/a_n, K) = 0$ and the cluster set $C(\{S_n/a_n : n \geq 3\})$ equals K with probability one. If $E\|X\|^2 < \infty$, then it is known that X satisfies the compact LIL if $S_n/a_n \xrightarrow{\text{prob}} 0$, but if $E\|X\|^2 = \infty$ the story is hardly complete. In this report we will indicate some conditions which identify the cluster set $C(\{S_n/a_n : n \geq 3\})$ provided $S_n/a_n \xrightarrow{\text{prob}} 0$ and $E(f^2(X)) < \infty$ for all continuous linear functions f on B, i.e. if $S_n/a_n \xrightarrow{\text{prob}} 0$ and X is weakly square integrable. We also give an example of a mean zero weakly square integrable random variable X with values in ℓ_2 such that $C(\{S_n/a_n : n \geq 3\})$ is the unit ball in ℓ_2 and X satisfies the bounded LIL in C_0. This is the first example of a weakly square integrable random variable such that $C(\{S_n/a_n : n \geq 3\})$ is non-compact. (Received February 12, 1979.)

766-F8 J. KUELBS, University of Wisconsin, Madison, Wisconsin 53706, J. ZINN, Michigan State University, East Lansing, Michigan 48824. The central limit theorem and the law of the iterated logarithm in Banach spaces.

In this talk we will discuss the relationship between the central limit theorem (CLT) and the law of the iterated logarithm (LIL) in Banach spaces . Letting $Lt = \ell n(t \vee e)$ and $L_2 t = L(Lt)$ we have the

Theorem. If X satisfies the CLT and $E \frac{\|X\|^2}{L_2\|X\|} < \infty$, then X satisfies the LIL. (Received February 12, 1979.)

766-F9 M.B. ALEKSANDROWICZ and A. WERON, Southern Illinois University, Carbondale, Illinois 62901 and Wroclaw Technical University, 50-370 Wroclaw, Poland. On Some Banach spaces related to stable measures. Preliminary report.

A measure μ on Banach space E is symmetric α-stable if for each $x^* \in E^*$ the distribution of real random variable $\langle x^*, x\rangle$ on (E, B_E) has the following characteristic function: $\exp(-c(x^*)|t|^\alpha)$, where $0 < \alpha \leq 2$. A Banach space $E \in V_\alpha$-class iff for each α-stable random measure μ and for each α-stable cylindrical measure ν the inequality for their characteristic functionals

$$|1 - X_\nu(x^*)| \leq |1 - X_\mu(x^*)| \quad \text{for } x^* \in E^*$$

implies that ν is a random measure. Such spaces were introduced by Nguyen Zui Tien and A. Weron (1978). It is the aim of this paper to present properties of Banach spaces which belong to the V_α-class. (Received February 12, 1979.)

*766-F10 A. Weron, Southern Illinois University, Carbondale, Illinois 62901 and Wroclaw Technical University, 50-370 Wroclaw, Poland. Gaussian cylindrical processes in Banach spaces.

Let E be a Banach space, S an arbitrary set. An L^2 stochastic process with values in E and with index set S is a family of weak second order random E-variables (X_s). A family (T_s) of cylindrical random variables (T_s), $T_s \in L(E^*,L_2(\Omega))$ is called a cylindrical process. We propose the method of the dilation theory for study of cylindrical processes which are Gaussian, stationary or square integrable martingales.

For example, an equivalence of the following two properties of a Banach space with unconditional basis (e_n) may be obtained: (1) E does not contain l_∞^n uniformly, (2) a positive kernel $R: S\times S \to L(E^*,E)$ is the covariance function of a Gaussian stochastic process with values in E iff $\forall s \in S \sum_{k=1}^{\infty} [(R(s.s)e_u^*)e_u^*]^{1/2}e_k$ is convergent in E. (Received February 12, 1979.)

(Author introduced by Professor James P. Kuelbs).

766-F11 EVARIST GINE-MASDEU, Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela, and V. MANDREKAR, and J. ZINN, Michigan State University, East Lansing, Michigan 48824. On sums of independent random variables with values in L_p $(2 \leq p < \infty)$.

In this work we study sums of independent random variables with values in L_p $(2 \leq p < \infty)$. We prove 1) three series theorem for independent random variables, and 2) weak law of large numbers and central limit problem for uniformly infinitesimal row-independent triangular arrays of random variables. The results are based on some inequalities of H. Rosenthal. As a consequence some results of Novikov and Yurinskii on i.d. laws are derived. Also, the results extend some work of Pisier and Zinn on CLT. (Received February 13, 1979.)

*766-F12 Alejandro de Acosta, Dept.of Math., I.V.I.C., Apdo.1827, Caracas, Venezuela. Integrability and uniform integrability of triangular arrays in Banach spaces.

Let $\{X_{nj}\}$ be a row-wise independent triangular array of B-valued random vectors (I) We prove that if $\{X_{nj}\}$ is uniformly bounded and $\{L(S_n)\}$ is relatively compact, then for all $\lambda>0$ $\sup_n E(\exp\lambda\|S_n\|)<\infty$; if B is of cotype 2, then this result may be sharpened. (II) From (I) we obtain integrability theorems for Poisson measures. (III) We define a class Φ of functions including arbitrary powers and certain exponential functions of the norm. Assuming that $\{L(S_n)\}$ is relatively compact and $\phi\in\Phi$, we give necessary and sufficient conditions for the uniform integrability of $\{\phi(S_n)\}$. (IV) We obtain from (III) n. and s. conditions for $\lim_n E\phi(S_n)=\int\phi d\nu$ under the assumptions $L(S_n)\to_w\nu$ and $\phi\in\Phi$. Several of the results were obtained jointly with E. Giné. (Received February 15, 1979.) (Author introduced by Professor James Kuelbs).

766-F13 DAVID ISAACSON and SANDY ZABELL, Rutgers University, New Brunswick, New Jersey 08903. The Continuum Limit of the One-dimensional Classical Heisenberg Model. Preliminary Report.

The one-dimensional, k-component classical Heisenberg model defines a stochastic process with values in the (k-1)-sphere. We prove (for k=1,2,3) that in the continuum limit this process converges weakly to Brownian motion on S^{k-1}. This result is related to the scaling limit of the k-component φ_1^4 Markov process. (Received February 15, 1979.)

*766-F14 A. ARAUJO, University of Chicago, Chicago, Illinois 60615. Some Questions in Probability on Banach Space Arising in Economics.

Let B be the Banach space of twice cont. diff. funct. over $(0,a)^n$ with sup norm. For each w,p in R^n_{++} and u in B increas. Let $\phi(P,u,w)$ be the set of maximizers of u in $\{x, P\cdot x = P\cdot w\}$. For Borel prob γ on B let $\psi(P) = \int\phi d\gamma$. When is ψ a cont. funct.? The ans. of this question is well

known, it is enough for γ to have proj. on some F.D. subs. that are abs. cont. with resp. Lebesgue. A much harder question whose ans. is not known is: Which γ makes ψ diff.? Let A be an open subset of B s.t. for u in A $\phi(p,u,w)$ is a cont. funct. The set of equil. p(e) for $e = (u_i,w_i)_{i=1}^n$ (u_i in A) is the set of P s.t.: $\Sigma\phi(p,u_i,w_i) = \Sigma w_i$. Third question: How big is the set E of e s.t. p(e) is finite, and can be described locally by cont. funct. of e? Let MZ be the set of Borel sets C s.t. $\exists\gamma$ Gauss. With full supp. s.t. $\gamma(C + x) \equiv 0$. Theorem: E^c is in MZ
(Received February 15, 1979.) (Author introduced by Professor James P. Kuelbs).

766-F15 K. SUNDARESAN and W. A. WOYCZYNSKI, Cleveland State University, Cleveland, Ohio 44115.
Laws of large numbers and Beck convexity in metric linear spaces. Preliminary report.

We study an analogue of the well known Banach space Beck convexity condition, in the context of certain metric linear, but not necessarily locally convex spacesE (and which perhaps in these circumstances, should be called a concavity condition). In particular, we show that our condition is equivalent to the validity of certain strong laws of large numbers for independent E valued random vectors. (Received February 19, 1979.)

766-F16 C.M. Deo, University of Ottawa, Ottawa Ont. K1N 9B4, Canada. A strong convergence theorem for stationary Gaussian sequences in a Hilbert space.

Let (S_n) be partial sums of a stationary Gaussian sequence taking values in a Hilbert space and let (a_n) be a sequence of integers satisfying (i) $0 \le a_n \le n$ (ii) $a_n \uparrow \infty$ and $a_n/n \downarrow$. We prove on a.s. functional limit theorem for sums of the form $S_n - S_{n-a_n}$. (Received February 19, 1979.)
(Author introduced by Professor Walter V. Philipp).

766-F17 Arnold L. Neidhardt, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, N.Y. 10012. A central limit theorem for diffusions. Preliminary report.

If the coefficients of a diffusion have radial limits at infinity, then in the distant future the process (suitably scaled) should converge in distribution to a diffusion whose coefficients are the limits of the original coefficients. Proving that this convergence occurs is hindered by the discontinuity at the origin of the limiting coefficients. The argument depends on getting the behavior of the limiting diffusion away from the origin to uniquely determine the way in which the process can leave the origin initially. (Received February 19, 1979.)

*766-F18 GREGORY J. MORROW, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801.
Approximation of rectangular sums of B-valued random variables. Preliminary report.

Let $\{\xi_{j,k};\ j,k \ge 1\}$ be independent identically distributed random variables assuming values in a real separable Banach space. Let $R(s,t) = \sum_{\substack{j\le s\\ k\le t}} \xi_{j,k}$ be a rectangular sum and put $a(s,t) = (s\cdot t \log\log(st))^{\frac{1}{2}}$. Suppose $\xi_{1,1}$ is pregaussian, has mean zero and belongs to $L^2 \log L$. Assume further that $\frac{R(s,t)}{a(s,t)}$ tends to zero in probability as $\min(s,t) \to \infty$. Then without loss of generality there exists a Brownian sheet $\{X(s,t);\ s,t \ge 0\}$ such that with probability one

$$||R(s,t) - X(s,t)|| = o(a(s,t)) \quad \text{as} \quad \min(s,t) \to \infty.$$

This result extends easily to sums of random variables indexed by lattice points in $\mathbb{R}^d$.
(Received February 13, 1979.)

766-F19 Alexandra Bellow, Northwestern University, Evanston, Illinois 60201 and Aryeh Dvoretzky, The Hebrew University, Jerusalem, Israel. A characterization of almost sure convergence. Preliminary report.

The object of this paper is to give a characterization of almost sure convergence for an L^1- bounded sequence of random variables taking values in a Banach space. For the purpose of our characterization we must allow unbounded stopping times (the set of bounded stopping times does not suffice) and we must introduce the notions of "dense set" and "abundant set" of stopping times. (Received February 23, 1979.)

766-F20 MICHAEL B. MARCUS, Northwestern University, Evanston, Illinois 60201. Weak Convergence of the Empirical Characteristic Function. Preliminary report.

Let F_n be the n^{th} empirical distribution function of a random variable X with characteristic function C(t). We give necessary and sufficient conditions for $n^{1/2}(C_n(t) - C(t))$, $t\varepsilon[-1/2,1/2]$ to converge weakly. Here $C_n(t)$ is the characteristic function of F_n. The solution employs techniques used in the study of the central limit theorem on Banach spaces. (Received February 27, 1979.)

Topology (22, 54, 55, 57, 58)

*766-G1 WILBUR WHITTEN, University of Southwestern Louisiana, Lafayette, La. 70504. Inverting double knots.

A tame, oriented knot K in (oriented) S^3 is strongly invertible, if there exists an orientation-preserving, PL involution of S^3 inverting K. J. Montesinos has conjectured in ["Problems in low dimensional manifold topology," Proc. of the A.M.S. Summer Institute in Topology, Stanford University, 1976, to appear] that every invertible knot is strongly invertible. In this paper, we refute this conjecture; our results are as follows. Theorem 1. A knot K is strongly invertible if and only if each double of K is strongly invertible. Corollary. No double of a noninvertible knot is strongly invertible; hence, there exist invertible knots that are not strongly invertible. Theorem 2. If L is a strongly invertible knot with exactly one maximal companion, C_L, then C_L is also strongly invertible. (Received January 18, 1979.)

*766-G2 Herbert C. Lyon, Northland College, Ashland, Wisconsin 54806. Incompressible Surfaces in the Boundary of a Handlebody - An Algorithm.

Let $c_1,\cdots,c_k$ be pairwise disjoint simple closed curves in the boundary of the genus n orientable 3-dimensional handlebody H_n, and assume each c_i, $1 \leq i \leq k$, is non-contractible in H_n. Let each c_i determine the cyclic element w_i in $\pi_1(H_n)$, a free group of rank n. Implicit in the Whitehead Theorem (4.20, p. 35, Lyndon and Schupp, Combinatorial Group Theory, Springer Verlag, 1977) is an algorithm for determining whether a basis for $\pi_1(H_n)$ has been chosen so that the sum of the lengths of the cyclic words w_i is minimal, and if not, for altering this basis so as to reduce this sum. Thus, assuming the basis B of $\pi_1(H_n)$ has been chosen so that the sum of the lengths of the cyclic words w_i is minimal, we prove that $Cl(\partial H_n - \bigcup_{i=1}^{k} N(c_i))$ is compressible iff there exists a nontrivial partition $B = B_1 \cup B_2$, $B_1 \cap B_2 = \emptyset$, such that $\bigcup_{i=1}^{k} \{w_i\} \subset < B_1 > \cup < B_2 >$. Related topological results are also proven, as are algebraic results of possible independent interest. (Received January 29, 1979.)

*766-G3 ROBERT MYERS, The University of Texas, Austin, Texas 78712. Homology 3-spheres which admit no PL involutions.

In Problem 3.24 of "Problems in Low Dimensional Manifold Theory" (Proceedings of the AMS Summer Institute in Topology, Stanford 1976) H. Hilden and J. Montesinos ask whether every homology 3-sphere is the double branched covering of a knot in S^3. The interest in this question lies in the fact that there is an algorithm, due to J. Birman and H. Hilden, for deciding whether such a manifold is homeomorphic to S^3. These manifolds admit PL involutions with simple closed curves of fixed points. In this paper we give a negative answer to this question by constructing an infinite family of pairwise non-homeomorphic, irreducible homology 3-spheres which admit no PL involutions. (Received February 5, 1979.)

*766-G4 R. C. Swanson, University of Missouri, Columbia, Missouri 65211. Spectral Properties of the adjoint representation of a dynamical system. Preliminary report.

For a compact manifold M and a diffeomorphism $G:M \to M$ one can define the adjoint representation of G as the bounded linear operator $G^{\#}$ on continuous vector fields such that

$$G^{\#}Y = TG \circ Y \circ G^{-1}, \text{ for } Y \text{ in } C(TM).$$

For the case of a flow with generator X one replaces sections of TM with sections of the quotient bundle TM/X if X is non-vanishing. By a well-known result of Mather, a dynamical system is Anosov if and only if 1 is not in the spectrum of $G^{\#}$. Now $G^{\#}$ is bounded on any of the Sobolev-Lebesgue spaces $L^p_k(TM)$ of vector fields whose first k derivations are p-summable with respect to a smooth invariant measure on M. J. Robbin has observed that if $1 - G^{\#}$ has dense range as an operator on $L^2_1(TM)$ then G is ergodic. Such systems are called infinitesimally ergodic. The author and C. Chicone have shown that a toral automorphism A is infinitesimally ergodic if and only if the spectrum of A lies in two circles off the unit circle. Geodesic flows of constant negative curvature are also infinitesimally ergodic. Another recent result, due to the author, is that G is Anosov iff $G^{\#}$ is hyperbolic on a Lebesgue space $L^p_0(TM)$, which allows "average estimates" as criteria for hyperbolicity. (Received February 5, 1979.)

766-G5 RONALD J. KNILL of Tulane University, New Orleans, Louisiana 70118. Some observations on the Seifert conjecture. Preliminary report.

Since Schweitzer's counterexample to the C^1 Seifert conjecture only partial results have been obtained on the C^∞ problem. Michael Handel [AMS Notices Abstract 78T-G61]has shown that an isolated one dimensional minimal set of a C^1 flow on S^3 must be a surface minimal set, clarifying thereby the relevance of the Denjoy flow to the existence of counterexamples to the Seifert conjecture. While Jenny Harrison and Colin Rourke have made interesting progress on improving the Schweitzer example, to my knowledge there is still no C^2 counterexample. Perhaps it is of interest to note there exists a C^∞ flow on S^3 which, although containing shift automorphisms and hence closed orbits, also contains a minimal set topologically conjugate to the minimal set of the Denjoy flow. I will explain this C^∞ flow and discuss some directions of further research. (Received February 5, 1979.)

*766-G6 S. J. LOMONACO, JR., State University of New York at Albany, Albany, New York 12222. A certain cell decomposition for 2-knot complements.

A cell decomposition is given for 2-knot complements. The consequences of this decomposition are given. Various examples and theorems are given. (Received February 9, 1979.)

766-G7 JULIAN I. PALMORE, University of Illinois, Urbana, IL 61801. Classifying homographic solutions of the n-body problem in E^4.

We prove the existence of many homographic solutions of the n-body problem in Euclidean space E^4 using topological methods. The existence of these similarity solutions depends on the existence of relative equilibria. As homothetic solutions give rise to central configurations, the general homographic solution is associated with configurations of relative equilibria. Central configurations are a proper subset of the relative equilibria in E^4 for any $n \geq 3$. This fact leads to many interesting reversals in E^4 of standard theorems on homographic solutions of the n-body problem in Euclidean space E^3. (Received February 22, 1979.)

766-G8 ERNESTO A. LACOMBA, Universidad Autonoma Metropolitana, P. O. Box 55-534, México 13 D.F. New notion of bifurcation sets in transitive mechanical systems. Preliminary report.

More natural definitions of bifurcation and critical values sets of the momentum and energy momentum maps are given, for homogeneous spaces considered as mechanical systems with symmetry. This is accomplished by applying former results of the author (Transitive Mechanical Systems, Proc. IV Latin Am. School of Math., Lima, Peru 1978), like a generalization of the notion of polhode from the rigid body, and fiber bundle characterizations of the geodesic flow-invariant subsets. The main features of our sets are kept, since inverse images of regular values are still C^∞ manifolds, and our bifurcations correspond to possible topological change in a broader sense.
The advantage of our method is that bifurcations and critical values are discerned, just from looking at certain properties of the polhode where they belong to (like possible manifold structure, being fiber of a local fibration, dimensionality, etc.) (Received February 22, 1979.)

*766-G9 ROBERT L. DEVANEY, Tufts University, Medford, Mass. 02155. Morse-Smale singularities in simple mechanical systems.

We exploit a technique introduced by McGehee to describe the behavior of a simple mechanical system in the neighborhood of an isolated singularity of the potential energy. The singularity is removed and is replaced by a manifold over which the system extends smoothly after a suitable change of time scale. Generically, the induced system is a gradient-like Morse-Smale system and so is relatively easy to understand. This has applications to questions of regularizability of the singularity and smoothness of the set of collision orbits. (Received February 22, 1979.)

766-G10 JONATHAN SIMON, University of Iowa, Iowa City, Iowa 52242. Wirtinger presentations and knot groups.

In this talk we shall discuss results announced in these Notices (25, Feb. 1978, Abstract 78T-G34, A-257, and 25, Oct. 1978, Abstract 78T-G112, A-607). The emphasis will be on describing: (1) how one actually tries to decide if a given group G, with annihilating element t, has a Wirtinger presentation; and (2) the relation of this question to the Poincaré conjecture.
(Received February 23, 1979.)

766-G11 JOAN S. BIRMAN, Columbia University, New York, New York 10027, and J.H. RUBINSTEIN, University of Melborune, Parkville, Victoria, Australia, 3052. Homeotopy groups of certain lens spaces.

Let $L(p,q)$ denote the lens space of type (p,q), and let $H(p,q)$ denote its homeotopy group, i.e. the group of all homeomorphisms $h: L(p,q) \to L(p,q)$ modulo the subgroups of those h which are isotopic to the identity map. Theorem: Let m,n be positive integers, and let $\epsilon = \pm 1$. Then $H(8mn - 2\epsilon, 4mn \pm 2m - \epsilon) =$

$$Z_2 \text{ if } \epsilon=+1,\ m \neq n \text{ or } m = n = 1$$
$$Z_2 \oplus Z_2 \text{ if } \epsilon=+1,\ m=n \neq 1$$
$$Z_4 \text{ if } \epsilon= -1,\ m=n$$

Partial results have been obtained for the case $\epsilon=+1$, $m \neq n$, where the methods apply but an unresolved number-theoretic difficulty remains. (Received February 23, 1979.)

766-G12 JOHN HEMPEL, Rice University, Houston, Texas 77001. Reducibility of Heegaard splittings. Preliminary report.

A Heegaard splitting of a 3-manifold M is a pair (M,F) where F is a surface splitting M into two handle bodies V_1 and V_2. We are interested in criteria for determining when a splitting can be reduced - $(M,F) = (M_1,F_1)\#(M_2,F_2)$ where $(M_i,F_i) \neq (S^3, S^2)$ (i=1,2), or equivalently that some nontrivial element of $N = \mathrm{Ker}(\pi_1(M)\to\pi_1(V_1)) \cap \mathrm{Ker}(\pi_1(M)\to\pi_1(V_2))$ is represented by a simple loop. We observe Theorem 1 Some element $1 \neq \alpha\in N$, is represented by a simple loop if and only if N contains a normal subgroup K of $\pi_1(S)$ such that $\pi_1(S)/K$ has more than one end. Theorem 2 $\pi_1(S)/K$ has more than one end if and only if the intersection pairing $H_1(\tilde{S})\times H_1(\tilde{S})\to\mathbb{Z}$ is singular; where $\tilde{S}\to S$ is the regular covering corresponding to K. Generalizing Papakyriakopoulos (Ann. of Math Studies No 84 (1975), 261-292) we develope formulae for computing this pairing modulo the word problem in $\pi_1(F)/K$. We discuss possible applications to the case in which M is an irreducible homotopy 3-sphere which admits a free involution.

(Received February 23, 1979.)

*766-G13 JEFFREY L. TOLLEFSON, University of Connecticut, Storrs, Ct. 06268. On the classification of PL involutions of 3-manifolds.

Let M be a closed, orientable, irreducible 3-manifold with $H_1(M;Z)$ infinite. Let ψ:Homeo(M)$\to$ Out(π) be the natural homomorphism where $\pi = \pi_1(M)$. The subset $K_2 \subset$ Out(π) corresponding to the PL involutions (via ψ) is characterized by W. Heil and the author [Topology 17, 1978 and Addendum]. This leaves the question as to how faithful ψ is in representing involutions. Involutions g and h are equivalent if $g = fhf^{-1}$ and strongly equivalent if f can be taken isotopic to the identity. Suppose that g is a given PL involution of M. If π has a nontrivial center $Z(\pi)$ then g can be extended to an action of SO(2) when $g\neq 1$ and to an action of SO(2) x Z_2 or O(2) when $g\neq 1$. When g can be extended to SO(2) or SO(2) x Z_2 take β to be the nontrivial involution in SO(2) and otherwise take β = identity. We prove that any PL involution h homotopic to g is strongly equivalent to either g or $g\beta$. It follows that if $Z(\pi)= 1$ then ψ induces a 1-to-1 correspondence between Inv(M),the set of strong equivalence classes of PL involutions, and $\mathrm{Tor}_2(\mathrm{Out}(\pi))$. If $Z(\pi) \neq 1$ then ψ induces a correspondence between Inv(M) and K_2 that is at most 2-to-1. A similar correspondence exists between equivalence classes of involutions and conjugate classes of K_2 in Out(π). (Received February 26, 1979.)

*766-G14 E. M. BROWN, Dartmouth College, Hanover, N. H. and C. D. Feustel, V.P.I. and S. U. Blacksburg, VA 24061. On proper essential embeddings of planes in 3-manifolds

An analog of the loop theorem is proved for noncompact 3-manifolds. In particular it is shown that the existence of an essential proper map of a plane into a 3-manifold implies the existence of an essential proper embedding of a plane into the 3-manifold.

Theorem Let M be a 3-manifold and let [a] be an end of M. Let $f:(R^2,[*]) \to (M,[a])$ be a proper map which carries the unique end [*] of R^2 to the end [a] of M. Assume $\pi_1(f)$ is nontrivial. Then there is a proper embedding $g:([R^2,*]) \to (M,[a])$ such that $\pi_1(g)$ is nontrivial.

The theorem above removes all restrictions from the result in our earlier paper "On properly embedding planes in 3-manifolds", Proc. AMS 55 (1976) 461-464. (Received February 26, 1979.)

766-G15 PETER B. SHALEN, New York University - Courant Institute, New York, N.Y. 10012. $PSL_2(\mathbb{C})$ and incompressible surfaces.

This talk summarizes a number of applications to 3-dimensional topology of a theorem of Hyman Bass's on subgroups of $PSL_2(\mathbb{C})$. (Received February 26, 1979.)

*766-G16 Walter D. Neumann, University of Maryland, College Park Maryland and Frank Raymond, University of Michigan, Ann Arbor, Michigan 48109 Automorphisms of Seifert manifolds.

Let (S^1, M) be an effective action, without fixed points, of the circle on a closed oriented 3-manifold M whose fundamental group is neither cyclic nor finite. Very explicit calculations of the homotopy groups of the group of homeomorphisms, $H(M)$, are obtained by studying the group of equivariant homeomorphisms of M. This, in turn, is used for analyzing the possible liftings of the finite subgroups of $\pi_o(H(M))$ into $H(M)$. The finite subgroups of $H(M)$ that act freely and are in the kernel of $H(M) \to \pi_o H(M)$ are cyclic and embedded in the S^1-action. The finite subgroups of $\pi_o(H(M))$ are usually cyclic or dihedral and if M is sufficiently complicated will just be $Z/2Z$. There are analagous results for Seifert manifolds with boundary and for those that admit no S^1-action. As an application, to surface theory the problem of geometrically realizing extensions of Fuchsion groups by finite groups is partially solved. (Received February 26, 1979.)

*766-G17 BENNY D. EVANS, Oklahoma State University, Stillwater, Oklahoma 74074. Involutions on standard orbits of the three sphere. Preliminary report.

Say a three- manifold M is a standard orbit of the three sphere if M is homeomorphic with the orbit space of a standard orthogonal action on the three sphere. Theorem. If f is a fixed point free involution on a standard orbit M of the three sphere, then M/f is a standard orbit of the three sphere. Special cases of thes theorem were proved earlier by Evans and Maxwell and by Rubenstein in case M contains a Klein bottle and by Myers in case M is a lens space. (Received February 27, 1979.)

*766-G18 PAIK K. KIM and DONALD SANDERSON, Iowa State University, Ames, Iowa 50011. On orientable torus bundles over the circle which contain Klein bottles. Preliminary report.

We answer the question which orientable torus bundles over S^1 admit (PL) embeddings of a Klein bottle. Precisely, Theorem: An orientable torus bundle over S^1, which contains a Klein bottle, is homeomorphic to a Seifert manifold $M(b)$ of type $\{b; (n_2,2)\}$. We remark that each $M(b)$ contains a Klein bottle.

Our approach can be applied to show, Theorem: No orientable torus bundles over S^1 with exceptions $S^1 \times S^1 \times S^1$, $M(0)$ admit orientation-reversing PL involutions with nonempty fixed-point set. We also classify all PL involutions on the spaces $M(b)$ with nonempty fixed-point set.

Following from our result, the class of manifolds $M(b)$ is the only orientable torus bundles over S^1 which allow nonorientable surfaces of any even genus to embed. Besides, these manifolds are of special interest, since P.E. Conner and F. Raymond have shown that the spaces $M(b)(b \neq 0)$ allow only a few finite groups to act("Manifolds with few periodic homeomorphisms", Lecture Notes in Math. 299, 1-75). (Received February 27, 1979.)

*766-G19 SELMAN AKBULUT, Rutgers University, New Brunswick, New Jersey 08903. Some local aspects of the topology of real algebraic varieties.

I will discuss some ambient results on the topological classification theory of real algebraic sets. This classification program jointly being carried with Henry King; in particular we have:

Theorem. If a closed smooth submanifold M^m of S^n bounds a smooth compact parallelizable manifold in S^n and $n > m+1$ then M is isotopic to the link of a real algebraic variety in $\mathbb{R}^{n+1}$ with isolated singularity at $0 \in \mathbb{R}^{n+1}$.

This is an ambient version of our general result that "A smooth closed manifold is a link of a real algebraic variety with an isolated singularity if and only if it is a boundary".

I will discuss the proof of the theorem in the case $n = 3$ and M is any link in S^3. (Received February 27, 1979.)

766-G20 DEBORAH GOLDSMITH, University of Michigan, Ann Arbor, Michigan 48109. Knot theory and three manifolds. Preliminary report.

Let a link L and S^3 be obtained from framed surgery on oriented curves $K_i \subset M$, with framing numbers n_i, where $M = S^3 \setminus \{\text{trivial link}\}$, and each K_i is homotopically trivial in M. Let $\pi: \tilde{M} \to M$ be the universal abelian covering space, with abelian group of covering translation G, freely generated by τ_i. Choose an oriented component $\tilde{K}_i \subset \pi^{-1}$ of $\{K_i\}$ for each i. Let the Hermitian matrix $\Lambda = [\lambda_{ij}]$ have entries $\lambda_{ij} \in \mathbb{Z}\setminus\{G\}$ defined by $\lambda_{ij} = \sum_{g\in G} lK\{\tilde{K}_i, g\tilde{K}_j\}\cdot g$, where $lK\{\tilde{K}_i, \tilde{K}_i\} = n_i$. Let $\sigma\{\tau_1,\dots,\tau_n\}$ be the signature of this matrix if τ_i is a unit complex number. Then $\sigma\{e^{2\pi i/p},\dots,e^{2\pi i/p}\}$ (plus an error term) is an invariant of concordant of L if p is any prime. (Received February 27, 1979.)

766-G21 C. McA. GORDON, University of California Berkeley, Berkeley, California 94720. Knots in the boundaries of contractible 4-manifolds.

A knot K in the boundary of a (compact) 4-manifold N is slice in N if $K = \partial D$ for some (smooth) 2-disc $D \subset N$. If there exists such a D with $\pi_1(\partial N - K) \to \pi_1(N - D)$ surjective, K is π_1-ribbon in N. (Ribbon knots in S^3 are π_1-ribbon in B^4.) Theorem 1. There exist knots $K \subset \partial N$, N contractible, such that (1) K is π_1-ribbon in an acyclic 4-manifold; (2) K is not π_1-ribbon in any contractible 4-manifold; (3) K is slice in a contractible 4-manifold if and only if K bounds a (not necessarily locally flat) PL disc in a contractible 4-manifold. Corollary. Either (a) K does not bound a PL disc in any contractible 4-manifold, or (b) K is slice but not π_1-ribbon in some contractible 4-manifold. A (smooth) concordance C in $S^3\times[0,1]$ between knots $K_i \subset S^3\times\{i\}$, $i = 0,1$, is ribbon from K_0 (to K_1) if C has no minima when put in the usual "critical level" position with respect to the height function $S^3\times[0,1]\to[0,1]$. Theorem 2. Modulo the 4-dimensional s-cobordism theorem, the only ribbon concordance from a torus knot is the product concordance. (Received February 27, 1979.)

766-G22 WOLFGANG R. G. HAKEN, University of Illinois, Urbana, Illinois 61801. On the homeomorphism problem of 3-manifolds.

• We consider compact 3-dimensional manifolds M^3 with or without boundary. M^3 may be presented as a finite simplicial complex. From the complex one may "read" in a well-known manner the homology groups and a presentation of the fundamental group of M^3; one may also obtain a system of linear equations, the "N-equations" of the complex, whose nonnegative integral solutions correspond to surfaces in M^3 which are either closed or "spanning surfaces" and are in a "normalized position" in a sense first defined by H. Kneser in 1928. The "fundamental solutions" of the N-equations allow one to algorithmically determine certain "interesting" surfaces which may be contained in M^3 (i.e., surfaces which are incompressible, boundary-incompressible, not boundary-parallel and of minimal genus). This is a simplified version of the algorithms described by the speaker in 1961/1962. Many special cases of the homeomorphism problem (to determine whether or not two given 3-manifolds are homeomorphic) can be solved by iterated application of these algorithms. However, for practical purposes the system of N-equations is rather large: The number of equations is three times the number of triangles in the interior of the complex, and the number of unknowns is seven times the number of tetrahedra. It is certainly advisable to simplify the presentation of the given M^3 as far as possible before applying the algorithms. It is well known how to produce a cell-decomposition of M^3 with only one 3-cell and only one vertex in each boundary component of M^3 (and with a vertex in the interior only if M^3 has no boundary). From such a decomposition one

can very conveniently read a group-presentation as well as obtain a corresponding "Heegaard diagram" of M^3 (in case of M^3 with boundary following a suggestion of Waldhausen); however, the system of N-equations may be larger than before. For a small system one needs a decomposition into simplicial cells with as few 3-cells as possible. This is obtained by first constructing a Heegaard diagram with each curve of length ≥ 3 so that the "complexity" k = sum of curve lengths minus two times genus is as small as possible. (In case of equal k-values, the smaller genus is preferred.) There is a convenient algorithm (using Whitehead-Zieschang reductions, handle cancellations, and the adding of "abbreviation handles") which yields a "relatively good" Heegaard diagram in the above sense. We conjecture that this algorithm always yields the best possible diagram(s) for M^3 in which case it would solve the homeomorphism problem for all 3-manifolds in a simple way. (Received February 27, 1979.)

Operations Research: Mathematics and Models

Abstracts for the AMS Short Course, Duluth, August 19–20, 1979

768-SC1 SETH BONDER, Vector Research, Inc., Ann Arbor, Michigan 48106. Mathematical modelling of military conflict situations.

The resolution of many decision issues (system developments, force structures, tactics and doctrine, etc.) in the Department of Defense (DOD) requires information regarding the results of potential military engagements and campaigns. This lecture will describe some of the mathematical and related modelling techniques used to generate this information in the tactical (vs. strategic) warfare arena. Background information regarding historical analytic structures and types of models currently employed in the DOD will be presented. Specific new developments in analytic and hybrid analytic models in the past 10-15 years will be described and some numerical results of their use presented.

Reading List

1. G. W. Evans II, G. F. Wallace and G. L. Sutherland, Simulation using digital computers, Prentice-Hall, Englewood Cliffs, New Jersey, 1967, Chapter 4.

2. F. W. Lanchester, Aircraft in warfare: The dawn of the fourth arm, Vol. 5, The principle of concentration, Engineering 98 (1914), 422-423.

3. S. Bonder, The Lanchester attrition-rate coefficient, Operations Res. 15 (1967), 221-232.

4. S. Bonder and R. Farrell (eds.), Development of models for defense systems planning, Report # SRL 2147 TR 70-2(U), Systems Res. Lab., Univ. of Michigan, Ann Arbor, Michigan, September 1970.

5. J. Taylor and G. Brown, Canonical methods in the solution of variable-coefficient Lanchester-type equations of modern warfare, Operations Res. 24 (1976), 44-69.

768-SC2 WARREN E. WALKER, The Rand Corporation, Santa Monica, California 90406. Fire department deployment analysis.

In recent years fire departments in urban areas have experienced a sharp increase in demands for their services while their budgets have generally grown at a rate less than that of inflation. Many of these departments have turned to systems analysts for help, realizing that, if they do not use more effectively what resources they have, their level of service will diminish. The Rand Corporation has provided assistance to the New York City Fire Department and others over the past decade, concentrating on deployment policies, which tie available resources to their distribution and movement in the field. This lecture will first provide a brief overview of the deployment policies that have been analyzed with the help of mathematical models. This will be followed by a more complete discussion of one of the policy questions: how should available fire companies be temporarily relocated to provide coverage when many other companies are busy fighting large fires?

Reading List

1. G. Carter, E. Ignall and K. Rider, An algorithm for the initial dispatch of fire companies, Report R-1997-NYC, The Rand Corporation, November 1977.

2. G. Carter and J. Rolph, New York City fire alarm prediction models: I. Box reported serious fires, Report R-1214-NYC, The Rand Corporation, 1973; ibid., II. Alarm rates, Report R-1215-NYC, The Rand Corporation, 1975.

3. J. Chaiken, E. Ignall and W. Walker, Deployment methodology for fire departments, Report R-1853-HUD, The Rand Corporation, September 1975.

4. E. Ignall, P. Kolesar, A. Swersey, W. Walker, E. Blum, G. Carter and H. Bishop, Improving the deployment of New York City fire companies, Interfaces 5 (1975), 48-61.

5. P. Kolesar and E. Blum, Square root laws for fire engine response distances, Management Sci. 19 (1973), 1368-1378.

6. P. Kolesar and W. Walker, An algorithm for the dynamic relocation of fire companies, Operations Res. 22 (1974), 249-274.

7. P. Kolesar, W. Walker and J. Hausner, Determining the relation between fire engine travel times and travel distances in New York City, Operations Res. 23 (1975), 614-627.

8. K. Rider, A parametric model for the allocation of fire companies in New York City, Management Sci. 23 (1976), 146-158.

9. W. Walker, Applying systems analysis to the fire service, Fire Engineering 128 (1975), 38-64.

768-SC3 WILLIAM P. PIERSKALLA, National Health Care Management Center, University of Pennsylvania, Philadelphia, Pennsylvania 19104. Mathematical modelling of health care delivery systems.

There are many areas in which mathematical models are important and useful in health care delivery. Two of these will be discussed here: (1) diagnostic screening for prevention of disease and (2) health planning. Non-contagious diseases arrive in a population in a seemingly stochastic manner. If testing procedures exist which are capable of detecting the disease before it would otherwise become known, and if such early detection provides benefit, the periodic administration of such a test procedure to the members of the population, that is, a mass screening program, may be advisable. Moreover, if the population is composed of subpopulations which exhibit different disease incidence rates and different unit costs of test applications, and if different tests which have different reliabilities for detecting the disease are available, then the question of allocating limited screening resources among the subpopulations arises. The optimal allocation depends upon the form of the disutility functions of the subpopulations. Comprehensive analytic models are needed to perform this allocation. Health planning can be viewed from many perspectives. Perhaps the most critical one facing the United States today is to contain the costs of health care and yet deliver quality care to the entire population of the U.S. Certain aspects of planning to achieve these objectives must be undertaken on a regional level, others at a subregional level, and still others at an institutional level. An integrated hierarchy of analytical models is needed to link the decisions at each of these levels. Decisions at the macro level involve the appropriate numbers of people by skills, numbers of facilities, and technological sophistication for a region. At the middle level, the decisions involve facility locations, their levels of technology and services and personnel needs to achieve minimum cost yet provide accessibility and quality of care in the subregions. At the institutional or micro level, analytic models are used to determine admissions and appointments, inventory levels and capital equipment, daily and weekly staffing, and facility scheduling. At all levels it is necessary to make these decisions by trading off competing objectives such as minimizing costs, increasing quality of care, and increasing accessibility and availability of services.

Reading List

1. T. Lincoln and G. H. Weiss, A statistical evaluation of recurrent medical examinations, Operations Res. 12 (1964), 187, 205.

2. R. Kirch and M. Klein, Surveillance schedules for medical examinations, Management Sci. 20 (1974), 1403-1409.

3. _____, Examination schedules for breast cancer, Cancer 33 (1974), 1444, 1450.

4. W. P. Pierskalla and J. A. Voelker, A survey of maintenance models: The control and surveillance of deteriorating systems, Naval Res. Logist. Quart. 23 (1976), 353-388.

5. P. Prorok, The theory of periodic screening. I: Lead time and proportion detected, Advances in Appl. Probability 8 (March, 1976), 127-143.

6. _____, The theory of periodic screening. II: Doubly bounded recurrence times and mean lead time and detection probability estimation, Advances in Appl. Probability 8 (September, 1976), 460-476.

7. A. B. Calvo and D. H. Marks, Location of health care facilities: An analytical approach, Socio-Economic Planning Sci. 7 (1973), 407-422.

8. P. Kolesar, A Markovian model for hospital admission scheduling, Management Sci. 16, 6 (February, 1970), B-384–B-396.

9. H. E. Miller, W. P. Pierskalla and G. J. Rath, Nurse scheduling using mathematical programming, Operations Res. 24, 5 (September-October, 1976), 857-870.

768-SC4 FREDERICK C. JOHNSON, National Bureau of Standards, Washington, D. C. 20234. Practical aspects of fishery management modeling.

The Pacific Coast salmon fisheries are considered to be the most sophisticated fishery system in the world [1]. In spite of a great deal of theoretical work [2], [3], [4], the practical problems associated with the management of these fisheries require a level of detail far exceeding a general theoretical framework for optimal resource utilization. While many of these problems are associated with the characteristic nature of common property resources [5], there also exist special catch allocation problems arising from federal court decisions on treaty Indian fishing rights [6]. In this talk we will first give an overview of the technical and other problems arising in salmon fisheries management. We will then discuss the development of a mathematical model for fishing regulation analysis. This model is currently used by the Washington State Department of Fisheries to evaluate the economic and biological impact of alternative salmon fishery regulation policies.

Reading List

1. P. A. Larkin, Maybe you can't get there from here: A foreshortened history of research in relation to management of Pacific salmon, J. Fisheries Res. Board of Canada 36 (1979), 98-105.

2. C. Clark, Mathematical bioeconomics: The optimal management of renewable resources, Wiley, New York, 1976.

3. _____, Mathematical models in the economics of renewable resources, SIAM Rev. 21 (1979), 81-99.

4. J. Gulland, The management of marine fisheries, Univ. Washington Press, Seattle, Washington, 1974.

5. G. Hardin, The tragedy of the commons, Science 162 (1968), 1243-1248.

6. R. Barsh, The Washington fishing rights controversy: An economic critique, Monograph Series, Univ. Washington Graduate School of Business Administration, Seattle, Washington, 1977.

768-SC5 RALPH L. DISNEY, Department of Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061. Queueing networks: An overview.

Networks of queues are only recently beginning to receive the attention they deserve. In this paper we will describe such networks, introduce and note several problems posed by such networks. We will provide as much background to these problems as time permits. Some attention will be paid to the major areas of unsolved problems that are in need of study.

Reading List

1. A. Barbour, Networks of queues and the method of stages, Advances in Appl. Probability 8 (1976), 584-592.

2. E. Cinlar, Introduction to stochastic processes, Prentice-Hall, Englewood Cliffs, New Jersey, 1975, Chapters 4-6, 8-10.

3. R. L. Disney, R. L. Farrell and P. R. de Morais, Characterization of M/G/1/N queues with renewal departures, Management Sci. 19 (1973), 1222-1228.

4. R. L. Disney, Random flow in queueing networks: A review and critique, AIIE Trans. 7 (1975), 268-288.

5. J. R. Jackson, Networks of waiting lines, Operations Res. 5 (1956), 518-521.

6. _____, Jobshop-like queueing systems, Management Sci. 10 (1963).
7. F. Kelly, Networks of queues, Advances in Appl. Probability 8 (1976), 416-432.
8. A. Lemoine, Networks of queues—A survey of equilibrium analysis. Management Sci. 24 (1977), 464-481.
9. _____, Networks of queues—A survey of weak convergence results, Management Sci. 24 (1978), 1175-1193.

768-SC6 ROBERT B. ROVINSKY, U. S. Department of Agriculture, Washington, D. C. 20250. Operations research: Applications in agriculture.

Agricultural researchers have been early and wide ranging users of Operations Research techniques and models. We first review those techniques appropriate to farm-level problems and those used in policy analysis, and discuss the possibilities inherent in both of these types of agricultural analyses. In particular, we will focus on mathematical models used for improving pest management and those used for pesticide policy planning.

Reading List

1. M. Petit, The role of models in the decision process in agriculture, Decision-Making and Agriculture (T. Dams and K. E. Hunt, Editors), Univ. Nebraska Press, Lincoln, Nebraska, 1977, 62-76.

2. R. C. Agrawal and E. O. Heady, Operations research methods for agricultural decisions, Iowa State Univ. Press, Ames, Iowa, 1972, especially Chapters 1, 2 and 5.

3. R. H. Day and E. Sparling, Optimization models in agricultural and resource economics, A survey of agricultural economics literature, Vol. 2, Quantitative methods, Univ. Minnesota Press, Minneapolis, Minnesota, 1977, 93-127.

4. M. Greenberger, M. A. Crenson and B. L. Crissey, Models in the policy process, Russell Sage Foundation, New York, 1976.

5. C. A. Shoemaker, Optimal management of an alfalfa ecosystem, Proc. a Conf. on Pest Management (G. A. Norton and C. S. Holling, Editors), Internat. Inst. of Appl. Systems Analysis, Laxenburg, Austria.

Erratum—Volume 26

C. J. ASH and A. NERODE, Recursive model theory in recursive algebra. Preliminary report. Abstract 764-E11, February 1979, Page A-249.

At the end of line 3, for "re sequence of formulas," read "re sequence of existential formulas."

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UNEMPLOYED MATHEMATICIANS, or those under notice of involuntary unemployment, are allowed two free advertisements during the calendar year; retired mathematicians, one advertisement. The service is not available to professionals in other disciplines, nor to graduate students seeking their first postdoctoral positions; however, veterans recently released from service will qualify. Applicants must provide:

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If desired more information may be obtained by writing to Professor M. A. Maurice, Wiskundig Seminarium der Vrije Universiteit, De Boelelaan 1081, Amsterdam, The Netherlands.

Applicants are requested to submit, within 3 weeks after the appearance of this issue, curriculum vitae and list of publications, mentioning number 310-2458: dienst Personeelszaken, Vrije Universiteit, P.O. Box 7161, 1007 MC Amsterdam, The Netherlands.

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Department of Mathematics
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The Colloquium on Fourier Analysis and Approximation Theory, organized by the János Bolyai Society, was held in Budapest, 16-21 August, 1976. The Proceedings contain the written version of most of the 88 lectures presented at the Colloquium. The editors have also included papers of authors who couldn't attend the Colloquium. The 77 papers published in this work have all been refereed.

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Proceedings of the Seminário de Holomorfia, Universidade Federal do Rio de Janeiro, 26-28 September, 1977

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Proceedings of the International Symposium on Approximation Theory, Universidade Estadual de Campinas (UNICAMP), Brazil, August 1-5, 1977

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