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MEETINGS
Calendar of Meetings

NOTE: This Calendar lists all of the meetings which have been approved by the Council up to the date at which 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 the meetings to which no numbers have yet been assigned.

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<td>January 23-27, 1968</td>
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<td>August 25-29, 1969</td>
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*The abstracts of papers to be presented in person at the meetings must be received in the Headquarters Offices of the Society in Providence, Rhode Island, on or before these deadlines. The deadlines also apply to news items. The next two deadline dates will be November 22, 1967 and January 17, 1968.*

OTHER EVENTS

- December 5-7, 1967: Conference on Communication Problems in the Mathematical Sciences. Providence, Rhode Island
- April 5-6, 1968: Numerical Solution of Field Problems in Continuum Physics. Durham, North Carolina

The *Notices* of the American Mathematical Society is published by the Society in January, February, April, June, August, October, November and December. Price per annual volume is $12.00. Price per copy $2.00. Special price for copies sold at registration desks of meetings of the Society, $1.00 per copy. Subscriptions, orders for back numbers (back issues of the last two years only are available) and inquiries should be addressed to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02904.

Second-class postage paid at Providence, Rhode Island, and additional mailing offices. Authorization is granted under the authority of the act of August 24, 1912, as amended by the act of August 4, 1947 (Sec. 34,21, P. L. and R.). Accepted for mailing at the special rate of Postage provided for in section 34,40, paragraph (d).

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Six Hundred Fiftieth Meeting
University of Tennessee
Knoxville, Tennessee
November 17-18, 1967

PROGRAM

The six hundred and fiftieth meeting of the American Mathematical Society will be held at the University of Tennessee, Knoxville, Tennessee, on Friday and Saturday, November 17-18, 1967.

Sessions for contributed papers will be held in the University Center; hour lectures will be in the University Center Auditorium.

By invitation of the Committee to Select Hour Speakers, Professor A. S. Householder of Oak Ridge National Laboratory will speak on "Normed and localization theorems for root of matrices"; Professor Bjarni Jonsson, Vanderbilt University, will address the meeting on "Representation of lattices"; and Professor Pasquale Porcelli of Louisiana State University will speak on "Survey of decomposition theory for rings of operators".

The Registration Desk will be located in the lounge of the University Center. Registration hours will be 9:00-5:00 Friday, November 17, and 9:00-12 noon on Saturday, November 18.

PROGRAM OF THE SESSIONS

The time limit for each contributed paper is ten minutes. The contributed papers are scheduled at 15 minute intervals. To maintain this schedule, the time limit will be strictly enforced.

FRIDAY, 1:00 P.M.

Invited Address, Auditorium, University Center

Normed and localization theorems for root of matrices
Dr. A. S. Householder, Oak Ridge National Laboratory, Tennessee, and University of Tennessee

FRIDAY, 2:10 P.M.

Sessions on Topology, Seminar Room, University Center

2:10-2:20
(1) Euclidean space modulo a cell, II
Professor J. L. Bryant, Florida State University (650-1)

2:25-2:35
(2) On H-enclosability of spheres
Professor P. L. Antonelli, University of Tennessee (650-3)

2:40-2:50
(3) Uncountably many quasi-translations of $S^3$
Professor C. D. Sikkema*, Professor Shin'ichi Kinoshita and Professor S. J. Lomonaco, Jr., Florida State University (650-21)

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

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(4) On the strong local simple connectivity of the decomposition spaces of toroidal decompositions
   Professor Steve Armentrout, University of Iowa (650-57)

(5) On irregular branched covering spaces of a kind of knots
   Professor Shin'ichi Kinoshita, Florida State University (650-28)

(6) Locally fenced 2-spheres
   Professor R. J. Daverman, University of Tennessee (650-22)

(7) Strongly cellular two-cells are tame in three-spaces
   Professor H. C. Griffith, Florida State University (650-14)

(8) On locally spherical spheres
   Professor W. T. Eaton, University of Tennessee (650-5)

FRIDAY, 2:10 P.M.

Sessions on Algebra I, Room 220, University Center

(9) A generalization of the prime number theorem
   Professor R. L. Robinson, Wofford College (650-35)

(10) Ideal theory of admissible L-rings. Preliminary report
    Mr. Joseph Neggers, University of Alabama (650-30)

(11) A note on semigroup rings
    Professor R. W. Gilmer, Jr., Florida State University (650-19)

(12) The number of semigroup varieties
    Professor Trevor Evans, Emory University (650-17)

(13) Exponential automorphisms of complete local rings
    Professor Nickolas Heerema, Florida State University (650-40)

(14) Equationally complete nonassociative algebras
    Mr. Tae-il Suh, Tennessee State University (650-16)

(15) Similar involutory matrices, modulo r
    Professor J. V. Brawley, Jr., Clemson University (650-7)

(16) Matrix inequalities over orthomodular lattices
    Professor J. H. Bevis, Virginia Polytechnic Institute (650-8)

FRIDAY, 2:10 P.M.

Session on Analysis I, Room 221, University Center

(17) Conjugate points of a third-order linear differential equation and its adjoint
    Mr. J. M. Dolan, Oak Ridge National Laboratory, Tennessee (650-52)

(18) A simple existence and uniqueness proof for a singular Cauchy problem
    Professor B. A. Fusaro, Queens College (650-48)

(19) Density of one graph along another
    Professor J. B. Brown, Auburn University (650-42)
    (Introduced by Mr. Ben Fitzpatrick, Jr.)

878
(20) Asymptotic expansions for the solutions of a class of nonhomogeneous differential equations
Professor T. G. Hallam, Florida State University (650-31)

(21) The nonhomogeneous linear difference equation with varying difference interval
Professor Tomlinson Fort, University of Georgia (650-29)

(22) Absolute convergence factors for $H^p$ series
Professor D. J. Caveny, Florida State University (650-12)

(23) On the characteristic initial problem for the wave equation
Professor E. C. Young, Florida State University (650-2)

(24) Tensor products and successive approximations for partial differential equations. Preliminary report
Professor J. W. Neuberger, Emory University (650-6)

FRIDAY, 2:10 P.M.

Session on Applied Mathematics and Analysis II, Room 222, University Center
2:10-2:20
(25) Optimal controls of vibrating beams
Professor Vadim Komkov, Florida State University (650-11)

2:25-2:35
(26) On Lighthill’s method of strained coordinates
Professor Craig Comstock, Pennsylvania State University (650-26)

2:40-2:50
(27) Multi-functions associated with Steiner systems
Professor Andrew Sobczyk, Clemson University (650-33)

2:55-3:05
(28) Generalized sine and cosine transforms. Preliminary report
Professor R. G. Blake, University of Florida (650-51)

3:10-3:20
(29) On the continuity of the generalized inverse
Mr. G. W. Stewart, III, University of Tennessee and Oak Ridge National Laboratory, Tennessee (650-54)

3:25-3:35
(30) The convergence and location of values of certain continued fractions
Professor F. A. Roach, University of Georgia (650-36)

3:40-3:50
(31) Multiplicative inverses of solutions for integral equations
Professor J. V. Herod, Georgia Institute of Technology (650-9)

FRIDAY, 4:15 P.M.

Invited Address, Auditorium, University Center
Representation of lattices
Professor Bjarni Jonsson, Vanderbilt University

SATURDAY, 9:00 A.M.

Invited Address, Auditorium, University Center
Survey of decomposition theory for rings of operators
Professor Pasquale Porcelli, Louisiana State University
Session on Topology II, Room 220, University Center
10:10-10:20
(32) Point-like upper semicontinuous decompositions of S^3
Mr. J. L. Bailey, University of Tennessee (540-4)

10:25-10:35
(33) Open simplicial maps of spheres on spheres
Professor Erik Hemmingsen, Syracuse University (650-23)

10:40-10:50
(34) Decomposable inverse limits with a single bonding map on [0,1] below the identity
Professor J. W. Rogers, Jr., Emory University (540-13)

10:55-10:05
(35) Open convergence
Mr. J. M. Boyte, Virginia Polytechnic Institute (650-34)
(Introduced by Professor C. E. Aull)

11:10-11:20
(36) Weak and strong cover compactness in regular and normal spaces
Mr. R. C. Briggs, University of Houston (650-24)

11:25-11:35
(37) Incompressible topological spaces
Mrs. J. O. Sawyer, Virginia Polytechnic Institute (650-49)
(Introduced by Dr. Peter Fletcher)

11:40-11:50
(38) Multi-valued contraction mappings
Professor S. B. Nadler, Jr., Louisiana State University, Baton Rouge (650-47)

Session on Algebra II, Seminar Room, University Center
10:10-10:20
(39) The van der Pol numbers
Professor F. T. Howard, Wake Forest University (650-56)
(Introduced by Professor Alfred Brauer)

10:25-10:35
(40) Order-endomorphisms of the semigroup of binary relations
Professor A. H. Clifford*, Tulane University, and Professor D. D. Miller, University of Tennessee (650-50)

10:40-10:50
(41) Homogeneous ideals in graded semirings. Preliminary report
Mr. P. J. Allen, University of Alabama (650-46)

10:55-11:05
(42) On general Z,P.I.-rings
Mr. C. A. Wood, Florida State University (650-39)

11:10-11:20
(43) Some remarks on complete integral closure
Professor William Heinzer, Louisiana State University, Baton Rouge (650-15)

11:25-11:35
(44) A new proof of a theorem by H. G. Landau on tournament matrices
Professor A. T. Brauer, Professor I. C. Gentry* and Miss Kay Shaw, Wake Forest University (650-44)
SATURDAY, 10:10 A.M.

Session on Functional Analysis I, Room 221, University Center
10:10-10:20
(45) Schauder decompositions, Schauder bases, and topological tensor products
Mr. H. F. Joiner, II, Florida State University (650-18)
10:25-10:35
(46) Sets of homeomorphisms. Preliminary report
Professor Andrew Sobczyk and Mr. Harold Reiter*, Clemson University
(650-32)
10:40-10:50
(47) On certain Banach spaces which are w*-sequentially dense in their second duals
Professor R. D. McWilliams, Florida State University (650-55)
10:55-11:05
(48) Localization of the strict topology via bounded sets
Professor J. R. Dorroh, Louisiana State University, Baton Rouge (650-41)
11:10-11:20
(49) On the cones associated to biorthogonal systems and bases in Banach spaces
Professor Mark Levin*, and Professor C. W. McArthur, Florida State University, and Professor Ivan Singer, Bucaresti, Romania (650-38)
11:25-11:35
(50) Bounded linear transformation on random norm spaces
Professor Kenzol Seo and Mr. B. J. Prochaska*, Clemson University
(650-27)
(Introduced by Professor C. V. Aucoin)
11:40-11:50
(51) Volumes generated by Daniell functionals on the space of all continuous functions over strictly sigma-compact metric spaces
Professor W. M. Bogdanowicz, Catholic University of America, and Professor H. G. Heyn*, University of Wyoming (650-10)

SATURDAY, 10:10 A.M.

Session on Topological Algebra and Linear Spaces, Room 222, University Center
10:10-10:20
(52) The boundary of a semilinear space. Preliminary report
Professor R. E. Worth, West Georgia College and University of Georgia (650-25)
10:25-10:35
(53) A note on means in Peano continua
Professor Kermit Sigmon, University of Florida (650-45)
10:40-10:50
(54) Connectedness-equivalent spaces on the line
Professor P. C. Hammer*, Professor S. G. Mrowka and Professor W. E. Singletary, Pennsylvania State University (650-43)
10:55-11:05
(55) The connectivity of means. Preliminary report
Professor Philip Bacon, University of Florida (650-22)
11:10-11:20
(56) A note on maximal locally compact semigroups
Mr. J. W. Stepp, University of Kentucky and Georgetown College (650-53)
(Introduced by Professor John Selden)
11:25-11:35
(57) Convex kernels and extreme points
Professor J. W. Kenelly*, Clemson University, and Mr. W. H. Ludescher, Loras College (650-37)

Tallahassee, Florida

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O. G. Harrold
Associate Secretary
Six Hundred Fifty-First Meeting
University of New Mexico
Albuquerque, New Mexico
November 18, 1967

PROGRAM

The six hundred fifty-first meeting of the American Mathematical Society will be held on Saturday, November 18, 1967 at the University of New Mexico in Albuquerque, New Mexico.

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited hour addresses at this meeting. Professor R. K. Getoor of the University of California, San Diego, will speak on "Some recent developments in Markov processes." His address will be given at 11:00 a.m. in Room 231 of the New Mexico Union. Professor Basil Gordon of the University of California, Los Angeles, will present a lecture on "Some recent developments in the theory of partitions." This talk will be given at 2:00 p.m. in Room 231 of the New Mexico Union. Sessions for contributed papers will be held at 9:30 a.m. and 3:30 p.m. in Room 231 of the New Mexico Union.

REGISTRATION

Registration for the meeting will begin at 8:30 a.m. in the lobby of the New Mexico Union. Information concerning the University of New Mexico and the city of Albuquerque, including a list of recommended restaurants, will be available at the Registration Desk.

ACCOMMODATIONS

The following six motels are the nearest ones to the University of New Mexico, which is located at approximately 2100 Central Avenue NE.

DE ANZA
4301 Central Avenue NE
Single $8.00
Double $9.00
Twin $11.00

CROSSROADS
1001 Central Avenue NE
Single $8.00
Double $10.00
Twin $12.00

HIGHWAY HOUSE
3200 Central Avenue SE
Single $8.00
Double $10.00
Twin $12.00

IMPERIAL 400
701 Central Avenue NE
Single $8.00
Double $10.00
Twin $12.00

RAMADA INN
4501 Central Avenue NE
Single $9.75
Double $11.25
Twin $12.25

TRAVELODGE
3711 Central Avenue NE
Single $8.00
Double $10.00
Twin $12.00

Motel reservations should be made directly with the preferred motel.

MEALS

Luncheon and snacks will be available at the Cafeteria and Snack Bar in the New Mexico Union. Coffee and donuts will be served at 10:30 a.m. and 3:00 p.m. in the registration area.
TRAVEL
Albuquerque is served by TWA, Continental, Trans Texas, and Frontier Airlines, and the Santa Fe Railroad. The principal highways into the city are US 66 (east-west) and US 85 (north-south). The average November temperatures in Albuquerque range from a daytime high of 55 degrees to a low of 30 degrees during the night.

PROGRAM OF THE SESSIONS
The time limit for each contributed paper is ten minutes. to maintain the schedule, the time limit will be strictly enforced.

SATURDAY, 9:30 A.M.

General Session, Room 231 New Mexico Union
9:30-9:40
(1) Decompositions of injective modules
Dr. R. B. Warfield, Jr., New Mexico State University (651-3)

9:45-9:55
(2) Topology of orders and modes
Professor D. W. Dubois, University of New Mexico (651-4)

10:00-10:10
(3) Remarks on absolutely convex subgroups. II. Preliminary report
Professor A. C. Morel, University of Washington (651-7)

10:15-10:25
(4) A generalization of the Perron-Frobenius theorem
Professor R. E. DeMarr, University of Washington (651-8)

SATURDAY, 11:00 A.M.

Invited Address, Room 231, New Mexico Union
Some recent developments in Markov processes
Professor R. K. Getoor, University of California, San Diego

SATURDAY, 2:00 P.M.

Invited Address, Room 231, New Mexico Union
Some recent developments in the theory of partitions
Professor Basil Gordon, University of California, Los Angeles

SATURDAY, 3:30 P.M.

General Session, Room 231, New Mexico Union
3:30-3:40
(5) Local times for transforms of Markov processes. Preliminary report
Professor R. J. Griego, University of New Mexico (651-2)

3:45-3:55
(6) An interesting imbedding for a class of Volterra operators
Dr. G. H. Pimbley, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico (651-1)

4:00-4:10
(7) Non-first-countable topological structure
Dr. J. M. Worrell, Jr., and Dr. H. H. Wicke*, Sandia Corporation, Albuquerque, New Mexico (651-5)

4:15-4:25
(8) A uniform boundedness theorem for nets
Professor Randolph Constantine, Jr., Fort Lewis College (651-6)

Las Cruces, New Mexico

R. S. Pierce
Associate Secretary

*For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.
Six Hundred Fifty-Second Meeting  
University of Illinois  
Urbana, Illinois  
November 25, 1967

PROGRAM

The six hundred fifty-second meeting of the American Mathematical Society will be held on Saturday, November 25, 1967, at the University of Illinois, Urbana, Illinois.

By invitation of the Committee to Select Hour Speakers for Western Sectional Meetings there will be two hour addresses. Professor Donald J. Lewis of the University of Michigan will speak at 11:00 a.m. on "Arithmetic and algebraic properties of value sets of polynomials". Professor Mark E. Mahowald of Northwestern University will speak at 2:00 p.m. on "A survey of homotopy theory of spheres". By invitation of the same committee there will be a special session of twenty-minute papers at 3:15 p.m. on "Categorical algebra", arranged by Professor Saunders Mac Lane of the University of Chicago. These two lectures and the special session will be held in 314 Altgeld Hall.

There will be two sessions for contributed papers at 9:15 a.m., one in group theory in 314 Altgeld Hall and the other on analysis and related topics in 156 Administration Building.

Registration will be held inside the north entrance of Altgeld Hall, beginning at 8:30 a.m. Altgeld Hall is located on the southeast corner of Wright and Green Streets in Urbana. The Administration Building is located just South of Altgeld Hall.

Approximately 100 guest rooms are available in the Illini Union, which is located just east of Altgeld Hall. The rates are $9.27 for single occupancy and $13.39 for double occupancy. All rooms are suitable for double occupancy. Requests for reservations should be addressed to Guest Room Reservations, 125 Illini Union, Urbana, Illinois 61801, and should refer to the meeting of the American Mathematical Society. The Illini Union provides free parking for registered guests.

Meals will be served in the cafeteria and in the Colonial Room of the Illini Union. A list of other suggested local restaurants will be available at the registration desk.

Champaign-Urbana is served by the Illinois Central Railroad, the Norfolk and Western Railway, and Ozark Air Lines. The Illinois Central has direct service from Chicago, New Orleans, and Miami. The Norfolk and Western provides direct connections with Detroit and St. Louis. Ozark Air Lines has direct service from Chicago, St. Louis, and Indianapolis.

On Friday, November 24, 1967, the University of Illinois will sponsor a symposium on the Theory of Finite Groups with the financial support of the G. A. Miller Endowment. The speakers will be Professor Reinhold Baer of the University of Frankfurt and New Mexico State University, Professor Richard Brauer of Harvard University, Professor Graham Higman of Oxford University, Professor Robert Steinberg of the University of California at Los Angeles and Yale University, Professor John Thompson of the University of Chicago, and Professor Helmut Wielandt of the University of Tübingen. The presiding officers will be Professors Everett Dade, Irving Reiner, Michio Suzuki, and John Walter of the University of Illinois at Urbana, and Professors Norman Blackburn and Noboru Ito of the University of Illinois at Chicago Circle.
PROGRAM OF THE SESSIONS

The time limit for each contributed paper is ten minutes. To maintain the schedule, the time limit will be strictly enforced.

SATURDAY, 9:15 A.M.

Session on Group Theory, 314 Altgeld Hall
9:15-9:25
(1) Generalized semigroup kernels. II
Professor R. O. Fulp, University of Houston (652-9)

9:30-9:40
(2) On primitive idempotents in group algebras
Professor C. W. Curtis, University of Oregon (652-10)

9:45-9:55
(3) M-groups and the supersolvable residual. Preliminary report
Mr. G. M. Seitz, University of Oregon (652-12)

10:00-10:10
(4) Ulm's theorem for totally projective groups
Professor P. D. Hill, University of Houston (652-15)

10:15-10:25
(5) Baer groups are free
Mr. P. A. Griffith, University of Houston (652-16)

SATURDAY, 9:15 A.M.

Session on Analysis and Related Topics, 156 Administration Building
9:15-9:25
(6) Differential-difference equations of advanced type
Professor C. H. Anderson, Ohio University (652-6)

9:30-9:40
(7) Gibbs sets and the generalized Gibbs phenomenon. Preliminary report
Professor Joaquin Bustoz, Jr., Ohio University (652-7)

9:45-9:55
(8) Monotone mapping properties of hereditarily infinite dimensional spaces
Professor J. M. Yohe, Mathematics Research Center, U. S. Army, University of Wisconsin (652-11)

10:00-10:10
(9) Mining properties of some endomorphisms defined on the torus
Professor W. V. Philipp, University of Illinois (652-14)

10:15-10:25
(10) On the sum of a square and the square of a prime
Professor G. J. Rieger, State University of New York, Buffalo (652-13)

10:30-10:40
(11) Non-negative matrices with non-negative inverses
Professor R. S. Spira, Michigan State University (652-1)

SATURDAY, 11:00 A.M.

Invited Address, 314 Altgeld Hall

Arithmetic and algebraic properties of value sets of polynomials
Professor Donald J. Lewis, University of Michigan
SATURDAY, 2:00 P.M.

Invited Address, 314 Altgeld Hall

A survey of homotopy theory of spheres
Professor Mark E. Mahowald, Northwestern University

SATURDAY, 3:15 P.M.

Special Session on Categorical Algebra, 314 Altgeld Hall

3:15-3:35
(12) On derived functors and cohomology
Professor Michael Barr, University of Illinois (652-5)

3:40-4:00
(13) Applied functorial semantics
Professor F. E. J. Linton, Wesleyan University (652-3)

4:05-4:25
(14) The calculus of comma categories
Professor J. W. Gray, University of Illinois (652-4)

4:30-4:50
(15) Categorical dynamics
Professor F. W. Lawvere, City University of New York (652-2)

4:55-5:15
(16) Descent and standard constructions (triples)
Professor J. M. Beck, Cornell University (652-8)

Urbana, Illinois

Paul T. Bateman
Associate Secretary

NEWS ITEM

MATSCIENCE
SIXTH ANNIVERSARY SYMPOSIUM

The Matscience Sixth Anniversary Symposium will take place in January, 1968, for two weeks. The sessions will be divided into three sections: theoretical physics, pure mathematics, and operations research and applications of stochastic processes. Among the scientists participating are Professors Roland Good, U.S.A.; S. Okubo, U.S.A.; W. H. J. Fuchs, U.S.A.; Shreeram Abhyankar, U.S.A.; Alladi Ramakrishnan, Matscience; S. K. Srivasan, I. I. T., Madras; K. R. Unni, Matscience; and Drs. A. M. Lee, Canada; H. P. Stapp, U.S.A.; Gordon Shaw, U.S.A.; B. Misra, Switzerland; V. Devanathan, University of Madras. There will also be representatives from various research institutions and universities in India.

The session on operations research and applications of stochastic processes, a new feature of the symposium, will be led by Dr. A. M. Lee, Director, Operations Research, Air Canada. Professor R. Vasudevan, Matscience, will give a general summary of some of the applications of the theory of stochastic processes to some physical problems.

Individuals interested in participating in the symposium may obtain further information from the Institute of Mathematical Sciences, Adyar, Madras-20, India.
The seventy-fourth annual meeting of the American Mathematical Society will be held at the San Francisco Hilton Hotel, San Francisco, California, in conjunction with the annual meeting of the Mathematical Association of America. The Society will meet from Tuesday, January 23, through Friday, January 26. The Mathematical Association of America will meet from Thursday, January 25, through Saturday, January 27.

The forty-first Josiah Willard Gibbs Lecture, entitled "Representation theory in physics," will be delivered by Professor Eugene P. Wigner of Princeton University in the Continental Ballroom of the San Francisco Hilton at 8:00 p.m. on Tuesday, January 23, 1968.

Dean A. A. Albert of the University of Chicago will give the Presidential Address in the Continental Ballroom at 1:30 p.m. on Tuesday, January 23. The title of his lecture is "On associative division algebras."

By invitation of the Committee to Select Hour Speakers for the Annual and Summer Meetings, there will be two invited addresses. Professor Wolfgang Wasow of the University of Wisconsin will speak at 1:30 p.m. on Thursday, January 25. The title of his address is "Connection problems for asymptotic series." Professor Louis Auslander of the City University of New York will present an address entitled "A survey of solvable Lie groups and applications" at 1:30 p.m. on Friday, January 26. Both of these invited addresses will be given in the Continental Ballroom.

The first George David Birkhoff Prize in Applied Mathematics will be awarded in the Continental Ballroom at 1:30 p.m. on Wednesday, January 24.

There will be two special sessions of twenty-minute papers. Papers will be given at these sessions by invitation and by selection from ten-minute papers submitted for the meeting. The topic for the first of these sessions is "Integration in Function Spaces," under the chairmanship of Professor Monroe Donsker, Courant Institute of Mathematical Sciences, New York University. This session will be held in the Continental Ballroom beginning at 9:00 a.m. on Tuesday, January 23.

The second special session of twenty-minute papers will be devoted to the topic of "Piecewise Linear Topology." The program chairman for this session is Professor Morris W. Hirsch of the University of California, Berkeley. This second special session will take place in the Continental Ballroom beginning at 9:00 a.m. on Wednesday, January 24. Those persons contributing abstracts to the Annual Meeting who feel that their papers would be appropriate for one of the special sessions should submit their abstracts two weeks earlier than the ordinary deadline in order to allow time for the necessary additional handling. Thus, to be considered for a special session, an abstract must be received in the Providence office of the Society no later than November 17, 1967.

There will be regular sessions for contributed ten-minute papers during the mornings and afternoons of January 23 and 24, and during the afternoons of January 25 and 26. There is a limit of three hundred and fifty on the number of papers which will be accepted for presentation at the meeting. Papers will be accepted for the meeting until either three hundred and fifty have been received or until the deadline of December 1 has passed, whichever occurs first. No ses-
1. San Francisco Hilton Hotel
2. Californian Hotel
3. Bellevue Hotel
4. Handlery Inn
5. Ramona Hotel
6. Olympic Hotel
7. El Cortez Hotel
8. Fielding Hotel
9. Franciscan Hotel
10. Stewart Hotel
11. Manx Hotel
12. Chancellor Hotel
13. Sir Francis Drake Hotel
14. Canterbury Hotel
15. Commodore Hotel
16. Civic Auditorium
17. YMCA Hotel (men and women)
18. Southern Pacific Depot (Third & Townsend)
19. Santa Fe Bus Depot
20. Greyhound Bus Depot
21. Downtown Airlines Terminal
sions for late papers will be held.

There will be an open meeting of the Committee to Monitor Problems in Communication in the Mathematical Sciences on Wednesday evening, January 24, at 9:00 p.m. in the Continental Ballroom. The committee is concerned with new or better devices for communicating mathematics, through research publication, reviewing journals, expository writing, meetings, films, etc. A number of topics will be introduced by the committee, with ample time between for full discussion from the floor. Anyone interested is invited to attend.

The business meeting of the Society will be held at 11:15 a.m. on Tuesday, January 23, in the Continental Ballroom. The Council of the Society will meet at 2:00 p.m. on Monday, January 22, in the Walnut Suite on the fourth floor of the San Francisco Hilton.

EMPLOYMENT REGISTER

The Mathematical Sciences Employment Register will be maintained from 9:00 a.m. to 5:00 p.m. on Wednesday, Thursday, and Friday in the Imperial Ballroom of the San Francisco Hilton.

EXHIBITS

The book and educational media exhibits will be displayed in the North and West Lounges on the ballroom floor of the San Francisco Hilton. The exhibits will be open from 9:00 a.m. to 5:00 p.m. on Tuesday, Wednesday, Thursday, and Friday.

REGISTRATION

The Registration Desk for this meeting will be in the East Lounge on the ballroom floor of the San Francisco Hilton. The Registration Desk will be open from 2:00 to 8:00 p.m. on Monday, January 22; from 8:00 a.m. to 5:00 p.m. on Tuesday, January 23; from 9:00 a.m. to 5:00 p.m. on Wednesday through Friday, January 24-26; and from 9:00 a.m. to 1:00 p.m. on Saturday, January 27. It will be helpful if persons attending the meet-
ings will register as soon as possible after their arrival.

The registration fees for the meetings are as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
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<tbody>
<tr>
<td>Member</td>
<td>$3.00</td>
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<tr>
<td>Member's family</td>
<td>$0.50</td>
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<tr>
<td>(first additional person)</td>
<td>no fee</td>
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<tr>
<td>(others in member's family)</td>
<td>no fee</td>
</tr>
<tr>
<td>Student</td>
<td>no fee</td>
</tr>
<tr>
<td>Non-member</td>
<td>$7.50</td>
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</tbody>
</table>

ACCOMMODATIONS

Accommodations for the meeting will be handled by the San Francisco Convention and Visitors Bureau. A form for requesting accommodations may be found on page 966 of these Notices. Persons desiring accommodations should complete this reservation form or a reasonable facsimile and send it to Mr. Homer Caswell, San Francisco Convention and Visitors Bureau, Fox Plaza, San Francisco, California 94102. All reservations will be confirmed. The San Francisco Convention and Visitors Bureau will make reservations in accordance with the preferences indicated on the reservation form, insofar as this is possible. It will not be necessary to send a deposit with the registration form. If a person is assigned to a hotel that requires a deposit, then that hotel will request a first night's deposit to hold the room. Requests for reservations should arrive in San Francisco no later than January 9, 1968. The accompanying map shows the location of the various hotels which have reserved rooms for the meeting, including the headquarters hotel, the San Francisco Hilton. A list of room rates at these hotels follows:

BELLEVUE HOTEL

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Rate</th>
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<tbody>
<tr>
<td>Doubles</td>
<td>$13.00 to $15.00</td>
</tr>
<tr>
<td>Twins</td>
<td>$15.00 to $18.00</td>
</tr>
<tr>
<td>Suites</td>
<td>$25.00 to $35.00</td>
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<tr>
<td></td>
<td>(parlor and 1 bedroom)</td>
</tr>
</tbody>
</table>

CALIFORNIAN HOTEL

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singles</td>
<td>$12.00 to $13.00</td>
</tr>
<tr>
<td>Doubles</td>
<td>$14.50 to $15.50</td>
</tr>
<tr>
<td>Twins</td>
<td>$16.00 to $17.00</td>
</tr>
<tr>
<td>Suites</td>
<td>$30.00</td>
</tr>
<tr>
<td></td>
<td>(parlor and 1 bedroom)</td>
</tr>
</tbody>
</table>
CANTERBURY HOTEL
Singles $12.00 to $18.00
Doubles $14.00 to $18.00
Twins $16.00 to $21.00
Suites $35.00
(parlor and 1 bedroom)
Suites $55.00
(parlor and 2 bedrooms)

CHANCELLOR HOTEL
Doubles $13.00
Twins $15.00

COMMODORE HOTEL
Singles $12.00 to $18.00
Doubles $15.00 to $20.00
Twins $16.00 to $22.00

EL CORTEZ HOTEL
Singles $11.00 to $14.00
Doubles $12.00 to $15.00
Twins $14.00 to $18.00
Suites $28.00 to $36.00
(comb. parlor and 1 bedroom)
(sleeps 4, 2 baths)

FIELDING HOTEL
Singles $12.00
Doubles $15.00
Twins $18.00
Suites $40.00
(parlor and 1 bedroom)

FRANCISCAN HOTEL
Singles $9.00 to $10.00
Doubles $12.00
Twins $14.00

HANDLERY MOTOR INN
Singles $18.00 to $28.00
Doubles $23.00 to $30.00
Twins $23.00 to $30.00

SAN FRANCISCO HILTON HOTEL
Singles $12.00 to $19.00
Doubles $16.00 to $21.00
Twins $16.00 to $21.00
Suites $52.00 and up

MANX HOTEL
Singles $14.00 to $15.00
Doubles $16.00 to $18.00
Twins $18.00 to $20.00

OLYMPIC HOTEL
Singles $12.00 to $15.00
Doubles $14.00 to $18.00
Twins $15.00 to $18.00
Suites $28.00 to $32.00
(parlor and 1 bedroom)

RAMONA HOTEL
Singles $10.00
Doubles $11.50
Twins $13.50
Suites $30.00
(parlor and 1 bedroom)

STEWART HOTEL
Singles $12.00 to $18.00
Doubles $16.00 to $20.00
Twins $16.00 to $22.00
Suites $40.00 to $75.00
(parlor and 1 bedroom)

SIR FRANCIS DRAKE HOTEL
Singles $15.00 to $22.00
Doubles $19.00 to $25.00
Twins $22.00 to $26.00
Suites $70.00
(parlor and 1 bedroom)

ENTERTAINMENT

There will be a No-Host Get-Together from 5:00 p.m. to 7:00 p.m. on Thursday, January 25, in the Hilton Plaza. Mixed drinks will be available at a cost of one dollar per drink. This will be the only major social function of the meeting, and everyone is invited to it.

There are many things to see and much to do in the San Francisco Bay area. Brochures describing various tours around the city will be available at the Registration Desk. These will include walking and automobile trips, Gray Line bus rides, and Harbor Tours by boat. There will also be brochures in the registration area describing some of the major attractions of San Francisco, such as Chinatown, North Beach, Golden Gate Park, and Nob Hill.

San Francisco has numerous museums and art galleries. At night there is entertainment available to suit all tastes, from jazz and "highly original" nightclubs to legitimate theater and classical musical events.

Some of the finest restaurants in the nation are located in San Francisco. The Convention Bureau will provide a list of the outstanding dining places in the city. There will also be a guide to Dining near the Hilton available at the Registration Desk. This will list the places to eat (both plain and fancy) which are located within a few blocks of the San Francisco Hilton.
MAIL AND MESSAGE CENTER

All mail and telegrams for persons attending the meetings should be addressed in care of the American Mathematical Society, The San Francisco Hilton, Mason and O'Farrell Streets, San Francisco, California 94102. Mail and telegrams so addressed may be picked up at the Registration Desk.

Through the courtesy of the Pacific Telephone Company, a message center will be provided to receive incoming calls for all members in attendance. The center will be located in the East Lounge near the Registration Desk. It will operate from January 23 through January 27 between 9:00 a.m. and 5:00 p.m. Messages will be recorded, and the name of any member for whom a message has been received will be posted until the message is picked up at the message center. Members are advised to leave the following number with anyone who might want to contact them at the meetings: 415-776-1390.

TRAVEL AND LOCAL INFORMATION

The airlines serving San Francisco include American, Delta, National, Pacific, Pacific Southwest, Pan American, Transworld, United, West Coast, Western, and various international carriers. There is bus transportation from the San Francisco International Airport to the downtown airport bus terminal which is next door to the Hilton.

Railroad service to San Francisco is offered by the Northern Pacific, Santa Fe, Southern Pacific, and Western Pacific Railroads. Taxi service is available from the various railroad depots to the Hilton Hotel.

The bus lines serving San Francisco include the Continental Trailways and the Greyhound Bus Lines. The bus terminals are located within a few blocks of the Hilton Hotel.

Those persons who come to San Francisco by car will find that several of the listed hotels offer free parking to their guests. The San Francisco Hilton has a parking garage within the hotel. Guests can register from their cars at the garage entrance. They will then be directed to a parking space on the same floor as their room.

During the month of January, San Francisco's average maximum temperature is 55 degrees and the minimum is 45 degrees. There is a likelihood of encountering some rain, so that rain coats, umbrellas, and rubbers or overshoes may prove useful. For clothing, medium weight wool suits or dresses are recommended.

COMMITTEE ON ARRANGEMENTS


R. S. Pierce
Associate Secretary

Las Cruces, New Mexico

NEWS ITEMS

MORE ON THE SMALE CASE

At its meeting on Thursday, October 12, the Department of Mathematics at Berkeley passed the following resolution: "Resolved: We ask Dean Elberg to communicate to Dr. Haworth the following opinion of our Department: 'We believe that recent activities of the National Science Foundation concerning Professor Stephen Smale's contract proposal are political in character. In the past, the Foundation's decisions were based on purely scientific criteria. We hope that the Foundation will rely on scientific criteria only in resolving the current difficulties and in making future decisions.'"

SYMPOSIUM ON INFINITARY LOGIC

An informal symposium on Infinitary Logic will be held on December 28-30, 1967, at the University of California, Los Angeles. Individuals interested in participating in the symposium should contact Professor Jon Barwise, Department of Mathematics, University of California, Los Angeles, California 90024.
The AMS Conference on Communication Problems in the Mathematical Sciences will be held in the Sheraton-Biltmore Hotel in Providence, Rhode Island, on December 5-7, 1967.

The scientific program of the Conference will include several panel discussions, each consisting of presentations by distinguished mathematicians and scientists, and a period of general discussion. There will also be a number of special addresses. Distinguished representatives from government agencies, foreign academies and societies, and other American and foreign associations interested in information exchange will participate in the Conference.

In conjunction with the Conference, the new AMS headquarters office building will be dedicated at ceremonies taking place on December 6.

PROGRAM

TUESDAY, December 5

9:00 a.m. - 9:30 a.m.
Address: Purpose of the Conference - Garden Room
Daniel Zelinsky, Northwestern University

9:30 a.m. - 11:30 a.m.
Panel on Exposition and Book Publishing - Garden Room
Felix Browder, University of Chicago; Hans Freudenthal, University of Utrecht, The Netherlands; Norman Steenrod, Princeton University; Edwin Hewitt (moderator), University of Washington

Noon-1:30 p.m.
Luncheon - Ballroom
Address: AMS Presidential View
Charles B. Morrey, Jr., AMS President
Address: M. V. Keldyš, President, Academy of Sciences, USSR

2:30 p.m. - 4:30 p.m.
Panel on Primary Journals and Related Information Systems I-Garden Room
Norman Cottrel, American Society for Metals; Hugh Wolfe, American Institute for Physics; Robert E. Gordon, Council of Biology Editors; J. F. Traub, Bell Telephone Laboratories; Alex Rosenberg (moderator), Cornell University

4:30 p.m. - 5:00 p.m.
Address: AMS Projects and Plans for Information Systems-Garden Room
Everett Pitcher, AMS Secretary
8:00 p.m. - 10:00 p.m.
Conversazione - Ballroom
A gathering for informal discussions. Refreshments will be served.

WEDNESDAY, December 6

9:00 a.m. - 11:30 a.m.
Panel on Primary Journals and Related Information Systems II - Garden Room
J. A. Dieudonné, University of Nice, France; Eldon Dyer, City University of New York; John Tukey, Princeton University; Robert G. Bartle (moderator), University of Illinois

11:30 a.m.
Buses leave from the Sheraton-Biltmore for the AMS headquarters building for dedication

11:45 a.m.
Dedication, Open House and Buffet Lunch - Heritage Building
The Honorable John H. Chafee, Governor of Rhode Island; The Honorable Joseph A. Doorley, Jr., Mayor of Providence

1:15 p.m.
Buses leave for the Sheraton-Biltmore

1:30 p.m. - 2:00 p.m.
Address - Garden Room
William S. Barker, NSF Office of Science Information

2:00 p.m. - 2:30 p.m.
Address - Garden Room
Dale B. Baker, Director, Chemical Abstracts Service

2:30 p.m. - 5:00 p.m.
Panel on Communication with Other Disciplines - Garden Room
George Carrier, Harvard University; Elliot Montroll, University of Rochester; Jerome Lettvin, M.I.T.; Jerome Wiesner, M.I.T.; Mark Kac (moderator), Rockefeller University

6:00 p.m. - 9:00 p.m.
Cocktail hour and Dinner - Ballroom
Address: Robert W. Cairns, Chairman of SATCOM, National Academy of Sciences

THURSDAY, December 7

9:00 a.m. - 9:30 a.m.
Address: - Garden Room
K. Chandrasekharan, Secretary, International Council of Scientific Unions

9:30 a.m. - Noon
Panel on Reviewing Journals - Garden Room
Irving Segal, M.I.T.; Stephen Juhasz, Editor, Applied Mechanics Review; Ralph Boas, Northwestern University; Richard Crittenden, Associate Editor, Mathematical Reviews; Erika Pannwitz, Editor, Zentralblatt fur Mathematik, Heidelberger Akademie der Wissenschaften; R. V. Gamkrelidze, Editor, Referativnyi Zurnal Matematika; W. J. LeVeque (moderator), Past Editor, Mathematical Reviews
HOTELS AND MOTELS

Hotels and motels in the area are listed below. An advance registration form appears on page 966 of these Notices. Individuals planning to attend the Conference should complete this form, listing preferred accommodations, and mail to the American Mathematical Society Providence office. Since there is no convention bureau in Providence, the AMS will arrange accommodations and perform other such services.

THE SHERATON-BILTMORE HOTEL
Dorrance Street
Providence, R. I. 02902
Single $10.50 $11.50 $12.50
Double $15.50 $16.50 $17.50
Twin $15.50 $16.50 $17.50

THE COLONY MOTOR HOTEL
1150 Narragansett Boulevard
Cranston, R. I. 02910
Single $10.00 $12.00
Double $15.00
Twin $19.00

15 minutes drive from the Sheraton-Biltmore

HOLIDAY INN
U. S. Route 6
Seekonk, Mass. 02771
Single $10.00
Double $14.00
Twin $17.00

15 minutes drive from the Sheraton-Biltmore
(Note: There is a 5% state tax in Massachusetts and Rhode Island.)

REGISTRATION

The Registration Desk will be located in the lobby of the Sheraton-Biltmore Hotel. It will be open on Tuesday, December 5, and Wednesday, December 6, from 8:00 a.m. to 5:00 p.m., and on Thursday, December 7, from 8:00 a.m. to noon.

WEATHER

In early December, the mean temperature in Providence varies from 44°F to 27°F. While the weather is extremely uncertain, there is a fairly good chance of snow at this time of year.

MAIL AND TELEGRAMS

Mail and telegrams to participants should be addressed to Conference on Communication Problems in the Mathematical Sciences, the Sheraton-Biltmore Hotel, Dorrance Street, Providence, Rhode Island 02902.

LOCAL INFORMATION

A map of the Providence area and information on restaurants, theaters, libraries, and other places of interest in and around Providence will be provided at the Registration Desk.

COMMITTEE

Members of the Conference Organizing Committee include the following:

H. A. Antosiewicz, University of Southern California
Felix Browder, University of Chicago
Jim Douglas, Jr., Rice University
Herbert Federer, Brown University
W. J. LeVeque, Chairman, University of Michigan
SIXTH ANNUAL SYMPOSIUM ON BIOMATHEMATICS AND COMPUTER SCIENCE IN THE LIFE SCIENCES

The University of Texas Graduate School of Biomedical Sciences at Houston, Division of Continuing Education, announces the sixth annual symposium on Biomathematics and Computer Science in the Life Sciences, which will be held at the Shamrock Hilton Hotel in Houston, Texas, on March 14-16, 1968.

The theme of the symposium is "Man, Machines, Mathematics, and Medicine." The topics for the sessions of the symposium are as follows: quantitative and theoretical biology; mathematical and applied statistical problems in biomedical research; experimental design in the biomedical sciences; bioengineering; information management—storage and retrieval; computer applications in the biomedical sciences; the man-machine interface.

Papers in interdisciplinary fields and appropriate papers on education will be welcomed by the Program Committee. Individuals interested in submitting abstracts are invited to communicate with the Office of the Dean, The University of Texas Graduate School of Biomedical Sciences at Houston, Division of Continuing Education, P. O. Box 20367, Houston, Texas 77025. To be reviewed for inclusion in the program, abstracts must be received before December 15, 1967.

SIAM CONFERENCE ON QUALITATIVE THEORY FOR DIFFERENTIAL AND INTEGRAL EQUATIONS

A conference on various problems in qualitative behavior of solutions of ordinary and partial differential equations, as well as delay differential and integral equations, will be held at the University of Wisconsin, Madison, on August 19-23, 1968. This conference occurs one week prior to the AMS, MAA, and SIAM summer meetings which will also be held in Madison on August 26-30.

To facilitate a wide exchange of ideas, a small number of invited lectures and a period for informal discussions are planned for each of the five days. There will also be one or more sessions for a limited number of contributed papers.

Dormitory space has been reserved for participants of the conference, and persons attending may wish to remain for the AMS meeting. It is expected that ONR will provide funds for stipends to cover travel and living expenses to those participants from academic institutions needing support.

Persons who are interested in attending the conference should communicate with Professor John A. Nohel, Department of Mathematics, Van Vleck Hall, University of Wisconsin, Madison, Wisconsin 53706, for further details.
The second annual Symposium on Some Questions in Mathematical Biology will be held on December 27, 1967, from 9:00 a.m. to 12 noon, at the Americana Hotel in New York City. This is an AMS-SIAM symposium, and it is being held in cooperation with Section A (Mathematics) of the American Association for the Advancement of Science, from December 26 to 31. Registration and hotel arrangements have been announced in SCIENCE magazine by AAAS.

The program, consisting of three one-hour addresses, was arranged by the AMS-SIAM Joint Committee on Mathematics in the Life Sciences. The members of this committee are Murray Gerstenhaber, chairman; Hans Bremermann and Alston Householder.

The speakers will address themselves to questions which are primarily of biological interest but in which some mathematical analysis is involved. The purpose of the symposium is to stimulate direct contact between biologists with some mathematical background and mathematicians.

Symposium on Some Questions in Mathematical Biology

Chairman: Professor Murray Gerstenhaber, University of Pennsylvania

9:00 a.m. The stability of mating behavior, Professor William Bossert, Harvard University

10:00 a.m. Statistical mechanics of neural networks, Professor J. D. Cowan, University of Chicago

11:00 a.m. Graphical analyses of ecological equations, Professor Robert H. MacArthur, Princeton University

It is expected that the National Institute of Health will provide financial support for the Symposium.

Another symposium will be held on December 27, from 2:00 p.m. to 5:00 p.m. The title of the symposium will be "Research Topics in Computer Science". This symposium has been arranged by Professor A. J. Perlis, Head of the Department of Computer Science at Carnegie-Mellon University. Presiding will be Dr. Saul Gorn, Professor of Computer Science at the University of Pennsylvania.

Symposium on Research Topics in Computer Science

Chairman: Professor Saul Gorn, University of Pennsylvania

2:00 p.m. On representation, Professor Allen Newell, Carnegie-Mellon University

3:00 p.m. Recent research in computational complexity, Professor Juris Hartmanis, Cornell University

4:00 p.m. Computer science research in a high energy physics laboratory, Professor William F. Miller, Stanford University.

Other parts of the program which might be of interest to mathematicians are as follows: December 28, from 9:00 to 12 noon, "Computer aided research"; and December 29, from 12 noon to 4:00 p.m., "Colloquium on education in mathematical sciences". There will also be addresses by Professor Cyrus Levinthal of Massachusetts Institute of Technology on "Protein folding"; Professor Don L. Bunker of the University of California, Irvine, on "Monte Carlo techniques in chemistry"; and Dr. C. W. Hirt of Los Alamos Scientific Laboratory on "Computer experiments in fluid dynamics".

There will be no sessions for con-
The Society will not have a registration desk, but it does encourage AAAS registration. The registration fee of $10.00 provides each registrant with (a) the book-size General Program, (b) a Convention Badge, necessary for admission to the Science Theatre and Exhibits, (c) posting in the Visible Directory of Registrants, (d) convention literature, and (e) the satisfaction of assisting with the expenses of the meeting.

Murray Gerstenhaber
Chairman
Philadelphia, Pennsylvania

NEW AMS PUBLICATIONS

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

Number 75
LOCALLY COMPACT TRANSFORMATION GROUPS AND C*-ALGEBRAS
By Edward G. Effros and Frank Hahn
96 pages; List Price $1.70; Member Price $1.28.

Within recent years, considerable study has been devoted to the group C*-algebra of a locally compact group. In order to further this research, J. Glimm has associated an analogous C*-algebra with each locally compact transformation group. The authors investigate this construction and use it to answer several questions in the theory of C*-algebras. In particular, they exhibit a minimal distal action of the integers on the torus having uncountably many distinct ergodic measures. They show that the corresponding C*-algebra is separable and simple but has uncountably many factor traces. Another action of the integers results in an unusual separable C*-algebra with only finite dimensional representations. Although the extremal unit traces and the primitive ideals of this C*-algebra are in one-to-one correspondence, the simplicial structure topology on the former differs from the Jacobson structure topology on the latter. A careful exposition of the theory of transformation group C*-algebras is included in the Memoir.

Number 76
A CLASS OF FUNCTIONAL EQUATIONS OF NEUTRAL TYPE
By J. K. Hale and K. R. Meyer
72 pages; List Price $1.60; Member Price $1.20.

Equations of neutral type are formulated in such a way as to permit appropriate extensions of many known properties in ordinary differential equations. Linear equations are analyzed in great detail and applications are given to stability and non-linear oscillations.

PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS

Volume 19
MATHEMATICAL ASPECTS OF COMPUTER SCIENCE
Edited by J. T. Schwartz
232 pages; List Price $6.80; Member Price $5.10.

This volume consists of papers presented at the Symposium on Mathematical Aspects of Computer Science held in April, 1966, in New York City. The following are the topics included: automatic theorem proving; assigning meaning to programs; correctness of a compiler for arithmetic expressions; context-free languages and Turing machine computations; computer analysis of natural languages; the use of computers in the theory of numbers; a machine calculation of a spectral sequence; numerical hydrodynamics of the atmosphere; the calculation of zeros of polynomials and analytic functions; linearly unrecognizable patterns; mathematical theory of automata.
The Committee on Support of Research in the Mathematical Sciences (COSRIMS) made substantial progress during 1966-1967 toward completion of its report which is expected early in 1968. A writing session held in the new Academy facility, Mount Hope Farm, Williamstown, Massachusetts, prepared material for a draft report to be discussed at a meeting of the Committee on Science and Public Policy in the Academy on October 1. At its annual meeting on March 13, the Division took steps to monitor consequences of the COSRIMS Report by setting up Committees for Graduate Education, Undergraduate Education, and Forms and Level of Support, and extended the functions of the Committee on Regional Development to cover New Centers for Research.

The Mathematics Survey under the auspices of the Conference Board of the Mathematical Sciences (CBMS) was also carried substantially to its conclusion during 1966-1967. This Survey worked in close collaboration with COSRIMS, furnishing data upon request and calling attention to problems in the support of research as they appeared in its own Survey program. A promising development for the future is a systematic approach to collecting data which will be relevant on a current basis for policy questions involving the mathematical sciences. After October 1, the CBMS office will occupy Room 834 in the Joseph Henry Building, 2100 Pennsylvania Avenue, N. W., Washington, D. C. 20037, which is now under lease to the Academy. This will facilitate liaison between CBMS and the Division.

In the international field the Division completed its work in support of travel to the International Congress of Mathematicians, Moscow, and to the General Assembly of the International Mathematical Union, Dubna. The Division also provided travel and publication support, with funds from the Ford Foundation, to the Second Inter-American Conference on Mathematical Education held in Lima on December 4-12, 1966. The proceedings of the conference are now in press and will appear in Spanish, Portuguese, and English.

The President of the Academy appointed a delegation, nominated by the Division, to represent the United States at the International Statistical Institute meeting in Canberra on August 28 to September 8, 1967. The members of the delegation were M. H. Hansen, chairman, R. T. Bowman, J. L. Doob, and Elizabeth L. Scott.

The Division is cooperating with the International Federation for Information Processing (IFIP) in support of the fourth global conference in the information sciences scheduled for Edinburgh on August 5-10, 1968. A Subcommittee on Travel Grants for Computer Science is being set up in the Division to review applications for support of travel to this congress.

Reflecting the effect of the Rosser Report of the Academy on Digital Computer Needs in Universities and Colleges and the Pierce Report to the President's Science Advisory Committee on Computers in Higher Education, the chairman of the Division scheduled a discussion on computer science for the evening session of the annual meeting of the Division. The participants were John R. Pierce, Bell Telephone Laboratories; Anthony G. Oettinger of Harvard University and President of the Association for Computing
Machinery; and Bruce Gilchrist of the IBM Corporation and President of the American Federation of Information Processing Societies. The chairman of the Division initiated discussions in the Governing Board looking toward a role for NRC in computing.

After consultation among ONR, the chairman of the Division, and the Committee on Mathematics Advisory to ONR, the administration of the ONR Postdoctoral Research Associateship program has been transferred to the Office of Scientific Personnel, NRC. The committee will continue its advisory function with the Division and will consult with the chairman of the Division on the nomination of a panel which will review the associateship applications.

The Division cooperated with the Fellowship Office in setting up new methods for naming a roster of experts from which panels to review fellowship applications are chosen.

The Division distributed some 550 copies of the 1966-1967 edition of "Fellowship and Research Opportunities in the Mathematical Sciences".

Taking account of efforts by the National Research Council to increase the effectiveness of its several Divisions, the Executive Committee laid the question of society representation before the annual meeting. Final action will be reviewed by the Executive Committee and reconsidered in 1968.

Copies of the complete Annual Report of the Division of Mathematical Sciences may be obtained by writing to Division of Mathematical Sciences, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418.

### NEWS ITEMS

**NSF TO SUPPORT REGIONAL COMPUTER EXPERIMENTS**

The National Science Foundation will accept proposals seeking support for a limited number of cooperative educational computing experiments. Through selected experimental projects, the Foundation plans to explore the costs and educational value of enabling educational institutions to share computers on a geographical basis.

In his 1967 message to Congress on health and education, President Johnson noted the promise which computers may have for education. He directed the Foundation, working with the Office of Education, to establish an experimental program for developing the potential of computers in education. Through the newly established Office of Computing Activities, the Foundation hopes to stimulate new ideas and approaches to computer utilization in the research and educational processes. One important requirement, to provide students and faculty with effective access to computers, is the goal of the computer-sharing projects.

Inquiries concerning such projects may be addressed to Special Projects Section, Office of Computing Activities, National Science Foundation, Washington, D.C. 20550.

**VACLAV HLAVATY RESEARCH ASSISTANT PROFESSORSHIPS IN MATHEMATICS**

The Mathematics Department at Indiana University announces the establishment of the new Vaclav Hlavaty Research Assistant Professorship in Mathematics. One award will be made annually to a young mathematician who shows definite promise in research. Each appointment is for three years with an academic year salary of at least $10,500. The teaching duties during the first academic year will involve three hours per week and during the next two academic years will involve six hours per week. The salary often can be supplemented by either research contracts or teaching during the summer months. There will also be an annual amount of $400 available for professional expenses such as travel to meetings, supplies, publication costs, etc. to be used at the discretion of the grantee. Inquiries or requests for application forms should be addressed to Professor George Springer, Chairman, Department of Mathematics, Swain Hall-East, Indiana University, Bloomington, Indiana, 47401. Preference will be given to applications received before February 15.
LETTERS TO THE EDITOR

Editor, the Notices

As a reviewer for Mathematical Reviews over the past ten years may I make a few supplemental comments on E. Cohen's interesting letter to the Notices, Vol. 14 (1967) p. 610 viewed over and against F. K. Schmidt's related remarks concerning Zentralblatt für Mathematik on pp. 606-609 of the same issue of the Notices?

First, a journal of abstracts to replace M. R. would be wholly unsatisfactory, I believe, on at least three grounds: (1) abstracts would tend to frustrate detailed independent judgement on authors conclusions, available to the community at large, and encourage a lack of self-criticism, since results would go largely unevaluated as far as a unified view of mathematics is concerned; (2) would be consistent with the thesis, apparently held by some savants to the effect that one's own work is much more vitally important than the careful evaluation of work of others, unless pecuniary compensation is made (a possible reason to account for the difficulty in recruiting creative reviewers for mathematics, the physical sciences, and engineering, especially since one would have to fancy himself possessing a great deal of knowledge indeed in order to accept money for merely making it available to others); and (3) would greatly facilitate the further fragmentation of mathematics, which might not be harmful to mathematics (if one could imagine anything doing harm to mathematics), unless one meditates, by cogent analogy, on reasons why cancer is harmful to any organic growth process.

Secondly, I, for only one, do not subscribe to Cohen's implicit remarks in his second paragraph that the Reviews, and certain other journals of the Society are non-research oriented. Fortunately, Cohen does not, by himself, decide that issue once and for all for the Society any more than I do or some third member of the Society does. Unless I am mistaken there is no real justification (except possibly one issuing from reason (2) of the preceding paragraph) for calling every review "non-research" since, it seems to me, some reviews contain original research whose value might well exceed the value of the original research in the paper being reviewed. Indeed, to call some journals of the Society research journals and others non-research journals is to produce as fruitless and misleading a distinction as to argue whether it is better to do research than to teach or vice versa. Fundamental theorems are few and far between and we should be glad to have them wherever they are found; be it the Notices, the Proceedings, the Transactions or elsewhere.

Finally, if we must have only one language for M. R. why not follow history's lesson and let it be Latin?

Albert A. Mullin
Taegu, Korea

The following are excerpts (reprinted with the permission of the publisher) from the Journal of the Proceedings of the Association of Graduate Schools 1966, p. 126, concerning effort reports:

"Be it resolved, that the Association of Graduate Schools [AGS] instruct its President to call upon the Association of American Universities [AAU] to join in addressing to the President of the United States our respectful requests:

1. That the present requirement for reporting of effort by individual members of the professorial staff be suspended immediately because it admits of no meaningful compliance; ...

"The earlier motion on individual effort-reporting had proposed involving CGS [Council of Graduate Schools in the United States] in the attempt to get a revision, and had not proposed immediate suspension of the present requirement while negotiations were being undertaken. Dean Halford feared that if negotiations
alone were proposed the results would be delayed two to four years, .... Furthermore, as the presidents of AAU had expressed interest in working with the AGS in implementing specific recommendations of the Policies Committee report, and since there are on many campuses separate officers other than the graduate deans who serve as research coordinators, the group decided to address the AAU presidents in these matters. Dean Halford announced that in the event that this invitation to the presidents is not acted upon by them, the deans would be informed by mail as to some alternate course of action.

"[After adjournment of the AGS meeting, President McCarthy transmitted this resolution to President Grayson Kirk and President Nathan Pusey, President and Secretary of AAU respectively. On December 2, 1966 he was informed that President Kirk has appointed a committee to consider the issues raised in this resolution. Its members were Herbert E. Longenecker of Tulane as chairman; President Fred H. Harrington, Wisconsin; President James A. Perkins, Cornell; Dean Ralph S. Halford, Columbia; and Dean Joseph L. McCarthy, University of Washington.—Ed.]

These relevant sections document my sentence (Notices, August 1967): "The Association of Deans of Graduate Schools took a unanimous stand against the reports last fall, but instead of taking action, passed the buck to the University Presidents, who, as far as I am able to learn, have done nothing about the problem." I repeat: The situation represents a clear failure in the exercise of academic responsibilities by some of our top university administrators.

Under the circumstances, I don't see how any dean with self respect can continue to pass on for signing to his faculty the effort reports. And I don't see how the professors can agree to sign them.

None of the professors challenges the right of Congress or the public to get accounting for its money. However, there is a certain type of accounting which, when applied to the universities and academic research, destroys (or at least inhibits) the possibility of achieving those results intended by the financial support given in the first place. This is somewhat analogous to the Heisenberg principle in physics, which implies that one cannot measure certain phenomena without at the same time changing these phenomena, by the very act of trying to measure them. As a consequence, it is hopeless to give a proper accounting of these phenomena except on a statistical basis.

As for the larger picture, the universities are becoming more and more dependent financially on the government. At a time when policies governing the universities are being determined for the foreseeable future, it is extraordinarily important that administrators, both at the university level (deans, etc.) and the government level (NSF Directors, etc.), should insure that traditional academic values and standards are upheld. Both in the Smale case, and the case of effort reports, which have erupted simultaneously, I find a failure in the exercise of these responsibilities on the part of administrators. Ultimately, it is also the responsibility of the professors to refuse to submit to requirements which destroy these standards.

Serge Lang
## VISITING FOREIGN MATHEMATICIANS

The following list contains the names of foreign mathematicians who are visiting at various institutions in the United States this year. The list is compiled from responses received on or before October 5, to requests sent out by the Society to academic institutions.

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STARTING SALARIES FOR MATHEMATICIANS WITH A PH.D.

This survey is compiled from questionnaires sent to 507 individuals who received a Ph.D. in mathematics during the first six months of 1967. In the past this survey has been made on the basis of doctorates received during the calendar year. In order that our information be more timely, the compilation of the list of doctorates and this survey is being transferred from a calendar to an academic year basis. This particular survey represents the transition period so that it only covers degrees received during a six month period. There were 340 usable returns; in addition 15 people accepted positions abroad and are not part of the study because salaries are not comparable.

The academic life attracted 79% of those reporting; of these 80% were primarily engaged in teaching, 17% in research and 3% were on fellowships. More than 80% of those engaged in academic pursuits were associated with universities rather than colleges or technical institutes.

Industry attracted only 12% of those reporting; 7% were connected with research institutions. The Category "government" which has been included in prior surveys has been left out of this one because only 2% of those reporting were connected with the government and this included several people in the armed services.

Geographically 38% accepted jobs in the northeast, 19% in the south, 20% in the midwest, 3% in the mountain states, 16% in the far west and 4% in Canada.

The great majority of Ph.D.'s reporting had some degree of experience before receiving their doctorate; 55% had more than a year's experience, 18% had between 1/2 year and a year, and 27% had less than 1/2 year of experience in their fields prior to the first postdoctoral appointment.

It should be noted that the first category listed below (teaching, nine month salary) represents 60% of all positions. Salaries are listed in hundreds of dollars.

<table>
<thead>
<tr>
<th>TEACHING (Nine Month Salary)</th>
<th>RESEARCH (Nine Month Salary)</th>
<th>FELLOWSHIP (Yearly Stipend)</th>
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<td>Year</td>
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<td>Median</td>
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<tr>
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<td>41</td>
<td>79</td>
</tr>
<tr>
<td>1965</td>
<td>54</td>
<td>82</td>
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<td>1966</td>
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<td>1967</td>
<td>70</td>
<td>93</td>
</tr>
<tr>
<td>**1967</td>
<td>65</td>
<td>96</td>
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</table>

<table>
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<tr>
<th>RESEARCH (Twelve Month Salary)</th>
<th>TEACHING (Twelve Month Salary)</th>
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</thead>
<tbody>
<tr>
<td>Year</td>
<td>Min.</td>
</tr>
<tr>
<td>1965</td>
<td>81</td>
</tr>
<tr>
<td>1966</td>
<td>75</td>
</tr>
<tr>
<td>*1967</td>
<td>80</td>
</tr>
<tr>
<td>**1967</td>
<td>80</td>
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<th>INDUSTRY (Twelve Month Salary)</th>
<th>RESEARCH INSTITUTES (Twelve Month Salary)</th>
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<tr>
<td>Year</td>
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<tr>
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<td>1965</td>
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<td>*1967</td>
<td>125</td>
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<tr>
<td>**1967</td>
<td>97</td>
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</table>

*These figures represent the survey compiled from returns sent in by individuals who received their doctorates in 1966.

**These figures represent the survey compiled from returns sent in by individuals who received their doctorates during the first six months of 1967.
PERSONAL ITEMS

Professor EUGENE ALBERT of the University of California at Davis has been appointed to an associate professorship at California State College at Long Beach.

Professor ALEXANDER ABIAN of Ohio State University has been appointed to a professorship at Iowa State University.

Dr. D. E. ARGANBRIGHT of the University of Washington has been appointed to an assistant professorship at Iowa State University.

Dr. LUCIO ARTIAGA of Dalhousie University, Nova Scotia, has been appointed to an assistant professorship at the University of North Carolina at Charlotte.

Professor L. M. BLUMENTHAL of the University of Missouri, Columbia, has received a Fulbright grant to lecture at the University of Buenos Aires, Argentina, from August 1, 1967 to October 1, 1967.

Mr. A. J. BOALS of Michigan State University has been appointed to an assistant professorship at the University of Iowa. He will be on leave of absence at the Institute for Advanced Study during the 1967-1968 term.

Dr. DOROTHY BOLLMAN of the University of Puerto Rico has been appointed to an assistant professorship at Iowa State University.

Dr. J. D. BRILLHART of the University of San Francisco has been appointed to an associate professorship at the University of Arizona.

Professor R. M. BROOKS of the University of Minnesota has been appointed to an associate professorship at the University of Utah.

Dr. F. P. CALLAHAN of the General Electric Corporation, Blue Bell, Pennsylvania, has been appointed a Lecturer of the faculty of the Graduate School at Pennsylvania State University.

Professor J. M. CHAIKEN, on leave from Cornell University, has been appointed a Research Associate at the Massachusetts Institute of Technology for the fall term 1967-1968.

Professor J. L. DENNY, JR., of the University of California, Riverside, has been appointed to an associate professorship at the University of Arizona.

Dr. C. L. DEVITO of DePaul University has been appointed to an assistant professorship at the University of Arizona.

Dr. P. R. FALLONE, JR., of Case Western Reserve University has been appointed to an assistant professorship at the University of Connecticut.

Professor SOLOMON FEFERMAN, on leave from Stanford University, has been appointed to a visiting associate professorship at the Massachusetts Institute of Technology for the academic year 1967-1968.

Professor A. M. FINK of the University of Nebraska has been appointed to an associate professorship at Iowa State University.

Mr. K. R. FULLER of the University of Oregon has been appointed to an assistant professorship at the University of Arizona.

Dr. D. R. FLOYD of New Mexico State University has been appointed to an assistant professorship at the University of Arizona.

Professor F. I. GROSS of the University of Alberta has been appointed to an associate professorship at the University of Utah.

Dr. W. L. HAMILTON of the University of Utah has been appointed to an assistant professorship at the University of Georgia, Athens.
Mr. BERNARD HARVEY of the University of Minnesota has been appointed to an assistant professorship at California State College at Long Beach.

Associate Professor N. A. HAYNES of the University of Missouri, Columbia, retired September 1, 1967, with the rank of Associate Professor Emeritus.

Professor S. H. HECKLER of the University of California, Berkeley, has been appointed to an assistant professorship at Case Western Reserve University.

Dr. J. G. HOLLINGSWORTH of Rice University has been appointed to an assistant professorship at the University of Georgia, Athens.

Dr. J. A. HUCKABA of the University of Iowa has been appointed to an assistant professorship at the University of Missouri, Columbia.

Dr. L. S. HUSCH of Florida State University has been appointed to an assistant professorship at the University of Georgia, Athens.

Dr. R. L. JOHNSON of the University of Kansas has been appointed to an assistant professorship at Iowa State University.

Professor R. F. KELLER of the University of Missouri has been appointed to an associate professorship at Iowa State University.

Dr. A. M. KIRCH of the University of Minnesota has been appointed to an assistant professorship at Iowa State University.

Dr. T. J. KYROUZ of the University of Wisconsin has been appointed to an assistant professorship at the University of Georgia, Athens.

Professor A. H. LACHLAN, on leave from Simon Fraser University, has been appointed to a visiting associate professorship at the Massachusetts Institute of Technology for the fall term 1967-1968.

Dr. D. A. LAWVER of the University of Wisconsin has been appointed to an assistant professorship at the University of Arizona.

Mr. J. P. LEDIAEV of the University of California, Riverside, has been appointed to an assistant professorship at the University of Iowa.

Professor WALTER LEIGHTON of Case Western Reserve University has been appointed to a professorship at the University of Missouri, Columbia.

Dr. G. W. LOFQUIST of Louisiana State University has been appointed to an assistant professorship at Florida Presbyterian College.

Professor D. W. LOVELAND of New York University has been appointed to an assistant professorship at Carnegie-Mellon University.

Professor KURT MAHLER of the Australian National University, Canberra, Australia, has been appointed to a visiting professorship at the University of Arizona.

Professor M. C. MCCORD of the University of Georgia, Athens, will spend the 1967-1968 academic year at the Institute for Advanced Study.

Dr. D. V. MEYER of Pella College will be on leave for the academic year 1967-1968 as a postdoctoral fellow at the University of Georgia, Athens.

Professor V. H. MILLER has returned to Montana State University after a year's leave of absence at Brigham Young University.

Dr. JACK NEBB of the University of Kentucky has been appointed to an assistant professorship at the University of Georgia, Athens.

Dr. J. H. NEUWIRTH of Hunter College has been appointed to an associate professorship at the University of Connecticut.

Professor NELSON ONUCHIC of the University of Sao Paulo, Brazil, has been appointed to a visiting professorship at Georgetown University for a period of ten weeks next spring in February, March and part of April.

Dr. G. L. PFEIFER of the University of Nebraska has been appointed to an assistant professorship at the University of Arizona.

Professor GIAN-CARLO ROTA of Rockefeller University has been appointed to a professorship at the Massachusetts Institute of Technology.

Professor HANNO RUND of the University of the Witwatersrand, Johannesburg, South Africa, has been appointed to a visiting professorship at the University of Arizona.

Professor G. E. SACKS of Cornell University has been appointed to a professorship at the Massachusetts Institute of Technology.

Professor SHOICHIRO SAKAI, on leave
from the University of Pennsylvania, has been appointed to a visiting professorship at the Massachusetts Institute of Technology for the academic year 1967-1968.

Mr. A. J. SCHAEFFER of the University of California, Berkeley, has been appointed to an assistant professorship at the University of Iowa.

Dr. STEPHEN SCHEINBERG of the Harvard Medical School has been appointed a Lecturer at the Massachusetts Institute of Technology.

Professor K. D. SCHMITT of the University of Nebraska has been appointed to an assistant professorship at the University of Utah.

Professor M. H. SCHULTZ of Case Western Reserve University has been appointed to an assistant professorship at Carnegie-Mellon University.

Professor T. I. SEIDMAN of Wayne State University has been appointed to a visiting associate professorship at Carnegie-Mellon University.

Dr. D. A. SENECHALLE of Tracor, Incorporated, and the University of Texas has been appointed to an assistant professorship at the University of Georgia, Athens.

Dr. F. D. SENTILLES of Louisiana State University has been appointed to an assistant professorship at the University of Missouri, Columbia.

Dr. N. E. SEXAUER of the University of Illinois has been appointed to an associate professorship at California State College at Long Beach.

Professor H. L. SHAPIRO of Pennsylvania State University has been appointed to a visiting assistant professorship at Carnegie-Mellon University.

Dr. W. E. SHREVE of the University of Nebraska has been appointed to an assistant professorship at the University of Connecticut.

Dr. F. J. SMITH of Purdue University has been appointed to an assistant professorship at the University of Connecticut.

Dr. W. S. SNYDER of the Oak Ridge National Laboratory, Oak Ridge, Tennessee, has been installed as President of the Health Physics Society for 1967-1968.

Mr. CHARLES SNYGG of the University of Michigan has been appointed to an assistant professorship at Morehouse College.

Professor D. C. SPENCER, on leave from Stanford University, has been appointed to a visiting professorship at the Massachusetts Institute of Technology for the period October 1 to December 31, 1967.

Dr. EUGENE SPIEGEL of the California Institute of Technology has been appointed to an assistant professorship at the University of Connecticut.

Professor IVAR STAKGOLD of Northwestern University will be on leave in 1967-1968 serving as Liaison Scientist in Mathematics for the United States Office of Naval Research in London, England.

Professor R. R. STOLL of Oberlin College has been awarded a National Science Foundation Science Faculty Fellowship and will spend the academic year at the Massachusetts Institute of Technology.

Professor K. SUNDARESAN of Carnegie-Mellon University has been appointed to an assistant professorship at the University of Missouri, Columbia.

Dr. D. C. TAYLOR of the University of Kentucky has been appointed to an assistant professorship at the University of Missouri, Columbia.

Dr. R. B. THOMPSON of the University of Wisconsin has been appointed to an assistant professorship at the University of Arizona.

Dr. R. S. TINDELL of Florida State University has been appointed to an assistant professorship at the University of Georgia, Athens.

Mr. S. E. WEINSTEIN of Michigan State University has been appointed to an assistant professorship at the University of Utah.

Dr. BRUCE WOOD of Lehigh University has been appointed to an assistant professorship at the University of Arizona.

PROMOTIONS

To Professor Emeritus. University of Iowa: N. B. CONKWRIGHT.

To Professor. University of Arizona: DEONISIE TRIFAN; Carnegie-Mellon University: V. J. MIZEL, R. A. MOORE; University of Georgia, Athens: T. R. BRAHANA; Iowa State University: G. W. PEG-LAR; Massachusetts Institute of Technology: P. D. CROUT, F. B. HILDEBRAND,
NEW AMS PUBLICATIONS

TRANSLATIONS OF MATHEMATICAL MONOGRAPHS

Volume 16
THE TOPOLOGY OF THE CALCULUS OF VARIATIONS IN THE LARGE
By L. A. Ljusternik
95 pages; List Price $9.30; Member Price $6.98.

The purpose of the book is to develop theorems about geodesics in various families of curves on certain manifolds by means of cohomology theory and to apply these theorems to the analysis in the large of functions on topological spaces; in particular, the second chapter gives some applications to nonlinear integral equations.

Volume 17
EXPANSIONS IN EIGENFUNCTIONS OF SELFADJOINT OPERATORS
By Ju. M. Berezanskii
Approximately 875 pages.

The general theory is developed in detail and is then applied to the construction of certain types of expansions for partial differential operators and difference operators, to the setting-up of integral representations for positive definite kernels, to the moment problem, and so forth. The necessary theory of boundary problems for differential equations is developed in detail, on the basis of the theory of generalized functions (distributions) of finite order.
During the interval from September 8 to September 26, 1967, the papers listed below were accepted by the American Mathematical Society for presentation by title. After each title on this program there is an identifying number. The abstracts of the papers will be found following the same number in the section on Abstracts of Contributed Papers in this issue of these Notices.

One abstract presented by title may be accepted per person per issue of these Notices. Joint authors are treated as a separate category; thus in addition to abstracts from two authors individually one joint abstract by them may be accepted for a particular issue.

(1) The immortality problem for non-erasing Turing machines
   Professor Dag Belsnes, University of Oslo, Norway (67T-700)

(2) Decision problems for tag systems
   Professors Dag Belsnes and Stal Aanderaa, University of Oslo, Norway (67T-698)

(3) The maximum of a linear fractional function over a parallelopiped
   Professor Adi Ben-Israel and Professor Abraham Charnes, Northwestern University, and Mr. W. W. Cooper, Carnegie-Mellon University (67T-701)

(4) Semigroups and resolvent operators
   Professor P. L. Butzer and Mr. S. Pawelke, Technical University of Aachen, Germany (67T-680)

(5) The singular submodule splits off
   Mr. V. C. Cateforis, University of Wisconsin (67T-686)

(6) Sets in discrete abelian groups which support Fourier-Stieltjes transforms only of absolutely continuous measures
   Professor R. W. Chaney, University of California, Santa Barbara (67T-699)

(7) The elementary theory of a homogeneous quadratic ring \( R \)
   Professor John De Cicco, Illinois Institute of Technology, and Professor Robert V. Anderson, Chicago State College (67T-697)

(8) Some variation problems concerning certain planar directional fields of force
   Professor John De Cicco, Illinois Institute of Technology, and Professor Arun Walvekar, Bombay, India (67T-683)

(9) Dedekind arithmetic
   Professor Erik Ellentuck, Rutgers, the State University (67T-688)

(10) On \( k \)-mersions of manifolds. Preliminary report
    Mr. S. D. Feit, Hamden, Connecticut (67T-689)

(11) Intuitionistic models and independence results in set theory. II. Preliminary report
    Mr. M. C. Fitting, Yeshiva University (67T-687)

(12) A new mathematical method of proving
    Dr. Baruch Gershuni, Amsterdam, The Netherlands (67T-677)

(13) Operator products and operator angles
    Professor K. E. Gustafson, University of Minnesota (67T-675)

(14) Tensor products of semigroups with minimal ideals
    Professor T. J. Head, University of Alaska (67T-673)

(15) Automatic problem formulation with applications to fluid mechanics
    Mr. J. C. Howard, NASA, Ames Research Center, Moffett Field, California (67T-692)

(16) On powers of groups and related questions
    Professor L. C. Kappe and W. P. Kappe, Ohio State University (67T-696)

(17) Convergence-preservation by a generalized Hausdorff mean
    Professor C. W. Leininger, University...
sity of Dallas (67T-693)

(18) Lip 1 and differentiability
Professor J. R. McLaughlin, Pennsylvania State University (67T-685)

(19) A note on stochastic difference equations
Dr. K. S. Miller, Columbia University Electronics Research Laboratories, New York (67T-679)

(20) A characterization of symmetric generalized proximity spaces
Mr. C. J. Mozzochi, University of Connecticut (67T-672)

(21) Additive prime-number theory and aesthetics. IV
Captain A. A. Mullen, U.S. Department of the Army (67T-670)

(22) Rigidity of complex hypersurfaces. Preliminary report
Professor Katsumi Nomizu, Brown University, and Mr. Brian Smyth, University of Notre Dame (67T-681)

(23) Upper bounds on homological dimensions
Dr. B. L. Osofsky, Institute for Advanced Study (67T-678)

(24) Hypersimplicity as a necessary and sufficient condition for nonindependent axiomatization, II
Professor M. B. Pour-El, University of Minnesota (67T-682)

(25) Decidability of monadic second-order theory of two successors
Professor M. O. Rabin, Hebrew University of Jerusalem, Israel, and IBM Research, Yorktown Heights, New York (67T-668)

(26) The decomposition of matrix-valued measures
Professor J. B. Robertson, University of California, Santa Barbara, and Professor Milton Rosenberg, University of Kansas (67T-676)

(27) A real-time solution of the origin-crossing problem
Dr. A. L. Rosenberg and Mr. M. J. Fischer, IBM Watson Research Center, Yorktown Heights, New York (67T-684)

(28) Ascendent and descendent graphs
Professor S. S. Shrikhande, University of Bombay, India, and Ohio State University (67T-671)

(29) A characterization of those finite groups with chained-Y lattices of subgroups
Dr. S. N. Sidki, University of Missouri at St. Louis (67T-669)

(30) Torsion invariants for pseudo-isotopies on closed manifolds
Dr. L. C. Siebenmann, University of Paris, France (67T-674)

(31) On bounded complete additive classes
Mr. M. L. Teply, University of Nebraska (67T-690)

(32) Open continuous mappings of μ-spaces
Dr. H. H. Wicke and Dr. J. M. Worrell, Jr., Sandia Corporation, Albuquerque, New Mexico (67T-695)

(33) Concerning the paracompact p-spaces of Arhangel'skii
Dr. J. M. Worrell, Jr., Sandia Corporation, Albuquerque, New Mexico (67T-694)

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ABSTRACTS OF CONTRIBUTED PAPERS

The November Meeting in Knoxville, Tennessee
November 17-18, 1967

650-1. J. L. BRYANT, Florida State University, Tallahassee, Florida 32306. Euclidean space modulo a cell. II.

Given a k-cell D topologically embedded in E^n, let E^n/D denote the quotient space obtained by identifying D to a point. Theorem 1. If D is a k-cell in E^n that is flat in E^{n+1}, then E^n/D x E^1 is homeomorphic to E^{n+1}. Results of Gillman (Duke Math. J. 33 (1966), 229-246) show that the hypothesis of this theorem is always satisfied when n = 3 so that the following corollary is immediate.

Corollary 2. If D is a k-cell in E^3, then E^3/D x E^1 is homeomorphic to E^4. This theorem with k = 3, together with a result of Lininger (Trans. Amer. Math. Soc. 118 (1965), 534-549), prove Corollary 3. Let K be a crumpled cube in E^3. Then E^3/K x E^1 is homeomorphic to E^4. (Received July 24, 1967.)

650-2. E. C. YOUNG, Florida State University, Tallahassee, Florida 32306. On the characteristic initial problem for the wave equation.

Let K = (t = r)^2 - \sum_{i=1}^{n}(x_i - \xi_i)^2 = 0, t \geq r, be the direct characteristic cone with vertex at (\xi, r), \xi = (\xi_1, \ldots, \xi_n) associated with the wave equation L(u) = u_{tt} - \sum_{i=1}^{n}u_{x_i}x_i = 0, n \geq 2. The classical characteristic initial value problem L(u) = 0 for points inside K = 0 such that u = F(x), x = (x_1, \ldots, x_n), on K = 0 has been solved by employing various devices, e.g., Riesz-\'integr\'e de Riemann-Liouville et le probl\'eme de Cauchy, Acta Math. 81 (1948), 107-115, and Courant and Hilbert, Methods of mathematical physics, Vol. 2, Interscience, New York, 1962, p. 750. Here the problem is solved by an extension of the Riemann method devised by Diaz and Martin [Riemann's method and the problem of Cauchy, II, Proc. Amer. Math. Soc. 3 (1952), 476-483]. (Received August 3, 1967.)


Let B^k, M^n, N^p be manifolds in Category C = Top, Diff or PL. M^n and N^p are H-enclosable in S^k if (1) k = n + p + 1, (2) there are C-imbeddings i: M^n \subseteq B^k and j: N^p \subseteq B^k with disjoint images and (3) there are deformation retractions of B^k - i(M^n) onto j(N^p) and B^k - j(N^p) onto i(M^n). This is expressed as B^k = [M^n, N^p][i,j] (mod C). If we restrict C to either Top or PL and assume the Poincar\'e conjecture valid for dim 3,4 we can prove Theorem 1. Let B^k, M^n, N^p be closed, connected and 1-connected in C and B^k = [M^n, N^p][i,j] (mod C). B^k = S^k (standard k-sphere in C) iff M^n = S^n and N^p = S^p. In Diff we prove Theorem 2. Any exotic 7-sphere is H-enclosable with S^7 in some homotopy 15-sphere, and Theorem 3. The exotic 16-sphere is not H-enclosable with S^{12} in any 29-manifold. Results (2) and (3) follow from work of C. T. C. Wall and Hsiang-Levine-Szczarba. (Received August 7, 1967.)

A theorem of Wardwell's for compact metric spaces is generalized for the specific space $S^3$. Define $H_0(G)$ to be the set of nondegenerate elements of $G$. For any countable ordinal $\alpha$ define $H_\alpha(G) = \bigcup \{H_0(G)\cap\limsup H_\beta \neq \emptyset, \forall \beta < \alpha\}$.

**Theorem.** If $G$ is an upper semicontinuous decomposition of $S^3$ into cellular sets and if for some countable $\alpha$, $G_1$ is a decomposition of $S^3$ such that $H_0(G_1) = H_\alpha(G)$ and $S^3/G_1 = S^3$, then $S^3/G = S^3$.

This can be applied to give a condition on how "bad" a decomposition of $S^3$ which is not $S^3$ must be.

**Theorem.** Let $G$ be an upper semicontinuous decomposition of $S^3$ into cellular sets with a countable number of nondegenerate elements such that $S^3/G \neq S^3$. Then there is a subset $F \subseteq H_0(G)$ and an upper semicontinuous decomposition $G_1$ of $S^3$ such that $H_0(G_1) = F$, $S^3/G_1 \neq S^3$, and $H_1(G_1) = H_0(G_1)$.

(Received August 21, 1967.)


A 2-sphere $S$ in $E^3$ is said to be strongly locally spherical if for each point $p$ in $S$ and each $\epsilon > 0$ there is a 2-sphere $S'$ such that $p \in \text{Int } S'$, $S' \cap S$ is a continuum irreducible with respect to separating $S$, and $\text{Diam } S' < \epsilon$. **Theorem.** A 2-sphere $S$ in $E^3$ is tame if and only if $S$ is strongly locally spherical. (Received August 21, 1967.)


Suppose that each of $m$ and $n$ is a positive integer and that $S_n$ denotes the linear space of all real-valued symmetric $n$-linear functions on $E_m$. If each of $u$ and $v$ is in $S_n$, denote by $uv$ the inner product $\sum_{p=1}^{\infty} \sum_{p_m=1}^{m} u(X_{p_1}, \ldots, X_{p_m}) v(X_{p_1}, \ldots, X_{p_m})$ where $X_1, \ldots, X_m$ is any orthonormal subset of $E_m$. If $u$ is in $S_n$ and $v$ is in $S_k$, then $u \otimes v$ is defined as the element $z$ of $S_{n+k}$ such that $(wu)v = wz$ for all $w$ in $S_{n+k}$ where $(wu)(y_1, \ldots, y_n) = u[w(y_1, \ldots, y_n)]$ for all $y_1, \ldots, y_n$ in $E_m$. Suppose that $D$ is a convex open subset of $E_m$ which contains the origin, $R$ is a real-valued function whose domain includes $D$, and $A$ is a member of $S_n$ such that $AA = I$. Define $T$ so that if $W$ is an $n$-times continuously differentiable real-valued function whose domain includes $D$, then $(TW)(p) = \sum_{q=0}^{n-1} (1/q!) W^{(q)}(0) p^q + \int_0^1 dj \left[ (1 - j)^{n-1}/(n - 1)! \right] S_{jp} [W^{(n)}(jp)] | p^n |$ for all $p$ in $D$ where, if $x$ is in $D$, $S_{x}v = v - [Ax - R(x)] A$ for all $v$ in $S_n$. **Lemma.** If $u$ is in $S_n$ and $v$ is in $S_k$, then $\|u \otimes v\| \leq \|u\| \|v\|$. **Theorem.** If $R$ is a polynomial and $W$ is a real-analytic function whose domain includes $D$, then there is a real-analytic function $Z$ and an open subset $D'$ of $D$ such that $|T^k W|_{k=1}^{\infty}$ converges uniformly to $A$ on $D'$ and $A[Z^{(n)}(p)] = R(p)$ for all $p$ in $D'$. (Received August 23, 1967.)

650-7. J. V. BRAWLEY, JR., Clemson University, Clemson, South Carolina 29631. Similar involutory matrices, modulo $r$.

Let $R$ denote a commutative ring with an identity, and let $R_n$ denote the $n \times n$ matrices over $R$. A matrix $A \in R_n$ is called involutory iff $A^2 = I$, where $I$ denotes the $n \times n$ identity matrix. A subset $C$ of $R_n$ is called a canonical set for the involutory matrices iff each involutory $A \in R_n$ is similar to $A$.
to one and only one member of $\mathbb{C}$. That member of $\mathbb{C}$ to which $A$ is similar is called the canonical form of $A$ relative to $\mathbb{C}$. (Note that the elements of $\mathbb{C}$ are involutory as $A$ is involutory iff $P^{-1}AP$ is involutory.) In this paper a canonical set $\mathbb{C}$ is found for the case when $R$ is the residue class ring of integers modulo $r$, $r$ arbitrary. The set $\mathbb{C}$ is obtained in such a manner that its members have zeros in most of their positions so that canonical forms are in some sense simple. Formulas for the number of elements in $\mathbb{C}$ are also given. (Received August 28, 1967.)


For matrices whose entries are elements of an orthomodular lattice a multiplication is defined by letting $AB$ be the matrix whose $ij$th entry is $\bigvee_{k=1}^{n}(A_{ik} \wedge B_{kj})$ where $A_{ik}$ and $B_{kj}$ represent the $ik$th and $kj$th entries of the matrices $A$ and $B$ respectively. In general the multiplication operation is nonassociative. For matrices $A$ and $B$ of appropriate size, conditions are given for finding solutions to the inequalities $XA \leq B$ and $XA \geq B$. These results are used to establish certain properties concerning the residuated character of the set of all $n$-square matrices over an orthomodular lattice. (Received September 5, 1967.)


Suppose that $S$ is the set of real numbers and $R$ is a normed ring with unity. A function $F$ from $S \times S$ to any ring is order-additive provided that $F(x,y) + F(y,z) = F(x,z)$ for all $x \leq y \leq z$ or $x \geq y \geq z$.

Let $\mathcal{O}^{+}$ denote the collection of order-additive functions from $S \times S$ to the nonnegative real numbers, $\mathcal{O}$ denote the collection of order-additive functions $V$ from $S \times S$ to $R$ for which there is a member $a$ of $\mathcal{O}^{+}$ such that $|a| \leq a$, and, if $V$ is in $\mathcal{O}$ and $\{a,b\}$ is in $S \times S$, then $\prod_{a}^{b}[1 + V]$ denote the continuously continued product of $1 + V$ from $a$ to $b$ as defined by J. S. Mac Nerney in [Illinois J. Math. 7 (1963), 148-173]. Let $\mathcal{O}A$ denote the subset of $\mathcal{O}A$ to which $V$ belongs only in case, for each $y$ in $S$, each of $1 + V(y,y^{+})$, $1 + V(y^{-},y)$, $1 + V(y,y^{+})$, and $1 + V(y,y^{-})$ has a multiplicative inverse in $R$. Theorem. There is a reversible function $J$ from $\mathcal{O}A$ onto $\mathcal{O}A$ which has the following properties: if $V$ is in $\mathcal{O}A$, then (i) $J[V] = V$, (ii) $J[V](a,b) = -V(b,a)$ only in case $a \sum_{b}^{b}|V^{2}| = 0$, (iii) $\prod_{a}^{b}[1 + J[V]] \cdot b \prod_{a}^{b}[1 + V] = 1$, and (iv) $J[V](a,b) = -b \sum_{a}^{a}[1 + V]^{-1}V$. (Received September 5, 1967.)


Let $X$ be a metric space such that there exists a sequence of compact sets $Q_{n} \subset X$ such that $Q_{n} \subset \text{int} Q_{n+1}$ for all $n$ and $X = \bigcup_{n=1}^{\infty}Q_{n}$ and $C$ the space of all real-valued continuous functions on $X$. Let $J$ be a Daniell functional on $C$, i.e. a positive linear functional continuous under pointwise monotone convergence everywhere on $X$. By the volume generated by $J$ we shall understand the volume $V$ as defined in the paper: W. Bogdanowicz, An approach to the theory of integration generated by Daniell functionals and representations of linear continuous functionals, Math. Ann. 173 (1967), 918

Let $V$ consist of all sets being differences of open sets of the space $X$. Theorem. Let $J$ be a Daniell functional on the space $C$ and $v$ the volume generated by it. Then there exists a compact set $Q \subseteq X$ such that (1) $v(A) = v(A \cap Q)$ for all $A \in V$. Conversely, if $v$ is a positive volume on $V$ satisfying the condition (1) then all functions $f \in C$ are $v$-summable, for definition see W. Bogdanowicz, Proc. Nat. Acad. Sci. USA 53 (1965), 492-498, and the restriction of the integral $\int fdv$ to $C$ yields a Daniell functional $J$ such that the volume generated by it coincides with the volume $v$. (Received September 11, 1967.)

Optimal controls of vibrating beams.

The optimal control problem is considered for the operator $L(w) = p(x)\lambda(x)\frac{\partial^2 w(x,t)}{\partial t^2} + \frac{\partial^2}{\partial x^2}(E(x) I(x) \frac{\partial^2 w(x,t)}{\partial x^2})$ subject to physically motivated assumptions on the coefficients $\rho A$ and $EI$, with suitable two point boundary conditions and initial conditions for $w(x,0)$ and $\partial w(x,0)/\partial t$. First, the fixed interval problem is discussed. Existence of optimal control and uniqueness of finite state are proved, and a maximal principle is given. These results are shown to be valid for optimum time controls. A following limiting process is introduced. Let $\phi(x,t)$ be the minimal time control resulting in the total final energy $E < E(0)$. Subdivide the interval $[E,E(0)]$, and on each subinterval introduce an optimal time control. The resulting control reducing $E(0)$ to $E$ is denoted by $\hat{\phi}_1$. It is proved that continuing this process, $\lim_{i \to \infty} \hat{\phi}_i = \hat{\phi}$ exists in the sense of generalized functions, and has the optimal property: $\hat{\phi}$ reduces the total energy at the greatest possible rate at each instant of time. Uniqueness properties and a maximal principle for $\hat{\phi}$ follow easily from construction. (Received September 13, 1967.)

Absolute convergence factors for $H^p$ series.

The multiplier class $(H^1, l^1)$ is the collection of all complex number sequences $(\lambda_n)$ such that $\sum |a_n|^{\lambda_n}$ converges for each sequence $(a_n)$ of coefficients of an $H^1$ function. A result of Hardy implies that the sequence $(n+1)^{-1}$ belongs to $(H^1, l^1)$. We give the following characterization of $(H^1, l^1)$.

Theorem. Let $(\lambda_n)$ be any sequence of complex numbers. Then $(\lambda_n) \subseteq (H^1, l^1)$ if, and only if, there is a bounded measurable function $g$ defined on the circle $|Z| = 1$ such that $|\lambda_n| = (1/2\pi)\int_0^{2\pi} g(e^{i\theta})e^{-in\theta} d\theta$ ($n = 0, 1, 2, \ldots$). The multiplier classes $(H^p, l^1)$ with $1 < p \leq \infty$ are also investigated. The following result on Hadamard factorization of $H^2$ functions is obtained. Theorem. If $q < \infty$ and $f \in H^2$, then there is a function $g \in H^q$, $g(z) = \sum a_n z^n$, and a $c_0$ sequence $(\lambda_n)$ such that $f(z) = \sum a_n \lambda_n z^n$. (Received September 14, 1967.)

Decomposable inverse limits with a single bonding map on $[0, 1]$ below the identity.

Theorem. If $M$ is a decomposable compact continuum with metric $d$ then there exists a continuous function from $[0, 1]$ onto $[0, 1]$ such that, if $0 < x < 1$, then $f(x) < x$ and such that $M$ is topologically equivalent to $\lim f$ (the inverse limit space with $f$ as the only bonding map) if and only if (1) $M$ is chainable, (2) $M$ is irreducible between some two of its points, $A$ and $B$, and (3) there exists a reversibly continuous transformation $\phi$ from $M$ onto $M$ such that $\phi(A) = A, \phi(B) = B$, and if $\epsilon > 0$ and $\delta > 0$,
then there exists a positive integer \( n \) such that if \( P \) is a point of \( M \) and \( d(B, P) > \delta \), then \( d(A, d^B(P)) < \epsilon \).

**Theorem.** Suppose \( f \) is a continuous function from \( [0, 1] \) onto \( [0, 1] \) such that if \( 0 < x < 1 \), \( f(x) < x \). Then if \( \lim f \) is irreducible between the points \( P \) and \( Q \), then \( P \) is one of the points \( 0, 0, \ldots \) and \( 1, 1, \ldots \) and \( Q \) is the other. A corollary of the last theorem is that the sin \((1/x)\)-continuum, which is obtainable from a rather simple single bonding map on \( [0, 1] \), cannot be obtained from any single bonding map \( f \) on \( [0, 1] \) with the property that if \( 0 < x < 1 \), then \( f(x) < x \). (Received September 15, 1967.)

650-14. C. GRIFFITH, Florida State University, Tallahassee, Florida 32306. **Strongly cellular two-cells are tame in three-space.**

The title result of Bing and Kirkor's paper *An arc is tame in 3-space if and only if it is strongly cellular*, Fund. Math. 55 (1964), 175-180, has been extended by Howell [A tameness condition for 3-cells, Abstract 627-52, these Notices, Amer. Math. Soc. 13 (1966), 52] to 3-cells in \( E^3 \). **Theorem.** A compact subset \( Z \) of \( E^n \) with a connected complement is strongly cellular if and only if there is an \((n - 1)\)-sphere \( S \) in \( E^n \setminus Z \) and a homotopy \( h: S \times I \to E^n \) such that \( h_0 \) is the identity, \( h_t \) is an imbedding for \( t < 1 \), \( h_t(S) \) and \( h_t'(S) \) are disjoint for \( t = t' \), and \( h_1(S) = \text{Bdry} Z \). When \( Z \) is a 2-cell in \( E^3 \) the map \( h_1 \) is seen to have some nice properties. For example, if \( W \) is the combinatorial interior of \( Z \) then \( h_1^{-1}(W) \) has exactly two components each of which is thrown onto \( W \) by \( h_1 \). These properties lead to the title theorem. (Received September 18, 1967.)

650-15. WILLIAM HEINZER, Louisiana State University, Baton Rouge, Louisiana 70803. **Some remarks on complete integral closure.**

If \( D \) is an integral domain with quotient field \( K \) then an element \( x \) of \( K \) is said to be *almost integral* over \( D \) if there exists a nonzero element \( y \) of \( D \) such that \( yx^n \) is an element of \( D \) for each positive integer \( n \). The set \( D^* \) of elements of \( K \) almost integral over \( D \) is called the *complete integral closure* of \( D \) and \( D \) is *completely integrally closed* if \( D^* = D \). Using an existence theorem of Jaffard's (see P. Jaffard's *Les systemes d'idéaux*, p. 78) an example is given of a Prüfer domain \( D \) such that \( D^* \) is not completely integrally closed. (Received September 18, 1967.)

650-16. TAE-IL SUH, Tennessee State University, 2648 University Station, Johnson City, Tennessee 37601. **Equationally complete nonassociative algebras.**

Let \( \Phi \) be a finite field of characteristic \( p \), and \( p^m \) the order of \( \Phi \). An associative algebra \( \mathfrak{A} \) over \( \Phi \) is called a \( p \)-algebra if \( a^{p^m} = a \) for each \( a \) in \( \mathfrak{A} \). An associative algebra over \( \Phi \) is called a \( p \)-zero-algebra if \( ab = 0 \) for all elements \( a \) and \( b \). The class of all \( p \)-algebras and that of all \( p \)-zero-algebras are both equational, that is, defined by a set of equations. Using Tarski's method in *Equationally complete rings and relation algebras*, Indag. Math. 18 (1956), 39-46, we have proved **Theorem.** A nonassociative algebra \( \mathfrak{A} \) over a finite field of characteristic \( p \) which has a nonzero idempotent element is equationally complete if and only if \( \mathfrak{A} \) is a \( p \)-algebra. **Theorem.** Let \( \mathfrak{A} \) be a nonassociative algebra over a finite field of characteristic \( p \) which has no idempotent element \( \neq 0 \) but an associative element \( \neq 0 \). \( \mathfrak{A} \) is equationally complete if and only if \( \mathfrak{A} \) is a \( p \)-zero-algebra. (Received September 19, 1967.)
650-17. TREVOR EVANS, Emory University, Atlanta, Georgia 30322. The number of semigroup varieties.

Austin (Quart. J. Math. 1966) has given an example of a set of semigroup identities which does not have a finite basis. A brief alternative proof of Austin's theorem is given and it is shown that the set contains an infinite irredundant subset which generates it. It follows that there are uncountably many varieties of semigroups. (Received September 21, 1967.)


The following theorem is proved: Let E be a locally convex space and let \( \{E_i\} \) be a sequence of subspaces of E such that (1) there exist projections \( \{P_i\} \) of the linear span M of \( \bigcup_{i=1}^{\infty} E_i \) such that \( \{E_i, P_i\} \) is a Schauder decomposition for M; (2) each \( P_i \) has a unique continuous extension \( P_i \) from M to its closure \( \overline{M} \) in E; and (3) the family \( \{S_n\} \) of operators defined by \( S_n = \sum_{i=1}^{n} P_i \) is equicontinuous. Then \( \{E_i, P_i\} \) is a Schauder decomposition for \( \overline{M} \) where \( \overline{E_i} \) is the closure of \( E_i \). This theorem has several known corollaries, in particular, a theorem of Gelbaum which states the result for basic sequences in Banach spaces [Duke Math. J. 17 (1950), 189, Theorem 1] and a theorem of Russo which substitutes the completeness of each \( E_i \) for condition (2) of the hypothesis [Monotone and E-Schauder bases of subspaces, Can. J. Math. (to appear)]. In addition, several general theorems about the existence of a Schauder decomposition or Schauder basis for the completion of \( E \otimes F \) under certain important topologies when either \( E \) or \( F \) (or both) has a Schauder decomposition or a Schauder basis are obtained. (Received September 21, 1967.)

650-19. ROBERT GILMER, Florida State University, Tallahassee, Florida 32306. A note on semigroup rings.

Let \( R \) be a commutative ring, let \( S \) be an additive abelian semigroup, and let \( T \) be the semigroup ring of \( S \) with respect to \( R \). In order that \( T \) be an integral domain, it is necessary and sufficient that these three conditions hold (1) \( R \) is an integral domain, (2) \( S \) is cancellative, and (3) if \( x \) and \( y \) are distinct elements of \( S \) and if \( n \) is a positive integer, then \( nx \neq ny \). (Received September 21, 1967.)

650-20. C. D. SIKKEMA, SHIN'Ichi KINOSHITA and S. J. LOMONACO, JR., Florida State University, Tallahassee, Florida 32306. Uncountably many quasi-translations of \( S^3 \).

An autohomeomorphism \( h \) of a compact metric space \( X \) is said to have equicontinuous powers at \( x \in X \), if for each \( \epsilon > 0 \) there exists a \( \delta > 0 \) such that whenever \( d(x, y) < \delta \), \( d(h^m(x), h^m(y)) < \epsilon \) for every integer \( m \). An orientation preserving homeomorphism of \( S^3 \) is called a quasi-translation if it fails to have equicontinuous powers at exactly one point. Kinoshita [On quasi-translations in 3-space, Fund. Math. 56 (1964), 69-79] showed that existence of a quasi-translation of \( S^3 \) that is not equivalent to a translation. *Theorem.* There exist uncountably many nonequivalent quasi-translations of \( S^3 \). The proof uses the \( r \)th penetration indices of Giffen [Abstract 607-19, these *Notices* 14 (1967), 666-667]. (Received September 25, 1967.)

A mean is a nonvoid Hausdorff space equipped with a continuous idempotent commutative multiplication. Theorems. A compact connected mean is unicoherent. A locally compact, connected, locally connected mean is unicoherent. There is no mean on the subset of the cartesian plane \( \{(0,y) : -1 \leq y \leq 1\} \cup \{(x,\sin(1/x)) : 0 < x \leq 1\} \). (Received September 25, 1967.)


Let \( S \) denote a 2-sphere in \( S^3 \), and let \( U \) denote a component of \( S^3 - S \). The sphere \( S \) is defined to be locally fenced from \( U \) if each point of \( S \) has arbitrarily small neighborhoods \( N \) such that \( \text{Bd} \ N \) is collared from \( U \). The following results, which generalize work by C. E. Burgess, indicate that the collars over subcontinua of \( S \) of unspecified nature tell as much about the embedding of the sphere as do the collars over arcs and simple closed curves. Theorem 1. If \( S \) is locally fenced from \( U \), and if \( U \) is an open 3-cell, then there exists a point \( q \) in \( S \) such that \( S \) is locally tame from \( U \) at each point of \( S - q \). Theorem 2. If each member of some dense subset of the space of all subcontinua of \( S \) can be collared from \( U \), and if \( U \) is an open 3-cell, then there exists a point \( q \) in \( S \) such that \( S \) is locally tame from \( U \) at each point of \( S - q \). (Received September 28, 1967.)

650-23. ERIK HEMMINGSEN, Syracuse University, Syracuse, New York 13210. Open simplicial maps on spheres.

Let \( f : S^n \rightarrow S^n \) be an open simplicial map with degree \( d \) of the \( n \)-sphere on itself. Let \( B_f \) be the set on which \( f \) fails to be a local homeomorphism; and let the local degree of \( f \) be \( d \) (maximal) at all points of \( B_f \). Then for \( n \geq 3 \) \( B_f \) is either empty or an orientable pseudomanifold which is \( S^2 \) when \( n \) is 4 and is a manifold when \( n \) is 5. (Received September 28, 1967.)

650-24. R. C. BRIGGS, University of Houston, Houston, Texas 77004. Weak and strong cover compactness in regular and normal spaces.

(1) A topological space \( S \) has Property Q if and only if for each open cover \( G \) of \( S \), there exists an open refinement \( H \) such that if \( \{h_i\}_{i=1}^{\infty} \) is a countably infinite subcollection of distinct elements of \( H \); if \( p_i \) and \( q_i \in h_i \), for each \( i \); and \( \{p_i\}_{i=1}^{\infty} \rightarrow p \in S \), then \( \{q_i\}_{i=1}^{\infty} \rightarrow q \). [J. N. Younglove, Fund. Math. 48 (1960), 15-25]. (2) \( S \) is strong cover compact if and only if for each open cover \( G \), there exists an open refinement \( H \) such that if \( \{h_i\}_{i=1}^{\infty} \) is a countably infinite subcollection of distinct elements of \( H \); if \( p_i \) and \( q_i \in h_i \) for each \( i \), \( p_i \neq p_j \) and \( q_i \neq q_j \), for \( i \neq j \); and the point set \( \{p_i\}_{i=1}^{\infty} \) has a limit point in \( S \), then \( \{q_i\}_{i=1}^{\infty} \) does. (3) \( S \) is weak cover compact if and only if each countable condition in (2) is replaced by an uncountable one. Each of these properties is equivalent to metrizability in a regular developable space, but no one of them implies normality in a regular \( T_1 \) space or collection-wise normality in a normal \( T_1 \) space. In a regular \( T_1 \) space, Property Q is an intermediate property between paracompactness and pointwise paracompactness. (Received September 28, 1967.)

A semilinear space is a commutative, cancellative additive semigroup \((S, +)\) with zero, on which is defined scalar multiplication by nonnegative real numbers such that the usual linear space relationships between addition and scalar multiplication are satisfied. Topological, metric, and Banach semilinear spaces will be defined. Letting \([x, y]\) denote the interval from \(x\) to \(y\), we define the boundary \(B(S)\) of a semilinear space \(S\) to be the set of all \(x\) in \(S\) for which there exists \(y \neq x\) such that \(x \in [y, z]\) implies \(x = z\). Theorem. Suppose \(S\) is a Banach semilinear space and \(x, y\) are points of \(S\) such that \(z \in B(S)\) implies \(x \not \in [x + y, z]\). Then \(y\) has an additive inverse. Given a Banach semilinear space \(S\), a maximal semilinear subspace \(L\) of \(B(S)\), \(x\) in \(L\) and \(y\) not in \(L\), let \(L \times y\) denote the closure of the set of all \(z\) such that \(z \in [u, v]\), for some \(u\) in \(L\) and \(v\) such that \(y \in [x, v]\). Theorem. Suppose \(S \neq B(S)\) and \(L\) is a maximal semilinear subspace of \(B(S)\). Then \(L_0 = \overline{X} = S\) if and only if \(x\) is not in \(L\) and \(x\) belongs to every maximal semilinear subspace of \(B(S)\) which is distinct from \(L\). (Received September 28, 1967.)


Lighthill has studied the differential equation
\[
(1) \quad (\xi + \epsilon u)u'(\xi) + q(\xi)u - r(\xi) = 0, \quad u(1) = b,
\]
where \(0 < \epsilon \ll 1, b > 0, 0 \leq \xi \leq 1\), by a perturbation method known as the Poincaré-Lighthill-Kuo method, or the method of strained coordinates. Wasow took this problem (1) and showed that Lighthill's method actually converges with the additional hypothesis that (2) \(q(\xi)u_0 - r(\xi) \neq 0\). Lin, on the other hand, has frequently mentioned an unpublished example, superficially very close to (1), on which Lighthill's method gives a erroneous answer, namely (3) \((\xi^n + \epsilon u)u' + n\xi^{n-1}u - 1 = 0, u(1) = b\) with \(n > 1\). We extend Lin's example and show a close connection between this example and Wasow's restriction. (Received September 27, 1967.)

650-27. B. J. PROCHASKA and KENZO SEO, Clemson University, Clemson, South Carolina 29631. Bounded linear transformation on random norm spaces.

Let \((L, f, \mu)\) and \((S, g, \rho)\) be random norm spaces \((r.n.s.)\) as defined by Šerstnev (Dokl. Akad. Nauk. SSSR 149 (1963), 280-283 = Soviet Math. Dokl. 4 (1963), 388-391). Let \(T\) be a linear transformation of \((L, f, \mu)\) into \((S, g, \rho)\). Definitions. \(T\) is bounded iff there exists an \(M \geq 0\) such that
\[
\|TX; x\| \leq M\|X; x\| \text{ for all } X \in L \text{ and real } x.
\]
\(T\) is mean-bounded iff (i) \(\int\|X; x\|dx\) is finite for all \(X \in L\), (ii) \(\int\|TX; x\|dx\) is finite for all \(X \in L\), and (iii) there exists \(M \geq 0\) such that \(\int\|TX; x\|dx \leq \int\|MX; x\|dx\) for all \(X\). (All integrals are from 0 to \(\infty\).) In both cases the bound is defined as the infimum of the set of scalars that satisfy the inequality. The bound and mean-bound are denoted \(M^*\) and \(M^0\), respectively. Theorem. If \(G\) is a bounded linear map on a normed linear space into a normed linear space with bound \(M\), then \(G\) is bounded and mean-bounded when the normed linear spaces are naturally embedded into \(r.n.s.\) and \(M = M^* = M^0\). Theorem. If \(T\) is bounded, then \(T\) is continuous with respect to the \(\epsilon - \delta\) topologies for \((L, f, \mu)\) and \((S, g, \rho)\). The converse of this theorem is false. Theorem. If \(T\) is bounded and \(\int\|X; x\|dx\) is finite for all \(X \in L\), then \(T\) is mean-bounded and \(M^0 \leq M^*\). There are spaces such that \(M^0 < M^*\). There exist mean-bounded transformations which are not bounded. (Received September 27, 1967.)

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On irregular branched covering spaces of a kind of knots.

Let $k$ be a clover leaf ($3_1$) or Stevedore's knot ($6_1$). Each of $\pi(S^3 - k)$ has a monodromy map onto $S_3$, the symmetric group of order 3. Each of branched covering spaces induced by these maps is a simply connected 3-manifold. It is proved that each of these 3-manifolds is a 3-sphere. Further the positions of links over these knots are determined. The method is somewhat more general, hence it can be applied for other cases, too. (See R. H. Fox, "Construction of simply connected 3-manifolds," in Topology of 3-manifolds, Prentice-Hall, Englewood Cliffs, N.J. 1962, pp. 213-216. (Received September 27, 1967.)

The nonhomogeneous linear difference equation with varying difference interval.

Let $h_1(z) = h(z)$ and $h_j(z) = h_{j-1}(z) + h_1(z + h_{j-1}(z))$ where $0 < e < h(z) < E$ and $\sum_1^\infty (1/h_j(z))$ diverges. A study is made of the equation $y(z) - (p_1(z)y(z + h_1(z)) + \ldots + p_n(z)y(z + h_n(z))) = s(z)$. Suppose $p_j(z) = \sum_{j=1}^\infty a_j(h)(z + h_j(z))^{-1}$, $a_j \geq 0$, and $s(z) = \sum_{j=1}^\infty a_j(1/h_j(z))$ diverges. These series are called generalized factorial series. The equation has a unique formal solution expressible as a generalized factorial series. If $h(z)$ is real and the series for $p(z)$ and $s(z)$ convergent over a right half-plane then the series for the solution converges uniformly over a right half-plane. (Received September 29, 1967.)

Ideal theory of admissible L-rings. Preliminary report.

Suppose $A$ is an abelian group with a binary operation $\cdot$ such that $x \cdot 0 = 0 = x \cdot 0$ for all $x \in A$ and such that all laws $[L_\alpha] = L$ postulated for $A$ can be expressed in the form $S(\phi_1(x_1, \ldots, x_\rho)) = 0$, $\phi_i(x_1, \ldots, x_\rho) \in A^\rho$, where $\phi_i(x_1, \ldots, x_\rho) = \sum_{\nu}\gamma_{i\nu}X_\nu\gamma_{i\nu} = 0$, and $S(X_1, \ldots, X_\rho)$ is a sum $\sum m_aW_a$, $m_a = \pm 1$ and $W_a$ an expression $X_i^t(U_\alpha)\gamma_{i\nu}$ involving elements $X_{ij}$ from the set $[X_1, \ldots, X_\rho]$ and parentheses according to one of the schemes $(X_{i1}(\ldots))$, $(X_{i1}(\ldots))$ or $(\ldots)$ in successive layers, then $A$ is an admissible L-ring. Theorem. If $A$ is an admissible L-ring and if $I$ is a subgroup of $A$ such that $A/I$ is an admissible L-ring under the multiplication $(x + I) \cdot (y + I) = x \cdot y + I$, then $I \cdot A \subseteq I$, $A \cdot I \subseteq I$ and conversely. Such subgroups are called L-ideals. A splitting cover for an admissible L-ring is a set of idempotents $[e_\alpha]$ such that for all $x, y \in A$, all $\alpha$, $x e_\alpha = x$, $e_\alpha x = x e_\alpha$, $y e_\alpha = y e_\alpha$ and such that $x(y e_\alpha) = x e_\alpha(y e_\alpha) = X e_\alpha$ have solutions $X \in A$. In addition we require that the mapping $\pi: A \rightarrow \Pi_\alpha A e_\alpha$ given by $\pi(x) = [x e_\alpha]$ is an injection and that $e_\alpha e_\beta = 0$ unless $\alpha = \beta$. Using admissible L-rings which admit splitting covers, it is possible to develop an ideal theory which parallels somewhat the ideal theory for boolean rings as described in M. H. Stone, Algebraic characterizations of special boolean rings, Fund. Math. 29 (1937). (Received September 29, 1967.)

The asymptotic behavior of the solutions of the nonlinear nonhomogeneous differential equation \( \gamma^{(n)} + f(t, \gamma(t), \gamma^1(t), ..., \gamma^{(n-1)}(t)) = h(t) \) is determined by exhibiting a complete asymptotic expansion for certain of the solutions of (*). Conditions are imposed on \( f \) in order that some (in certain instances, all) of the solutions possess asymptotic expansions similar to those of the perturbed equation \( \gamma^{(n)} = h(t) \). The asymptotic expansions are derived for the following three cases: (i) the particular solution of \( \gamma^{(n)} = h(t) \) is dominant for large \( t \); (ii) there is an intermingling between the asymptotic behaviors of the complementary solution and particular solutions of \( \gamma^{(n)} = h(t) \); (iii) the complementary solution is dominant for large \( t \). (Received September 29, 1967.)

650-32. ANDREW SOBCZYK and HAROLD REITER, Clemson University, Clemson, South Carolina 29631. Sets of homeomorphisms. Preliminary report.

For a topological space \( X \), a proper \( n \)-tuple is any ordered sequence \((p_1, ..., p_n)\) of \( n \) different points of \( X \). For two different proper \( n \)-tuples \((p_1, ..., p_n), (q_1, ..., q_n)\) we consider sets of homeomorphisms of \( X \) onto \( X \), \( H_1, ..., H_n \), where the homeomorphisms \( h \) \( \in H_1 \) satisfy \( h(p_i) = q_1, h(p_i) = p_i \), \( i = 2, ..., n \), those in \( H_2 \) satisfy \( h(q_i) = q_1, h(p_i) = q_i \), \( i = 3, ..., n \), ..., those in \( H_n \) satisfy \( h(q_i) = q_i, i = 1, ..., n-1, h(p_n) = q_n \). A set of homeomorphisms \( H \), all of which move \((p_1, ..., p_n)\) into \((q_1, ..., q_n)\), is factorable with factors \( H_1, ..., H_n \), written \( H = H_n \circ H_{n-1} \circ ... \circ H_1 \), in case each \( h \in H \) may be expressed as a composite \( h = h_n \circ h_{n-1} \circ ... \circ h_1 \), \( h_i \in H_i \), \( i = 1, ..., n \), and also each composite belongs to \( H \). Among other results, it is shown, in case \( X \) is the Euclidean plane \( E^2 \), for any pair of proper \( n \)-tuples, that \( H = H_n \circ H_{n-1} \circ ... \circ H_1 \), where \( H \) is the set of all homeomorphisms of \( E^2 \) onto \( E^2 \) which move \((p_1, ..., p_n)\) into \((q_1, ..., q_n)\), and \( H_i \) for each \( i \) is the set of all homeomorphisms which satisfy the appropriate conditions as stated above. For this case, at the time of this writing, some questions about uniqueness of the factors \( h_n, ..., h_1 \) are not answered. Other results and questions concern metrizable spaces and subsets of their groups of onto isometries. (Received September 29, 1967.)

650-33. ANDREW SOBCZYK, Clemson University, Clemson, South Carolina. Multi-functions associated with Steiner systems. Preliminary report.

Results obtained in the paper include the following. For a (combinatorial) configuration of 7 vertices, there are 30 Steiner systems (abbreviated as S's), each consisting of 7 mutually disjoint triangles or triples (abbreviated as t's). Each t is common to 6 S's. It is not possible to partition the 35 t's into 5 S's. Two disjoint S's are possible; but of any 3 S's, at least 2 must have a common t. For a given \( S_1 \), there are 8 different S's which are disjoint from \( S_1 \). The 30 by 35 combinatorial design (of S's by t's which they contain) is completely described; in particular it is found that it cannot be represented as the multi-function of the incidences of h- and k-faces of a simplex. If the t's of any two disjoint S's are colored, then 21 tetrahedrons or quadruples (q's) each have two colored t's, and the other 14 q's each have one colored t. At least 14 t's must be colored in order that each q contain at least one colored t. Following is an application. A very recent result of Isbell, improving earlier work of the author, is that the Ramsey number \( R(4,4;3) \geq 12 \). By use of a "double 7" and...
properties of $S$'s, the author hoped to show $R(4,4;3) < 14$, to complement Isbell's result. Instead, it is proved that $R(4,4;3) \not\geq 14$. Thus the present situation is: $14 \not\leq R(4,4;3) \leq 18$. (Received September 29, 1967.)

650-34. J. M. BOYTE, Virginia Polytechnic Institute, Blacksburg, Virginia 24061.
Open convergence.

We shall say that a sequence of sets $\{A_i\}$ **converges openly** to a set $A$ if and only if given an open set $G$ such that $A \subseteq G$ then there exists and $n$ such that $i \geq n$ implies each open set $G_{A_i}$ which contains $A_i$ has the property that $G_{A_i} \cap G \not\subseteq \emptyset$. The following theorems have been proven. **Theorem.** A topological space $(X, T)$ is connected if and only if $A$ is a subset of $X$ such that $\emptyset \not\subseteq A \not\subseteq X$ then there exists a sequence $\{A_i\}$ openly $A$ such that $A_i \cap A \not\subseteq \emptyset$ for each $i$. **Theorem.** A topological space $(X, T)$ is regular if and only if $\{x_i\}$ openly $x$ implies $\{A_i\}$ converges $x$. Let $F$ be any closed set in a topological space $(X, T)$. Then $(X, T)$ is normal if and only if $\{A_i\}$ openly $F$ implies $\{A_i\} \rightarrow F$. **Theorem.** Let $(X, T)$ be first countable. Then $(X, T)$ is regular if and only if $\{x_i\}$ openly $a$ implies $\{x_i\} \rightarrow a$. **Theorem.** Let $(X, T)$ be first countable. Let $\{A_i\}$ openly $A$. If $A$ is compact then there exists $x \in A$ and a subsequence $\{A_{i_k}\}$ of $\{A_i\}$ such that $\{A_{i_k}\}$ openly $\{x\}$.
(Received September 29, 1967.)

650-35. R. L. ROBINSON, Wofford College, Spartanburg, South Carolina 29301. A generalization of the prime number theorem.

Let $L$ denote the set of positive integers all of whose prime factors have multiplicity $> 1$. Denote by $f$ any real-valued arithmetical function for which there exists a number $s$ such that
(1) $f(p) = s$ for all primes $p$; (2) $f(mn) = f(m) + f(n)$ for all relatively prime integer pairs $m,n$ and (3) the set $\{sf(n): n \in L\}$ has greatest lower bound $b$. Define $N(x,r,f)$ to be the number of positive integers $n \leq x$ for which $f(n) = r$, and in cases $t \neq 0$, define $u$ to be the largest integer not exceeding $(rs - b)/s^2$. **Theorem.** For $s = 0$, $N(x,r,f) = Ax + O(x 1/2 \log^2 x)$. The parameter $A$ is given by $A = (6/\pi^2) \sum f(m)/\psi(m)$ where $l$ is the characteristic function of $L$, $\psi(m) = m \prod_{p|m}(1 + 1/p)$, and the summation extends over all $m$ such that $f(m) = r$. If $s \neq 0$, then $N(x,r,f) = Bx + O(x \log^2 x)$ if $u < 0$, $N(x,r,f) = O(x^{1/2})$ if $u = 0$, $N(x,r,f) = Bx/\log x + O(x/\log^2 x)$ if $u = 1$, and $N(x,r,f) = Bx(\log \log x)^u - 1/\log x + O(x(\log \log x)^{u-2}/\log x)$ if $u \geq 2$. Here $B = (1/(u - 1)) \prod p/(p-1)$, the sum extending over all $m$ for which $f(m) = r - su$. If we take $g$ to be the function such that $g(n)$ is the total number of prime factors of $n$, multiple factors counted multiply, then for integral $r$, $N(x,r,g)$ is the number of integers not exceeding $x$ with $r$ prime factors. In particular, $N(x,1,g)$ is the number of primes not exceeding $x$. The above result for the function $g$ was obtained by Landau. The case $s = 0$ represents a refinement of a theorem of Kubilius. (Received September 29, 1967.)

650-36. F. A. ROACH, University of Georgia, Athens, Georgia. The convergence and location of values of certain continued fractions.

The continued fractions considered are of the form $(A) \sqrt[1]{b_1} + \sqrt[2]{b_2} + \sqrt[3]{b_3} + \ldots$. By a convergence set is meant a set of complex numbers having the property that if each $b_n$ belongs to it, $(A)$ converges. If $M$ is a convergence set by the value region associated with $M$ is meant the set of all
complex numbers \( z \) such that, for some sequence \( b_1, b_2, b_3, \ldots \) from \( M \), \( z \) is either an approximate or the limit of (A). Theorem. A closed half-plane is a convergence set for (A) if and only if it contains no pure imaginary number between \( 2i \) and \(-2i\). Moreover, if \( H \) is such a closed half-plane and \( u \) the element of \( H \) nearest \( 0 \), then the value region associated with \( H \) is the circular disk \( |z - \bar{u}/k|u| \leq 1/k \) where \( k = 1 + (1 - (2|\mu|)^2)/|\mu|^2)^{1/2} \). With the aid of this theorem, results of a similar nature are obtained for certain sets with complements which are open convex sets containing \( 0 \). (Received October 2, 1967.)


Since a compact convex set is the convex hull of its extreme points, the question arises whether the convex kernel of a starshaped set is related to the stars of its extreme points. In a set \( S \), the point \( x \) sees via \( S \) the point \( y \) provided the segment \( xy \) is contained in \( S \). The \( S\)-star of a point \( x \), \( S(x) \), is taken to be the points \( y \) that \( x \) sees via \( S \). The convex kernel of a starshaped set \( S \) is known to be the intersection of the stars of all the points of \( S \). Extreme points of nonconvex sets are usually defined to be points of the set that are not interior to a segment formed by two points of \( S \). Under this definition examples in the plane show that the convex kernel is not given by the intersection of the stars of the extreme points. However, extreme points of convex sets are also not interior to segments contained in the set. Definition. A point is extremal when it is not interior to a segment contained in the set. Theorem. If \( S \) is a compact starshaped set in the plane, its convex kernel is the intersection of the stars of its extremal points. The result does not hold in three dimensional Euclidean space. (Received October 3, 1967.)

650-38. IVAN SINGER, Institutul de Matematica, Str M. Eminescu YF, Bucuresti 9, Romania, C. W. McARTHUR and MARK LEVIN, Florida State University, Tallahassee, Florida 32306. On the cones associated to biorthogonal systems and bases in Banach spaces.

Let \( E \) be a Banach space and \( (x_n, f_n) \) a total biorthogonal system. \( (\{x_n\} \subset E, \{f_n\} \subset E^*) \).

Definition. The cone \( K \) associated to the system is defined by \( \{x \in E : f_n(x) \geq 0, n = 1, 2, \ldots \} \).

The following theorems are representative of those obtained. Theorem 1. Assume that for \( x \in K \) the series \( \sum_{i=1}^{\infty} f_i(x)x_i \) converges. Then the following statements are equivalent. (1°) For every \( x \in K \), the series \( \sum_{i=1}^{\infty} f_i(x)x_i \) is weakly unconditionally Cauchy. (2°) For every \( x \in K \) the series \( \sum_{i=1}^{\infty} f_i(x)x_i \) is unconditionally convergent. (3°) \( K \) is normal. (4°) For every \( x \in K \), the set \( P_x = \{ y \in E : 0 \leq y \leq x \} \) is linearly homeomorphic to a finite cube or the fundamental cube of Hilbert. Definition. A basis \( \{x_n\} \) of \( E \) with \( \|x_n\| = 1 \) is said to be of type \( l_\infty \) if there exists a constant \( \eta > 0 \) such that \( \|x_n\| \geq \eta \sum_{i=1}^{n} a_i \) for any finite sequence \( a_1, \ldots, a_n \). A closed convex subset \( B \) of a closed convex cone \( K \) (having 0 as extreme point) in \( E \) is said to be a base of \( K \) if for every \( x \in E \) \( \sim \{0\} \) there exist unique \( b \in B \) and scalar \( \lambda > 0 \) such that \( x = \lambda b \). Theorem 2. Let \( \{x_n\} \) be a basis of \( E \) with \( \|x_n\| = 1 \) and let \( \{f_n\} \subset E^*, f_i(x_j) = \delta_{ij} \). Then \( \{x_n\} \) is of type \( l_\infty \) if and only if the cone \( K \) associated to \( (x_n, f_n) \) has a (norm-) bounded base. (Received October 2, 1967.)
A commutative ring $R$ is called a general Z.P.I. -ring if every ideal of $R$ can be represented as a finite product of prime ideals. A general Z.P.I. -ring $R$ in which every ideal of $R$ is uniquely represented as a finite product of prime ideals is called a Z.P.I. -ring. S. Mori stated characterizations of a general Z.P.I. -ring and a Z.P.I. -ring in Allgemeine Z.P.I.-Ringe, J. Sci. Hiroshima Univ. (1940), 117-136. An example is given to show that Mori's conditions on a general Z.P.I.-ring and a Z.P.I.-ring are sufficient but not necessary. Results of H. S. Butts and Robert W. Gilmer, Jr., in Primary ideals and prime power ideals, Canad. J. Math. (1966), 1183-1195, are used to obtain a characterization of a general Z.P.I.-ring $R$; this question is open only in the case $R$ contains no identity. **Theorem 1.** Let $R$ be a commutative ring without identity. (A) If $R$ contains a proper prime ideal, then $R$ is a general Z.P.I.-ring if and only if $R$ satisfies the following four conditions: (1) $R$ is Noetherian; (2) there are no ideals properly between $R$ and $R^2$; (3) there are no ideals properly between each maximal ideal and its square; (4) $\bigcap_{i=1}^{\infty} R^i$ is a field. (B) If $R$ contains no proper prime ideal, then $R$ is a general Z.P.I.-ring if and only if $R$ satisfies the following two conditions. (1) $R$ is Noetherian; (2) there are no ideals properly between $R$ and $R^2$. **Theorem 2.** If $R$ is a commutative ring with identity, then $R$ is a general Z.P.I.-ring if and only if $R$ is Noetherian and each primary ideal in $R$ is a power of its radical. (Received October 2, 1967.)

**Exponential automorphisms of complete local rings.**

Let $(R, M)$ be a complete local ring having characteristic zero and let $\mathcal{D}$ be the set of derivations $d$ on $R$ such that $d(R) \subset M$ and $d(M) \subset M^2$. In the unequal characteristic case we assume also that $d^p(R) \subset p^2R$ where $p$ is the characteristic of the residue field of $R$. If $d \in \mathcal{D}$, $\exp d = \sum_{i=0}^{\infty} (d^i/i!)$ converges in the $M$-adic topology as does $\sum_{i=0}^{\infty} w_i(d_1, d_2)$ where $w_i(d_1, d_2)$ is the Lie element of degree $i$ in the infinite sum $\log(\exp d_1 \exp d_2)$ as given by the Campbell Hausdorff Formula. Thus $\mathcal{D}$ is a group with respect to the operation $d_1 \ast d_2 = d_1 + d_2 + \sum_{i=0}^{\infty} w_i(d_1, d_2)$ and $E$ the set of automorphisms $\exp d$ for $d \in \mathcal{D}$ is an invariant subgroup of the automorphism group of $R$. Also, the map $\exp : (\mathcal{D}, \ast) \to E$ is an isomorphism. If $R$ is an unramified $v$-ring $E$ is the group of all inertial automorphisms. Other results are obtained particularly concerning the lower central series of $E$ in case $R$ is an unramified $v$-ring or a power series ring over a field. (Received October 2, 1967.)

**Localization of the strict topology via bounded sets.**

The strict, or $\beta$, topology was introduced by Buck and has proved in many ways to be a useful topology on $C(S)$, the space of bounded continuous functions on a locally compact Hausdorff space $S$. The topology of the title, called the bounded strict or the $\beta'$ topology, is the finest locally convex linear topology on $C(S)$ which coincides with $\beta$ on bounded sets. $\beta'$ and other "localizations" of $\beta$ are discussed by H. S. Collins and the author in Remarks on certain function spaces, to appear in Math Annalen. The $\beta'$ topology was useful to the author in Semigroups of maps in a locally compact space, Canad. J. Math. 19, and to D. Sentilles in Kernel representations of operators and their adjoints.
Pacific J. Math. (to appear). All of the above mention that $\beta' = \beta$ if $S$ is paracompact. Here we prove that $\beta' = \beta$ for all locally compact $S$. An immediate consequence is that a linear transformation from $C(S)$ into a locally convex t.v.s. is $\beta$-continuous if its restriction to each bounded set is $\beta$-continuous. Buck had mentioned this for functionals. (Received October 2, 1967.)

650-42. J. B. BROWN, Auburn University, Auburn, Alabama. Density of one graph along another.

The word "graph" shall mean the graph of a real function, and $c$ denotes the cardinality of the continuum. **Definition.** Suppose $F$ and $G$ are graphs with $X$-projection $[0,1]$. The statement that $F$ is dense (c-dense) along $G$ means that if $[a,b]$ is a subinterval of $[0,1]$, then there is a point (are $c$-many points) of intersection of $F$ and $G$ with abscissa in $[a,b]$. **Theorem 1.** If $F$ is a graph with $X$-projection $[0,1]$, then $F$ is dense along the graph of a function of Baire class 1 with domain $[0,1]$. However, there is a graph with $X$-projection $[0,1]$ which is not dense along the graph of any continuous function with domain $[0,1]$. **Theorem 2.** If $F$ is a graph with $X$-projection $[0,1]$, then $F$ is c-dense along the graph of a Lebesgue measurable function with domain $[0,1]$. However, there is a graph with $X$-projection $[0,1]$ which is not c-dense along the graph of any Baire function with domain $[0,1]$. **Theorem 3.** There exists a graph $F$ with $X$-projection $[0,1]$ which is c-dense along the graph of every Lebesgue measurable function with domain $[0,1]$. (Received October 2, 1967.)


In this paper is stated a series of results concerning arcwise connectedness and spaces which have the same connected sets as usual on the line. Not only topological spaces but more general Appert and Frechet spaces are developed. (Received October 2, 1967.)


Let $r_1 \leq r_2 \leq ... \leq r_n$ be nonnegative integers. H. G. Landau [Bull. Math. Biophysics 15 (1953), 143-148] obtained necessary and sufficient conditions that these numbers are the row-sums of a tournament matrix. Another proof was given by H. J. Ryser in the book of Hans Schneider [Recent advances in matrix theory, University of Wisconsin Press, 1964, pp. 110-113]. In this paper a new proof for this result is obtained. (Received October 2, 1967.)


A mean is a commutative idempotent topological groupoid. **Theorem.** If a Peano continuum admits a mean, then it is unicoherent. **Corollary.** If a one-dimensional Peano continuum admits a mean, then it is a tree. This shows that, at least in the metrizable case, the assumption of associativity in a result of Anderson and Ward (Illinois J. Math. 5 (1961), 182-186) can be eliminated. (Received October 2, 1967.)
A semiring $(R, +, \cdot)$ is a nonempty set on which there are defined two associative binary operations such that (1) addition is commutative, (2) $R$ contains a zero and (3) multiplication distributes over addition both from the left and from the right. A nonempty subset $I$ of a semiring $R$ is called an ideal in $R$ provided: (1) $a + b \in I$, $\forall a, b \in I$; (2) $ar, ra \in I$ whenever $a \in I$ and $r \in R$; and (3) if $a, b \in R$, $b \in I$ and $a + b \in I$, then $a \in I$. The notion of a graded semiring was defined and investigated. Certain algebraic properties of homogeneous ideals were obtained. Sufficient conditions are given in order that the radical of a homogeneous ideal in a graded semiring be homogeneous. Necessary and sufficient conditions are given in order that a homogeneous ideal be completely prime in a graded semiring. (Received October 2, 1967.)

Multi-valued contraction mappings.

Let $(X, d)$ be a complete metric space, let $2^X$ denote the nonempty compact subsets of $X$, and let $H$ be the Hausdorff metric for $2^X$. A function $F: X \rightarrow 2^X$ is said to be a multi-valued contraction mapping iff there is a real number $0 \leq a < 1$, such that $H(F(x), F(y)) \leq ad(x, y)$ for all $x$ and $y$ in $X$. Theorem. If $(X, d)$ is a complete metric space and $F: X \rightarrow 2^X$ is a multi-valued contraction mapping, then $F$ has a fixed point (i.e., there is an $x_0 \in X$ such that $x_0 \in F(x_0)$). The theorem is applied to obtain some fixed point theorems for single-valued mappings and the problem of continuous traces is discussed. (Received October 2, 1967.)

A simple existence and uniqueness proof for a singular Cauchy problem.

Consider the Cauchy problem in $M + 1$ space-time variables $(x, t) = (x_1, \ldots, x_M, t)$: $(\ast) u_{tt} + kt^{-1}u_t = F(x,t,u,u_t,u',u'')$, $(t > 0$, $k$ real), with $u(x, 0) = f(x)$, $u_t(x, 0) = 0$. Here $u'$ and $u''$ denote generic 1st and 2nd space-derivatives, and the functions $F$ and $f$ are analytic in their arguments. Theorem. The Cauchy problem $(\ast)$ has for $k \geq 0$ a unique analytic solution. The equation in $(\ast)$ specializes for $F = \Delta u$ to the EPD equation whose study by A. Weinstein (1952) has given rise to a vast literature. Some methods used to prove existence and uniqueness for various generalizations of the EPD problem are: divergent integrals, Fourier technique, transmutation operators, and basic sets of polynomials. This proof makes use of the classic Cauchy-Kowalewski theorem. In the usual way $u$ is assumed to have a formal power series expansion, and certain coefficients are determined by the initial data. The remaining series coefficients, however, are determined from the series as given by $u_{tt} + kt^{-1}u_t$. This approach brings out the fact that a majorant for the analytic problem $(\ast)$; $k = 0$ is also a majorant for the singular problem $(\ast)$; $k > 0$, proving the theorem. (Received October 2, 1967.)

Incompressible topological spaces.

A topological space is incompressible provided it is not homeomorphic to any proper subspace of itself. Theorems are presented which lead toward the characterization of incompressible spaces.
Theorem. Every compact connected manifold is incompressible. Theorem. If $X$ is a topological space with only finitely many components, each of which is incompressible, then $X$ is incompressible. An example is given to show that a space with infinitely many components, each of which is incompressible, is not necessarily incompressible. Additional theorems are included which relate this concept to the idea of dimensional type [Sierpinski, General topology, University of Toronto Press, Toronto, 1956]. (Received October 2, 1967.)


All the union-preserving, converse-preserving order-endomorphisms of the semigroup of all binary relations on a set are described. (Received October 2, 1967.)


A generalized sine or cosine transform is defined to be a convergent sequence of Fourier sine or cosine transforms. This is similar to Temple's development of generalized exponential transforms and is more readily understood by engineering and physical science students than is the development based on Schwartz distributions. (Received October 2, 1967.)


Let $L_3$ be a third-order linear differential operator with continuous coefficients on a half-line $[a, \infty)$, e.g., $L_3 = y''' + py' + qy$, $p, q \in C[a, \infty)$, or the Canonical Form of John H. Barrett [Ann. Mat. Pura Appl. 65 (1964), 253-274]. For each $t \in [a, \infty)$, let $\kappa_n(t)$ be the $n$th conjugate point of $t$ as defined by M. Hanan [Pacific J. Math. 11 (1961), 919-944]. For $i, j = 1, 2, 3 \leq i + j \leq 4$, let $\tau_{ij}$ be as defined by N. V. Azbelev and Z. B. Caljuk [Mat. Sbornik 51 (1960), 475-486].

Definition 1. For $i, j = 1, 2, 3 \leq i + j \leq 4$, let $z_{ij}(t)$ denote the least number $b > t$ for which there exists a solution of $L_3(y) = 0$ with a zero of multiplicity at least $i$ at $t$ followed by a zero of multiplicity at least $j$ at $b$. Definition 2. $Z(t) = \max_{i+j=3} z_{ij}(t)$, $R(t) = \max_{i+j=3} \tau_{ij}(t)$. The functions $z_{ij}^*, \tau_{ij}^*$, $R^*$, $n^*$, and $Z^*$ are defined similarly for the formal adjoint of $L_3$. The principal results are the following.

Theorem 1. Either (i) $\kappa_1(t) = R(t) = Z(t)$, or (ii) $\kappa_1(t) < R(t) < Z(t)$, $t \in [a, \infty)$. Theorem 2. For $t \in [a, \infty)$ and $R(t) < \infty$, $\kappa_2(t) = \kappa_2^*(t) < R(t)$. Theorem 3. For $t \in [a, \infty)$ and $R(t) < Z(t) < \infty$, there exists a positive integer $\nu$ such that $\kappa_\nu(t) \neq \kappa_\nu^*(t)$. (Received October 2, 1967.)


Let $\mathcal{D}$ be the class of semigroups and let $\mathcal{L}$ be those members of $\mathcal{D}$ that are locally compact. We use the notation $S < T$ ($S, T \in \mathcal{D}$) to mean $S$ is a subsemigroup of $T$. By $S \triangleleft T$ we mean both $S < T$ and $S$ is dense in $T$. Finally we introduce the notion of a maximal semigroup: If $S \in \mathcal{L}$,
then $S$ is said to be maximal in $\mathcal{F}$ if $S$ is closed in all $T \in \mathcal{F}$ with $S \subset T$. \textbf{Theorem.} If $S \in \mathcal{F}$, then there exists a $T \in \mathcal{F}$ such that $T$ is maximal in $\mathcal{F}$ and $S \subset T$. Also a class of noncompact members of $\mathcal{F}$ that are maximal in $\mathcal{F}$ is discussed. (Received October 2, 1967.)

650-54. G. W. STEWART, III, University of Tennessee, Knoxville, Tennessee 37916. On the continuity of the generalized inverse.

Let $A$ be an $m \times n$ matrix and $A^1$ its Moore-Penrose generalized inverse. Let $P = AA^1$ and $R = A^1A$. Let $\| \cdot \|$ denote the spectral matrix norm. \textbf{Theorem.} For the $m \times n$ matrix $E$, let $E_1 = PER$, $E_2 = (I - P)ER$, $E_3 = PE(I - R)$, $E_4 = (I - P)E(I - R)$. Let $\gamma = \| A \| \| A^1 \|$, $\gamma = (1 - \kappa \| E_1 \| / \| A \|)^{-1}$, and $\beta_1 = \gamma x \| E_1 \| / \| A \| (i = 1, 2, 3, 4)$. Suppose $\| A^1 \| E_1 \| < 1$. If $\text{Rank } (A + E) = \text{Rank } (A)$, then $\| (A + E)^{-1} - A^{-1} \| \| A^1 \| \leq \beta_1 + \gamma \sum_{i=2}^{4} \| \beta_1^2 (1 + \beta_1^2) \|^{1/2}$. If $\text{Rank } (A + E) \neq \text{Rank } (A)$, then $\| (A + E)^{-1} \| \geq \| E \|^{-1}$. \textbf{Corollary.} If $\lim_{n \to \infty} A_n = A$, then $\lim_{n \to \infty} A_n^1 = A^1$ if and only if $\text{Rank } (A_n) = \text{Rank } (A)$ for all sufficiently large $n$. (Received October 2, 1967.)

650-55. R. D. McWILLIAMS, Florida State University, Tallahassee, Florida 32306. On certain Banach spaces which are $w^*$-sequentially dense in their second duals.

If $X$ is a Banach space and $\pi$ is the canonical mapping of $X$ into its second dual $X^{**}$, let $H(X)$ be the quotient space $X^{**}/\pi(X)$ and let $K(X)$ be the $w^*$-sequential closure of $\pi(X)$ in $X^{**}$. \textbf{Theorem.} The space $H(X)$ is separable if and only if $X$ has a subspace $Y$ such that $Y^{**}$ is separable and $X/Y$ is reflexive. \textbf{Corollary.} If $H(X)$ is separable, then $K(X) = X^{**}$. \textbf{Corollary.} The space $X$ is reflexive if and only if $X$ is $w$-sequentially complete and $H(X)$ is separable. It is noted that if $H(X)$ is separable and $M$ is a separable subspace of $X^*$, then $M^*$ is separable and hence $K(M) = M^{**}$. Further, $H(X^*)$ and $[H(X)]^*$ are isomorphic; hence $H(X)$ is separable if $H(X^*)$ is separable. If $H(X)$ is separable, then every bounded linear mapping from $X$ into $l_1$ is completely continuous. The results are related to results of Civin and Yood [Quasi-reflexive spaces, Proc. Amer. Math. Soc. 8 (1957), 906-911] and of the author [Abstract 638-37, these Notices 13 (1966), 826]. (Received October 2, 1967.)


Consider the rational numbers $V_0$, $V_1$, $V_2$, ..., defined by $[x^2/6] [x(e^x + 1) - 2(e^x - 1)]^{-1} = \sum_{s=0}^{\infty} V_s (x^s/s!)$. These numbers were first introduced by van der Pol and were used in the process of "unsmoothing" a "smoothed" function of three variables (B. van der Pol, Smoothing and "unsmoothing", in M. Kac, Probability and related topics in physical sciences, New York, 1957, pp. 223-235). Using well-known properties of the Bessel function of index $n + (1/2)$, we can prove that the $V_n$s have the following relationship to the Rayleigh function: If $V_2n(v)$ is the Rayleigh function of order $2n$, then $V_2n(3/2) = (-1)^{n+1} \cdot 2^{2n-1} V_{2n}/(2n)!$. Other properties of $V_n$ can be proved by induction on $n$. For example, if we define $\alpha_p(n)$ as the exponent of the highest power of a prime $p (p > 3)$ dividing the denominator of $V_n$ and $\nu_p(n)$ as the highest power of $p$ dividing $n!$, then $\alpha_p(n) \leq [n/(p - 3)] - \nu_p(n)$. Furthermore, $\alpha_p[n(p + 3)] = n - \nu_p[n(p - 3)]$ and $\alpha_p[n(p + 3) + 1] = n - \nu_p[n(p - 3) + 1]$. (Received October 2, 1967.)
A topological space $X$ is strongly locally simply-connected if and only if each point of $X$ has arbitrarily small simply connected open neighborhoods. An upper semicontinuous decomposition $G$ of $E^3$ is a toroidal decomposition of $E^3$ if and only if there is a sequence $M_0, M_1, M_2, \ldots$ of compact $3$-manifolds-with-boundary in $E^3$ such that (1) for each $i$, $\text{Int } M_{i+1} \subseteq M_i$ and each component of $M_i$ is a solid torus and (2) $g$ is a nondegenerate element of $G$ if and only if $g$ is a nondegenerate component of $\bigcap_{i=0}^\infty M_i$. By a simple toroidal decomposition we mean one in which $M_0$ is connected and for each torus $T_a$ at the $n$th stage, the $(n + 1)$st stage tori in $T_a$ form a chain of solid tori circling $T_a$. For each such $a$, $m_a$ denotes the number of solid tori in this chain, and $n_a$ denotes the number of times the chain circles $T_a$. It is known (Armentrout and Bing, Fund. Math. 60 (1967), 81-87; Sher, Thesis, University of Utah, 1966) that if for each index $a$, $m_a < 2n_a$, the decomposition space associated with $G$ is topologically distinct from $E^3$. We establish the following stronger result: If $G$ is a point-like simple toroidal decomposition of $E^3$ and for each index $a$, $m_a < 2n_a$, then the associated decomposition space is not strongly locally simply connected. (Received October 3, 1967.)
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651-1. G. H. PIMBLEY, University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87544. An interesting imbedding for a class of Volterra operators.

We consider the characteristic value problem \( u(x) = \lambda \int_0^x K(x - y)u(y)dy \) for Volterra operators with continuous kernel \( K(x) > 0 \). It is well known that such operators are defined in \( C(0,1) \) and have no characteristic values, the resolvent set consisting of the entire spectral plane. Such problems are imbedded in a family \( F_\alpha \) of similar problems: \( u(x) = \lambda \int_0^{\alpha x} K(\alpha x - y)u(y)dy \), parameterized by \( \alpha > 0 \).

If \( \alpha \leq 1 \), consideration of the iterates \( u_{n+1}(x) = \lambda \int_0^{\alpha x} K(\alpha x - y)u_n(y)dy \) shows that there are no characteristic values or functions as expected [Petrovskii, p. 40]. If \( \alpha > 1 \) however, problems \( F_\alpha \) must be considered on \( C(0,\infty) \), with \( \int_0^\infty K(x)dx < \infty \). Employing a technique borrowed from Krein and Rutman [Amer. Math. Soc. Transl. No. 26, Amer. Math Soc., Providence, R. I., Theorem 6.2, p. 68] we show that there exists a positive characteristic value \( \lambda_\alpha \) when \( \alpha > 1 \), and a positive characteristic function. Employing Laplace transforms it is shown that the representation \( \lambda_\alpha = \alpha / \int_0^\infty K(x)dx \) is valid for \( \alpha > 1 \), and spurious for \( 0 \leq \alpha \leq 1 \). The positive Krein-Rutman characteristic value disappears when \( \alpha > 1 \) decreases to \( \alpha = 1 \). (Received September 28, 1967.)


Transformations of standard processes possessing local times are investigated and the local times, when they exist, of the transformed processes are identified in terms of the original local times. For example the following is shown: Theorem. Let X be a standard process with a reference measure. Let \( A = \{ A(t), t \geq 0 \} \) be a strictly increasing continuous additive functional of X. Let \( X' \) be the process obtained from X by random time change via A. Then, if \( L_x \) is the local time of X at x then the local time \( L_x' \) of \( X' \) at x exists and is given by \( L_x'(t) = L_x(A_t), a.s., \) for \( t \geq 0 \) where \( A_t = \inf \{ s : A(s) > t \} \) is the inverse of A. (Received September 28, 1967.)

651-3. R. B. WARFIELD, JR., New Mexico State University, Las Cruces, New Mexico 88001. Decompositions of injective modules.

Certain Krull-Schmidt-type theorems are proved in an Abelian category and applied to the theory of injective modules. The most complete result is the following Theorem 1. Any injective module over a valuation ring is the injective envelope of a direct sum of indecomposable injective modules, and any two such decompositions are equivalent. We remark that the indecomposable injective modules over a valuation ring have been completely classified by E. Matlis. Theorem 1 is derived from the analog of the well-known Azumaya theorem generalized to Abelian categories and applied to the category whose objects are injective \( R \)-modules and whose morphisms are equivalence classes of homomorphisms where f and g are equivalent if they agree on a large submodule.
Theorem 2. In an Abelian category satisfying axiom Ab. 5 and having injective envelopes, any two countable direct sum (cocartesian) decompositions of an injective object have isomorphic refinements.

Corollary 1. Any two countable direct sum decompositions of an injective module have isomorphic refinements. Corollary 2. Any two countable decompositions of an injective module as the injective envelope of a direct sum of injective modules have isomorphic refinements. The methods used are partly based on those used by P. Crawley and B. Jónsson. (Received October 2, 1967.)

651-4. D. W. DUBOIS, University of New Mexico, Albuquerque, New Mexico 87106.

Topology of orders and modes.

Let $F$ be a (totally) orderable field, let $\mathcal{O}$ and $\mathcal{M}$ be, respectively, the sets of all orders and of all modes ($M$ is a mode provided $F = M \cup (-M) \cup M^{-1}$) of $F$, regarded as subspaces of the Harrison space of all primes of $F$. Let $B$ be the intersection of all $B_M$ over $M$ in $\mathcal{M}$; for $b$ in $B$ and $M$ in $\mathcal{M}$, set $\overline{b}(M) = \sup \{r; b - r \in M\}$, where $r$ is rational. Sample theorems. $\mathcal{O}$ and $\mathcal{M}$ are compact totally disconnected Hausdorff spaces. The topology of $\mathcal{O}$ is the weakest open topology for which all $\overline{b}$ are continuous. The function $\text{Arch}$, where $\text{Arch} M = (B_M \cap M) \setminus J_M$, maps $M$ into itself, and may be discontinuous. In some cases, if $\overline{b}$ vanishes over an open set, then $b = 0$. Example. If $Q(X)$ is the one-variable function field over the rationals then $\text{Arch} (A'(Q(X)))$ is homeomorphic with the one point compactification of the reals. (Received October 2, 1967.)

651-5. J. M. WORRELL, JR. and H. H. WICKE, Sandia Corporation, Division 5261, P. O. Box 5800, Albuquerque, New Mexico 87115. Non-first-countable topological structure.

R. L. Moore's Foundations of point set theory generalizes, without significant loss of content, the theory of metric spaces by using topological methods. The generalization of metric spaces by uniform spaces to a non-first-countable situation has topologically unsatisfactory features [Abstract 67T-125, these Notices 14 (1967), 251-252], and has been largely concerned with "uniform geometry" [Isbell, Math. Surveys No. 12, Amer. Math. Soc., Providence, R. I., 1964] as opposed to topology. As an essential preliminary to a topological study of non-first-countable spaces the authors investigated spaces having bases of countable order [these Notices 1964-1], obtaining a theory which provides an appropriate first-countable setting for topological completeness, mapping theorems, and an arc theorem, and which illuminates the less general theory of Moore spaces. The theory of $\mu$-spaces [Abstract 648-188, these Notices 14 (1967), 687] transposes base of countable order theory to "uniform" non-first-countable structures. This report, the first of a series, concerns a wider class of spaces, arrived at after considerable experimentation, which the authors propose as a suitable basis for a topological theory of non-first-countable structure in the context of absolute embedding invariances. A fundamental result underlying this theory is a characterization of the $T_1$ open continuous images of $T_2$ paracompact $p$-spaces. (Received October 2, 1967.)
651-6. RANDOLPH CONSTANTINE, JR., Fort Lewis College, College Heights, Durango, Colorado 81301. A uniform boundedness theorem for nets.

Definition. If \( \{ f_d : d \in D \} \) is a net, each value of which is a function from the set \( S \) into the metric space \( E \) and \( M \subseteq S \), then \( f \) is said to be pointwise eventually bounded on \( M \) provided that for each \( x \in M \), the point net \( f(x) \) is eventually bounded. Theorem. If each of \( \{ S_1, \| \cdot \|_1 \} \) and \( \{ S_2, \| \cdot \|_2 \} \) is a normed linear space, \( T_\cdot \) is a net of continuous linear transformations on \( S_1 \) into \( S_2 \) and \( M \) is a second category subset of \( S_1 \) such that \( T_\cdot \) is pointwise eventually bounded on \( M \), then the number net \( \| T_\cdot \| \) is eventually bounded. (Received October 2, 1967.)


For definitions see Fuchs, Partially ordered algebraic systems, Pergamon Press, Oxford, 1963. (I) A partial answer to Problem 11 of the above reference is found. Let \( \mathcal{O} = \langle G, \cdot \rangle \) be an \( 0^* \)-group with unit element \( e \), let \( \mathcal{S} = \langle H, \cdot \rangle \) be a subgroup of \( G \). Then the following conditions are equivalent (i) \( \mathcal{S} \) is an absolutely convex subgroup of \( \mathcal{O} \); (ii) For every \( h \in H \) and for every \( g \in G - H \), \( e \in S(g, hg^{-1}) \). (II) It follows from (I) that if \( \mathcal{O} = \langle G, \cdot \rangle \) is an \( 0^* \)-group with center \( C \) and if \( \mathcal{S} = \langle H, \cdot \rangle \) is a subgroup with \( \{ e \} \subset H \subset C \), then \( \mathcal{S} \) is not an absolutely convex subgroup of \( \mathcal{O} \). As is known, (II) does not hold when \( \{ e \} \subset H = C \). (III) By (II), if \( \mathcal{O} = \langle G, \cdot \rangle \) is an Abelian \( 0^* \)-group and if \( \mathcal{S} = \langle H, \cdot \rangle \) is an absolutely convex subgroup of \( \mathcal{O} \), then \( H = \{ e \} \) or \( H = G \). (Received October 2, 1967.)


The classical Perron-Frobenius theorem states that a nonnegative square matrix has a nonnegative eigenvalue. We generalize this theorem to the following situation: If \( A \) is a partially ordered linear algebra which satisfies certain natural conditions (but which are too lengthy to include in this abstract), then a nonnegative element of \( A \) has a nonnegative eigenvalue. The proof is algebraic in nature and can be applied to various operator algebras. (Received September 26, 1967.)
The November Meeting in Urbana, Illinois
November 25, 1967


It is shown that if a matrix \( A = [a_{ij}] \), \( a_{ij} \geq 0 \), is invertible and has more than \( n \) \( a_{ij} > 0 \), then \( A^{-1} \) has both positive and negative entries. Thus, a matrix \( A \) is of the form \( P \)D with \( P \) a permutation matrix and \( D \) a diagonal matrix with positive diagonal elements if and only if \( A \) is invertible and both \( A \) and \( A^{-1} \) have nonnegative entries. An integer matrix which maps the positive \( n \)-tuples onto themselves is a permutation matrix. (Received August 29, 1967.)

652-2. F. W. LAWVERE, City University of New York, 33 West 42nd Street, New York, New York 10036. Categorical dynamics.

Axioms are given and discussed for categories in which classical particle and fluid dynamics can be discussed without explicit introduction of real numbers. Though these categories are much more "pleasant" than those of differentiable manifolds, etc., we are able, using the notions of algebraic theory and of topos, to show the existence of categories satisfying the axioms, the method promises to extend to quantum mechanics. (Received September 14, 1967.)


Among some nontrivial specializations of Jon Beck's tripleableness theorem are the Stone duality theory and a generalization of Lawvere's characterization of algebraic categories. (Received September 14, 1967.)


Comma categories \((F,G)\) as introduced by Lawvere are an important tool in category theory and deserve systematic treatment. So far, five operations and their relations seem useful.

(i) a product \( (F,G) \times_A (G,H) \rightarrow (F,H) \); (ii) The identification of natural transformations from \( F \) to \( G \) with functors \( A \rightarrow (F,G) \) (Courtesy of Jon Beck); (iii) If \( m : F' \rightarrow F \) and \( n : G \rightarrow G' \) are natural transformations then there is an induced functor \((m,n) : (F,G) \rightarrow (F',G')\); (iv) If \( m \) and \( n \) are as in (iii) then there is a system of natural transformations involving functors between \((MF,NG), (MF,NG'), (MF',NG), (MF',NG')\) and \((M,N)\); (v) A hyperproduct involving comma categories whose entries are projections of other suitable comma categories onto their factors. Among the applications which flow smoothly from this machine are hom functors (of course), a treatment of adjoint functors (Jon Beck suggested that this should exist) and the triple on \((\text{Cat}, B)\) whose algebras are split fibrations over \( B \). (Received September 14, 1967.)

Certain questions of abstract category theory are studied with a view to applications in homological algebra. (Received September 14, 1967.)


Consider the equation \[ y'(x) = f(x, y(x), y(x + h_1), \ldots, y(x + h_p)), \quad 0 = h_0 < h_1 < \ldots < h_p < \infty. \]

An existence-uniqueness theorem is given. A nonexistence theorem is obtained which pertains to a large subclass of the equations discussed by Wright (The nonlinear difference-differential equation, Quart. J. Math. 17 (1946), 245-252). Two oscillation theorems are given for the equation \[ y'(x) = a(x)f(y(x + 1)). \] Finally, consider the equation \[ \sum_{i=1}^{p} a_{ij} y_j'(x + h_j) = g(x), \quad a_{0n} \neq 0, \quad a_{pn} = 0. \] An expansion theorem is obtained which gives all solutions in terms of a particular solution and a series of characteristic solutions. For a large class of forcing terms \( g(x) \), the particular solutions arise in a natural way. (Received September 20, 1967.)


Let \( \{s_n(z)\} \) be a sequence of complex valued functions defined in a domain \( D \) of the complex plane. The Gibbs set of \( \{s_n(z)\} \) at \( z_0 \in \overline{D} \) is \( G(z_0) = \{W : W = \lim_{k \to \infty} s_{n_k}(z_k) ; z_k \to z_0, \; n_1 < n_2 < \ldots\} \). Theorems are proved on connectedness of \( G(z_0) \). Define \( G_k(z_0) = \{W : W = s_k(z), \; k \geq n, \; |z - z_0| \leq 1/n, \; z \in D\} \). Then \( G(z_0) = \bigcap_{n} G_n(z_0) \). Let \( R_n(z_0) \) be the closed convex hull of \( G_n(z_0) \). The core of \( \{s_n(z_0)\} \) at \( z_0 \) is \( R(z_0) = \bigcap_n R_n(z_0) \). Let \( t_n(z) \) be the transform of \( \{s_n(z)\} \) by a regular matrix. The core of \( \{t_n(z)\} \) is denoted by \( TR(z_0) \). Necessary and sufficient conditions are found for \( TR(z_0) \subseteq R(z_0) \). This extends theorems by Agnew [Amer. J. Math. 61 (1939), 178-186]. The core \( F(z_0) \) of a function \( f(z) \) is the core of \( t_n(z) = f(z) \) at \( z_0 \). Let \( s_n(z) \to f(z) \) in \( D \). The generalized Gibbs phenomenon occurs at \( z_0 \) if \( R(z_0) \subseteq F(z_0) \) is not satisfied. Necessary and sufficient conditions are found for a regular matrix to not induce the generalized Gibbs phenomenon. The definition of the generalized Gibbs phenomenon is used to extend a theorem by B. Kuttner [J. London Math. Soc. 20 (1945), 136-139]. (Received September 25, 1967.)


There is a close relationship between descent theory in algebraic geometry and the theory of categories which are definable by means of standard constructions (tripleable categories). The "tripleability theorem" sheds some light on descent criteria. The form of Čech cohomology used in descent theory is an appropriate triple cohomology theory. Its interpretation is discussed from the triple point of view. (Received October 2, 1967.)

652-9. R. O. FULP, University of Houston, Houston, Texas 77004. Generalized semigroup kernels, II.

Assume \( K \) is a collection of ideals of a semigroup \( S \). The \( K \)-kernel of \( S \), denoted \( S_K \), is defined
to be $\bigcap K$. If $K$ is the set of all ideals of $S$, then $S_K$ is called the kernel of $S$. Let $M$ denote the set of all maximal ideals of $S$ and let $P$ denote the set of all prime ideals of $S$. Theorem. The kernel of $S$, the kernel of $S_M$, and the kernel of $S_P$ are all identical. Let $E$ denote the maximal semilattice homomorphic image of $S$ and $\eta$ the natural homomorphism from $S$ onto $E$. Theorem. $S_M \subseteq S_P$ if and only if $E$ contains a zero $z$ and $e \in E \setminus \{z\}$ implies that $e$ is maximal in $E$ and $\eta^{-1}(e)$ is simple. Corollary. If $E$ has a zero $z$ and $\eta^{-1}(z)$ is simple, then $S_M = S_P$ if and only if $e \in E \setminus \{z\}$ implies $e$ is maximal in $E$ and $\eta^{-1}(e)$ is simple. (Received October 2, 1967.)


Let $H$ be a subgroup of a finite group $G$. Let $\psi$ and $\xi$ be irreducible complex characters of $H$ and $G$, respectively, such that $(\xi, \psi^G) = 1$. Let $e_\psi$ be a primitive idempotent in the complex group algebra $CH$ of $H$ such that $CHe_\psi$ affords $\psi$. Then $\xi : e_\psi CGe_\psi \rightarrow C$ is an algebra homomorphism. Conversely, every algebra homomorphism $\phi : e_\psi CGe_\psi \rightarrow C$ is the restriction to $e_\psi CGe_\psi$ of a unique irreducible character $\xi$ of $G$ such that $(\xi, \psi^G) = 1$. Assume $\psi(1) = 1$, and let $\{x_i\}$ be representatives of the $(H, H)$-double cosets with $Hx_iH = H$. For each $i$ such that $\psi = \psi(x_i)$ on $H \cap H^{-1}$, let $\beta_i$ be the function on $G$ such that $\beta_i(1) = |H|^{-1} - 1$, $\beta_i(hx, k) = \psi(h)^{-1} \psi(k)^{-1}$, $h, k \in H$, and $\beta_i(e) = 0$ for $e \notin Hx_iH$. The elements $[\beta_i]$ form a basis for $e_\psi CGe_\psi$. Let $\beta_i$ be the function corresponding to the corresponding to the double coset $(Hx_iH)^{-1}$, and let $\text{ind}(x_i) = [H : H \cap H^{-1}]$. Then $|\beta_i|$ and $|\text{ind}(x_i)^{-1} \beta_i|$ form dual bases for the Frobenius algebra $e_\psi CGe_\psi$ with respect to the bilinear function $\lambda : (\beta_j, \beta_i) = a_{ij}$, where $a_{ij} = \sum a_{ijk} \delta_k$. If $\phi : e_\psi CGe_\psi \rightarrow C$ is an algebra homomorphism, then $u = (\{G : H\}^{-1}) \sum e_\psi \psi(x_i) (\text{ind}(x_i))^{-1} \phi(\beta_i)$ is a primitive idempotent of $CG$ affording the character $\xi$ of $G$ corresponding to $\phi$. Moreover $\xi(1) [G : H] \text{l.c.m.} \text{ind}(x_i)$, where the l.c.m. is taken over the set $\{i : \psi = \psi(x_i)\}$ on $H \cap H^{-1}$. (Received October 3, 1967.)


The first example of a hereditarily infinite dimensional (HID) space was constructed in 1965 by D. W. Henderson. An HID space is an infinite dimensional compact metric space each of whose nondegenerate subcontinua is infinite dimensional. In this paper, the behavior of HID spaces under monotone mappings is studied. An HID space which maps monotonecally onto the Hilbert cube is constructed, and using that space, the following theorem is proved. Theorem. Let $X$ be a compact metric space. Then there is an HID compactum $Y$ and a monotone map $f : Y \rightarrow X$ such that for each $p \in X$, $f^{-1}(p)$ is HID. Moreover, the components of $Y$ are in 1-1 correspondence with the components of $X$ under the correspondence $c(y) \leftrightarrow c(f(y))$. It is also shown that an arbitrary compactum of dimension $\geq n$ (in particular, any HID space) can be mapped monotonecally onto some $n$-dimensional space, and that, for given $n$, every compactum (in particular, any HID space) is a monotone image of some $n$-dimensional space. (Received October 2, 1967.)


If $\mathcal{F}$ is a formation of solvable groups, let $G^\mathcal{F}$ be the $\mathcal{F}$-residual of $G$. Let $\mathcal{F}$ be the...
formation of supersolvable groups. Dornhoff proved that if $G$ is a finite solvable group and if the Sylow subgroups of $G$ are well-behaved, then $G$ is an M-group. If $G$ is an M-group, what can be said about $G$? In this paper several special cases are considered, and in each of these cases information about the structure of the group, in particular the structure of the $S$-residual, is obtained. As an example, $G$ is a super-M-group if each irreducible character of $G$ can be induced from a linear character of a normal subgroup of $G$. Theorem. If $G$ is a super-M-group, then $G$ is nilpotent, and for any saturated formation $F$ containing all nilpotent groups, $G$ splits over $G$. The $S$-residual is not determined for the general M-group, although there are some restrictions. Theorem. There exists an infinite class of groups each member of which is the $S$-residual of some solvable group, but no member of which is the $S$-residual of an M-group. (Received September 29, 1967.)


Denote by $H(x)$ the number of integers $n \leq x$ of the form $n = b^2 + p^2$ ($p$ prime). Using the sieve method for upper bounds, we get Theorem 1. For a certain constant $c > 0$ and $x \geq 10$ we have $H(x) > cx(\log x)^{-1}$. Furthermore, denote by $E(x)$ the number of integers $n \leq x$ of the form $n = p_1^2 + p_2^2$ ($p_1, p_2$ prime). Using the prime number theorem and the sieve method, we obtain Theorem 2. $E(x) = (\pi/2)x(\log x)^{-2}(1 + r(x))$ with $r(x) = O((\log x)^{-2/3}(\log \log x)^{2/3})$. (Received October 2, 1967.)


$T_x = \theta x \pmod{1}$ ($\theta > 1$, noninteger) maps the unit interval onto itself and has a uniquely determined invariant measure equivalent to the Lebesgue measure: $T$ is an endomorphism. Rohlin, Amer. Math. Soc. Transl. (2) 39 (1964), 1-36, proved that $T$ is an exact endomorphism and thus mixing of every degree. These results are generalised to the $n$-dimensional torus: The map $T_x = \Delta x \pmod{1}$ (where $\Delta$ is an $n \times n$ matrix not having only integer elements having roots of unity greater than 1 and satisfying one more condition) is an exact endomorphism. (For integer matrices this is well known, the invariant measure being the Lebesgue measure.) (Received October 2, 1967.)

652-15. PAUL HILL, University of Houston, Houston, Texas 77004. Ulm's theorem for totally projective groups.

The reduced $p$-primary group $G$ is said to be totally projective if $p^a \operatorname{Ext}(G/p^a G, X) = 0$ for each $X$ and each ordinal $a$. For example, if $G$ is countable, or more generally a direct sum of countable groups, then $G$ is totally projective. However, unlike a direct sum of countable groups, a totally projective group may have arbitrarily large length. Theorem. If $G$ and $G$ are totally projective groups, then they are isomorphic if and only if they have the same Ulm invariants. (Received October 2, 1967.)

652-16. P. A. GRIFFITH, University of Houston, Houston, Texas 77004. Baer groups are free.

An abelian group $G$ is called a Baer group if $\operatorname{Ext}(G, T) = 0$ for all torsion groups $T$. Theorem. A group $G$ is a Baer group if and only if it is free. (Received October 2, 1967.)
Decidability of monadic second-order theory of two successors.

Let \( T = \{ 0, 1 \}^* \), \( S_0 : T \rightarrow T \), \( S_1 : T \rightarrow T \) be the functions \( S_0(x) = x0 \), \( S_1(x) = x1 \). The following result, which is an almost immediate consequence of Theorems 1-2, announced in the Abstract "Finite automata over infinite trees," answers a question of Büchi's: Theorem 1. The monadic second-order theory of the structure \( \langle T, S_0, S_1 \rangle \) is decidable. This theorem has numerous consequences. The following answers a question of Grzegorczyk's: Theorem 2. The first-order theory of the lattice of all closed subsets of the real line is decidable. A corollary of this is the decidability of first-order theory of boolean algebras with additional unary predicates \( P_1, ..., P_n \) denoting an increasing sequence of ideals. Theorem 3. The monadic second-order theory of countable ordered sets is decidable. Corollary. The weak monadic second-order theory of ordered sets is decidable. This extends Ehrenfeucht's result of decidability of theory of ordered sets. All the decision procedures in question are primitive recursive (even elementary). (Received July 5, 1967.)

A characterization of those finite groups with chained-Y lattices of subgroups.

Let \( G \) be a finite group and \( L = L(G) \) be the lattice of subgroups of \( G \). Definitions. (i) \( L \) satisfies the chained-Y property iff given any two maximal chains of elements of \( L \), \( C_1: C_1^{(0)} \supset C_1^{(1)} \supset ... \supset C_1^{(n)} = E \) and \( C_2: C_2^{(0)} \supset C_2^{(1)} \supset ... \supset C_2^{(n)} = E \), where \( C_1^{(0)} \neq C_2^{(0)} \), then \( C_1 \cap C_2 : C_1^{(0)} \cap C_2^{(0)} \supset C_1^{(1)} \cap C_2^{(1)} \supset ... \supset C_1^{(n)} \cap C_2^{(n)} = E \) is a maximal chain, after removing the repetitions. (ii) \( G \) is said to be a CY-group iff \( L(G) \) satisfies the Long-Y property. (iii) \( G = \text{Hol}(P_1, P_2) \), where \( o(P_1) = p_1 \) and \( o(P_2) = p_2 \), \( p_1 \) and \( p_2 \) are prime numbers, is called a \( K \)-group. (iv) A group \( N \) is involved in a group \( G \) provided there exists \( L \) and \( H \), subgroups of \( G \), such that \( H/L \cong N \). Theorem. \( G \) is a CY-group iff (1) \( G \) is a supersolvable LY-group and (2) No \( K \)-group is involved in \( G \). (Received July 19, 1967.)

Additive prime-number theory and aesthetics. IV.

This paper continues the formalization of desiderata on aesthetics by G. D. Birkhoff (Aesthetic measure, Cambridge, Mass., 1933) and by N. Wiener (Aesthetics, in 1960 edition of The Encyclopedia Americana, Vol. 1, pp. 198-203). Postulate (for nonconstructive proofs only). For every (mathematical) GETANKA-form there exists a GETANKA poem with that syllable-count structure. Definition. A dual poem of a \( p \)-line twin-GETANKA (if it exists) is a \( p \)-line GETANKA found by replacing the syllable-count of each line of the twin-GETANKA by a prime with which it is paired as a twin-prime. Lemma 1. Every classical HOKKU and TANKA has a dual poem which is a twin-GETANKA. Lemma 2. There exists, constructively, an 11-line twin-GETANKA with a total syllable-count of 101 that has a dual poem which is a twin-GETANKA with a total syllable-count of 103; Similarly, for a 17-line
twin-GETANKA with total syllable-count 179. Questions. Does every twin-GETANKA with sufficiently many lines have a dual poem which is (1) a twin-GETANKA? (2) a GETANKA? (Received August 7, 1967.)

67T-671. S. S. SHRIKHANDE, University of Bombay, Bombay 1, India. Ascendent and descendent graphs.

R. C. Bose introduced the notion of a partial geometry \((r, k, t)\) and a pseudo-geometric graph \((r, k, t)\) [Pacific J. Math. 13 (1963), 389-419]. Using another result of R. C. Bose [Abstract 67T-496, these Notices 14 (1967), 706] in which he introduces the concept of a descendent graph \(G^*\) of a graph \(G\) (called the ascendent of \(G^*\)), the following result is proved. Theorem. If pseudo-geometric graphs \((r, 2r - 1, r - 1)\) and \((r, 2r, r)\) (respectively pseudo-geometric graphs \((r, 2r + l, r)\) and \((r, 2r, r - 1)\)) stand in the relation of descendent and ascendent graphs, then both of them cannot be simultaneously geometrisable. (Received August 10, 1967.)


Let \(X\) be a set with power set \(P(X)\). M. W. Lodato (On topologically induced generalized proximity relations, Proc. Amer. Math. Soc. 15 (1964), 417) gives axioms for a symmetric generalized proximity space (denoted \(\mathcal{P}\)) on \(X\). Definition. A set \(B\) in \(P(X)\) is said to be a \(p\)-neighborhood of a set \(A\) in \(P(X)\) with respect to \(\mathcal{P}\) (notation \(A \triangleright B\)) iff \((A, X - B)\) is not in \(\mathcal{P}\). Consider the following axioms for any \(A, B, C,\) and \(D\) in \(P(X)\). (Q<sub>1</sub>) \(X \triangleright X\); (Q<sub>2</sub>) \(A \triangleright B\) implies \(A \subset B\); (Q<sub>3</sub>) \(A \subset B\) \(\mathcal{P}\) \(A \subset C \subset D\) implies \(A \subset D\); (Q<sub>4</sub>) \(A \triangleright B\) implies \((X - B) \triangleright (X - A)\); (Q<sub>5</sub>) \(A \triangleright B\) implies \(A \triangleright C\) or there exists an \(x\) in \((X - C)\) such that \(|x| \triangleright B\). Theorem. For any symmetric generalized proximity space, \(\mathcal{P}\), on \(X\), \(Q_1, Q_2, Q_3, Q_4,\) and \(Q_5\) are true. Theorem. Let \(\Delta\) be a subset of \(P(X) \times P(X)\). By \(A \Delta B\) we mean \((A, B)\) is in \(\Delta\). Suppose \(\Delta\) satisfies axioms \(Q_1, Q_2, Q_3, Q_4,\) and \(Q_5\). Then \(\mathcal{P}\), a subset of \(P(X) \times P(X)\), defined by: \((A, B)\) is not in \(\mathcal{P}\) iff \(A \Delta (X - B)\), is a symmetric generalized proximity space on \(X\). Furthermore, \(B\) is a \(p\)-neighborhood of \(A\) with respect to \(\mathcal{P}\) iff \(A \Delta B\). (Received September 12, 1967.)

67T-673. T.J. HEAD, University of Alaska, College, Alaska 99701. Tensor products of semigroups with minimal ideals.

Let \(A\) and \(B\) be commutative semigroups with minimal ideals \(H\) and \(K\). Theorem 1. \(H \otimes K\) is imbedded in \(A \otimes B\) and is the minimal ideal of \(A \otimes B\). Theorem 2. If \(A\) and \(B\) are Archimdean then regarding Rees factors we have: \(A \otimes B / H \otimes K \cong A/H \otimes B/K\). Theorem 3. If \(A\) is cyclic of index \(m\) and period \(r\) and \(B\) is cyclic of index \(n\) and period \(s\) then \(A \otimes B\) is cyclic with index \(\text{gcd} |m, n|\) and period \(\text{gcd} |r, s|\). (Received August 17, 1967.)


For any smooth \((C^\infty)\) manifold \(X\) with boundary \(bX\) let \(\mathcal{K}_2(X)\) denote the group of components of the space of those diffeomorphisms (= pseudo-isotopies), \(\psi: X \times I \to X \times I\) such that \(\psi((X \times 0 \cup bX \times I)\)
is identity. (I is the interval $[0, 1]$.) $\mathcal{H}^2_2(X \times 1)$ is abelian. Consider a smooth fibration $F \to E \to S^1$ with connected fiber of a closed connected $C^\infty$ manifold $E$ of dimension $\geq 5$ over the circle. Let $H \subset G \to \mathbb{Z}$. Suppose that $t \in G$ go to $1 \in \mathbb{Z}$, and define $\theta: H \to H$ by $\theta(h) = t^{-1}ht$. Theorem. There is a sequence of group homomorphisms: $\mathcal{H}^2_2(F \times 1) \to \mathcal{H}^0_2(F \times 1) \to \mathcal{H}^2_2(E)$. Wh$H^1$Wh$G^p$, $\mathcal{K}_0^H \to \mathcal{K}_0^G$, where Wh is in the Whitehead torsion functor and $\mathcal{K}_0$ the projective class group functor. It is exact except at the two points $\cdot \mathcal{P}_1$, at which $p = i = 0$ and $p$ is split modulo the image of $i$. $\theta$ comes from a self-diffeomorphism of $F$ determined (to isotopy) by the fibration. All $i$ come from inclusion. The last $p$ factorizes as $\mathcal{H}^2_2(E)$, then $p(x) + (-1)\dim F_p(x)$ is an isotopy invariant of $F \times 1$. The case $E = F \times S^1$ shows that 'pseudo-isotopy' $\neq$ 'isotopy', in dimensions $\geq 5$. (Received September 1, 1967.)

67T-675. K. E. GUSTAFSON, University of Minnesota, Minneapolis, Minnesota. Operator products and operator angles.

Let $g_m (-B) = \min_{x} \|B - I\|$, $\epsilon \geq 0$. Let $\cos A = \inf_{x} \text{Re}[Ax, x] \cdot \|Ax\|^{-1}$, $x \in \text{N(A)}$, $\|x\| = 1$. Here $B$ and $A$ are bounded operators on a Banach space $X$, and $[x, y]$ is a semi-inner product; an operator $T$ is called accretive if $0 \leq m_T = \inf_{x} \text{Re}[Tx, x]$, $\|x\| = 1$. Theorem. If $g_m (-B) \leq \cos A$, then $BA$ is accretive. Corollary. Let $B$ and $A$ be self-adjoint, $\|B\| = \|A\| = 1$, both accretive. Then $BA$ is accretive if $(1 - m_B)(1 + m_B)^{-1} \leq 2m_A^{1/2}(1 + m_A)^{-1}$. (Received September 5, 1967.)

67T-676. J. B. ROBERTSON, University of California, Santa Barbara, California 93106, and MILTON ROSENBERG, University of Kansas, Lawrence, Kansas 66044. The decomposition of matrix-valued measures.

Suppose that $M$ is an $n \times m$ matrix-valued measure on a $\sigma$-algebra $F$ over a set $\Omega$. We can then define $\int \Phi dM$ for a suitable class of $k \times n$ matrix-valued functions $\Phi$. We define and study appropriate notions of the total variation of a matricial measure and of the absolute continuity, Radon-Nikodym derivative, and singularity of one matricial measure with respect to another. In particular we prove matricial versions of the Hahn-Jordan decomposition, Radon-Nikodym theorem, and Lebesgue decomposition. In this theory nonnegative hermitian-valued measures often play the role of the positive measures. In order to insure the uniqueness of a Lebesgue decomposition, one cannot just define the mutual singularity of two measures, but the mutual singularity of two measures given a third nonnegative hermitian-valued measure. Thus we obtain not one, but a class of Lebesgue decompositions. Throughout this study generalized inverses and nonorthogonal projections have been prominent. (Received September 8, 1967.)


Theorem. There is no totality (class or set) which would include as an element under other elements a plural class. Proof. (1) A plural class is represented in the form $a_1, a_2, \ldots$. (2) A singular class is represented in the form: $(a_1, a_2, \ldots)$. (3) Any plural class can be transformed in

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(4) We call a representation of a totality in the form of a totality of the same kind a true representation. (5) In order that a plural class can serve as element under other elements of a class, it must be enclosed in a true representation in usual or other parentheses. (6) But then the plural class becomes a singular class. (7) Hence it is not possible for classes to have a plural class as element under other elements. (8) Hence there do not exist in the concerning formal theory classes which have a plural class as element under other elements. (9) The same proof holds mutatis mutandis for sets. (10) Hence our theorem. This result corresponds to the sharper postulate of von Neumann-Bernays that no class can serve as element of a totality. New in our proof is the deduction from the trueness of a representation. (Received September 8, 1967.)


Theorem. Let R be a ring all of whose ideals are generated by \( \mathbb{N}_n \) elements. Then the global dimension of R < \( n + 1 \) + the weak global dimension of R. This generalizes a result of C. U. Jensen, Homological dimensions of \( \mathbb{N}_n \)-coherent rings, Math. Scand. 20 (1967), 55-60. Theorem. Let D be a directed set of cardinality \( \mathbb{N}_n \), and let \( \{M_d : d \in D \} \) be a directed system of R-modules. Then the dimension of \( \lim M_d \) exceeds the supremum of the dimensions of the \( M_d \) by at most \( n + 1 \). This generalizes a result of Berstein, On the dimension of rings and modules, IX, Direct limits, Nagoya Math. J. 13 (1958), 83-84. (Received September 11, 1967.)


Let \( \{y_t\}_{-\infty < t < \infty} \) be a mean zero stochastic process which satisfies the autoregressive equation (*) \( y_t + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_p y_{t-p} = u_t, \beta_p \neq 0, \) where \( u_t \) are uncorrelated random variables with means zero and common variance. The \( \beta_i \) may be functions of \( t \). While the solution of (*) and the computation of the covariance function of \( \{y_t\} \) may be accomplished in a variety of ways, a particularly efficient method is the Green's function technique of linear difference equations. The formulas obtained are not only of theoretical interest, but also yield a convenient algorithm for calculating the covariance function of the \( \{y_t\} \) process. Generalizations are readily made. (Received September 13, 1967.)


Let X be a complex Banach space with elements \( f, g, \ldots, E(X) \) the Banach algebra of endomorphisms of X, \( \{T(t) : t \geq 0\} \) a one-parameter semigroup of operators of class \( (C_0) \) in \( E(X) \), \( A \) the infinitesimal generator of \( \{T(t)\} \) and \( R(\lambda; A) \) the resolvent of \( A \). New and equivalent definitions of the operator \( A \) are given by \( Af = s - \lim_{\lambda \to \infty} \lambda^{-1} \{[\lambda R(\lambda; A)]f - f\} \) (fixed \( n = 1, 2, \ldots, f \in X \)) whenever the limit exists. Theorem 1. The following statements give equivalent definitions of the \( r \)th power \( A^r \) \( (r = 1, 2, \ldots, \) whenever the limits exist (a) \( A^r f = s - \lim_{\lambda \to \infty} \lambda^{-r} \{[\lambda R(\lambda; A)]f - f\} \) \( (t \in D(A^{-1}) \)); (b) \( A^r f = s - \lim_{\lambda \to \infty} (\lambda^r/r!) \lim_{k \to \infty} \{[R/k]R(\lambda k; A) - I\}f (f \in X) \); (c) \( A^r f = s - \lim_{\lambda \to \infty} \lambda^r \{[\lambda R(\lambda; A) - I]/\lambda \}f (f \in X) \). Comparing the order of approximation of \( f \) by \( T(t)f \) and
\[ \mathbf{AR}(\lambda; \Lambda)f \text{ we have Theorem 2.} \] Let \( f \in X \). Then \( \|T(t)f - f\| = O(t) \) (\( t \to 0^+ \)) iff \( \|\mathbf{AR}(\lambda; \Lambda)f - f\| = O(\lambda^{-1}) \) (\( \lambda \to \infty \); every fixed \( n = 1, 2, \ldots \)). \textbf{Theorem 3.} The statements (a), (b) and (c) of Theorem 1 are equivalent if one replaces existence of the limits by boundedness in the norm. \textbf{Theorem 4.} A family \( \{S(\lambda)\}; \lambda > \omega \) of operators in \( E(X) \) is the resolvent of a closed linear operator \( \Lambda \) such that \( \Lambda \) generates a semigroup of class \((C_0)\) iff (i) \( S(\lambda_1) - S(\lambda_2) = (\lambda_2 - \lambda_1) S(\lambda_1) S(\lambda_2) (\lambda_1, \lambda_2 > \omega) \); (ii) \( \lim_{\lambda \to \infty} \|\mathbf{AS}(\lambda)f - f\| = 0, f \in X \); (iii) \( \|S(\lambda)\|^n \leq M(\lambda - \omega)^{-n} (\lambda > \omega; n = 1, 2, \ldots \)). There are applications to the semigroup of left translations and the singular integrals of Weierstrass, Cauchy, Abel-Poisson and Picard. (Received September 13, 1967.)


Let \( M \) be an \( n \)-dimensional Kählerian manifold. For any Kählerian immersion of \( M \) into an \((n + 1)\)-dimensional Kählerian manifold \( \tilde{M} \) of constant holomorphic curvature, it is shown that the null space and hence the rank of the second fundamental form of \( M \) are intrinsic and that \( M \) is rigid in \( \tilde{M} \). The rigidity is contained as a special case in Calabi's results \([\text{Isometric imbedding of complex manifolds, Ann. of Math. 58 (1953), 1-23}])\), but our proof is more direct and more in line with classical differential geometry. When \( M \) is regarded as a real submanifold of codimension 2 in \( \tilde{M} \), the type number of \( M \) as defined by C. B. Allendoerfer is half of the rank of the second fundamental form. (Received August 29, 1967.)

67T-682. M. B. POUR-EL, University of Minnesota, Minneapolis, Minnesota 55454. Hyper-simplicity as a necessary and sufficient condition for nonindependent axiomatization. II. This is a continuation of Abstract 67T-524 (these Notices 14 (1967), 715). \textbf{Theorem 2.} Let \( \mathcal{F}^* \) be a finitely axiomatizable effectively inseparable theory. Then there exists an axiomatizable extension \( \mathcal{F} \) of \( \mathcal{F}^* \) which is not independently axiomatizable. \textbf{Corollary.} There exists an axiomatizable extension \( \mathcal{F} \) of the theory \( Q \) of undecidable theories which is not independently axiomatizable. (\( \mathcal{F} \) may be chosen to be compatible with Peano Arithmetic.) \textbf{Remarks} (a) It can be shown by example that one cannot omit the restriction "finitely axiomatizable" from Theorem 2. This follows from the fact that every axiomatizable extension of a decidable theory is independently axiomatizable. (b) The remark of Abstract 67T-524 is not completely correct: Theorem 1 of this abstract does not hold for intuitionistic logics. (My thanks to Reznikoff for pointing this out.) Nevertheless it is possible to construct axiomatizable theories of intuitionistic logic which are not independently axiomatizable. (Received September 15, 1967.)


In the Euclidean plane, the work \( W \) of a particle due to the influence of a directional field of force \( \mathbf{F} \) is always identical to that due to a positional field of force \( \mathbf{F}_0 \) and a resistance \( R \) along the normal to an arbitrary path described by the particle. Then \( \mathbf{F} \) is conservative if and only if \( \mathbf{F}_0 \) is...
conservative. Moreover, they possess a common potential function $U$. Velocity and natural families are studied for an arbitrary directional field of force. These families are those of a positional field of force if and only if the directional field of force possesses the properties described above. Finally, the variation of Kasner integral $\int v^{1+k} \, ds = \text{minimum}$, for an arbitrary directional field of force are studied in detail. (Received June 19, 1967.)


Let $A_n = \{L_1, R_1, \ldots, L_n, R_n\}$ be an alphabet of $2n$ letters. For each letter $a$ in $A_n$, and for each word $w$ over $A_n$, let $(a; w)$ denote the number of occurrences of letter $a$ in $w$. The $n$-dimensional origin-crossing language is the set $O_n = \{w \in A_n^n: \text{for all } 1 \leq i \leq n, (L_i; w) = (R_i; w)\}$. The geometric name of $O_n$ stems from the interpretation of each letter $L_i$ ($R_i$) in $A_n$ as an instruction to take one step left (right) along the $i$th axis in $n$-space. Theorem. For every integer $n$, $O_n$ is real-time recognizable by a one-tape Turing machine. This is all the more surprising in view of: Theorem. For each $n \geq 1$, $O_n$ is real-time recognizable by an $n$-counter machine but not by any $(n-1)$-counter machine. (For relevant definitions, see A. Rosenberg, Real-time definable languages, Abstract 66T-286, these Notices 13 (1966), 495, and P. Fischer, A. Meyer, and A. Rosenberg, Real-time counter machines, Abstract 67T-76, these Notices 14 (1967), 150.) (Received August 22, 1967.)


By use of trigonometric series we show that $Lip^1$ is the weakest condition of its kind that implies differentiability almost everywhere. More precisely, we prove Theorem. If $f$ is continuous on $[0, 2\pi]$, then the condition $|f(t + h) - f(t)| = O(\omega(h))$ uniformly in $t$, where $\omega(h) \rightarrow \infty$ arbitrarily slowly as $h \downarrow 0$, does not imply that $f$ is differentiable on a set of positive measure. (Received September 18, 1967.)

67T-686. V. C. CATEFORS, University of Wisconsin, Madison, Wisconsin. The singular submodule splits off.

Let $R$ be a commutative ring with 1. An ideal $I$ of $R$ is large if $I \cap xR \neq 0$ for every $0 \neq x \in R$. If $M$ is an $R$-module, then $Z(M) = \{m \in M/ (0; m) \text{ is large}\}$, where $(0; m) = \{x \in R/ \exists m \in M : mx = 0\}; M$ is of bounded order, if $M_0 = 0$ for some large ideal $I$ of $R$; $M$ splits if $Z(M)$ is a direct summand of $M$.

Theorem 1. The following statements are equivalent (a) Every $R$-module $M$ splits. (b) $R$ is (von Neumann) regular and every $R$-module $M$ with $Z(M)$ of bounded order, splits. (c) $Z(R) = 0$ and for every large ideal $I$ of $R$, $R/I$ is semisimple (with d. c. c.). (d) Every $R$-module $M$ with $Z(M) = M$ is $R$-injective. If $R$ satisfies any of the conditions (a) - (d), then $R$ is hereditary. Theorem 2. If $Z(R) = 0$, then the following statements are equivalent (a) Every $R$-module $M$ with $Z(M)$ of bounded order, splits. (b) $R$ is semihereditary and for every large ideal $I$ of $R$, $R/I$ has d. c. c. Theorem 3. If every finitely generated $R$-module splits, then $R$ is semihereditary. The converse is not in general true. (Received September 18, 1967.)
67T-687. M. C. FITTING, Yeshiva University, 611 West 112 Street, New York, New York 10025.

Intuitionistic models and independence results in set theory. II. Preliminary report.

This continues Abstract 67T-497, these Notices 14 (1967), 706. A collection of transfinite sequences of S. Kripke's intuitionistic models is defined. Denote one such sequence by $|S_\lambda|$. The notion of $S_\lambda$ being an intuitionistic first order universe is also defined. Theorem. $S_\lambda$ is an intuitionistic first order universe if and only if $M_\lambda$ (in Godel's sense) is a classical first order universe. Natural analogs are found in $S_\lambda$ for ordinals, cardinals, and constructable sets. Sample theorem. If $M_\lambda$ is a first order universe, if $A$ is the analog in $S_\lambda$ of the ordinal $\alpha$, and if $\alpha$ is a cardinal of $M_\lambda$, then $A$ is the analog of a cardinal in $S_\lambda$. Suitable sequences $|S_\lambda|$ establish the independence of the axiom of choice, the continuum hypothesis, and the axiom of constructability. P. Cohen's complete sequences are not used, although many of the methods of proof are those of Cohen. (Received September 18, 1967.)

67T-688. ERIK ELLENTUCK, Rutgers, The State University, New Brunswick, New Jersey.

Dedekind arithmetic.

Let $ZF = \text{set theory without the axiom of choice}$, $\omega = \text{finite cardinals}$, and $\Delta = \text{Dedekind cardinals}$. Let $\mathfrak{A}$ be a truth table combination of equations between polynomials in $+$, $\cdot$, and variables.

Theorem 1. $(ZF \vdash \mathfrak{A}$ universally holds in $\Delta) \iff (ZF \vdash (i) \mathfrak{A}$ universally holds in $\omega$, and (ii) for any $\mathfrak{A}'$ obtained from $\mathfrak{A}$ by replacing some but not all of the variables of $\mathfrak{A}$ by finite cardinals, there is a Horn reduction of $\mathfrak{A}'$ which eventually holds in $\omega$). Let $\Sigma = \text{finite sums of indecomposable cardinals where } x \text{ is indecomposable if } x = y + z \text{ implies } y \in \omega \text{ or } z \in \omega$. Let $L = \text{first order sentences in a language whose terms are polynomials in } + \text{ and variables}$. Theorem 2. $|\mathfrak{A} \in L: ZF \vdash \mathfrak{A}$ holds in $\Sigma| \text{ is decidable}$. Let $ZF^0 = ZF + \text{the axiom of choice for sets of finite sets}$. Theorem 3. $ZF^0_0 \vdash$ universal $\leq$ comparability in $\Delta$ implies $\langle \omega, +, \cdot \rangle$ is an elementary subsystem of $\langle \Delta, +, \cdot \rangle$. Let $ZF^0_0 (\Delta) = ZF^0_0 + \text{there exists a cardinal } k \text{ universal in the sense that for every pair of combinatorial functions } f \text{ and } g, f(k) = g(k) \text{ implies } f(n) = g(n) \text{ eventually holds in } \omega$.

Theorem 4. If $ZF$ is consistent then so is $ZF^0_0 (\Delta)$. (Received September 18, 1967.)

67T-689. S. D. FELT, 6 Waite Street, Hamden, Connecticut.

On $k$-mersions of manifolds.

Preliminary report.

Let $M^N$ be an $n$-dimensional $C^\infty$ manifold and $W^P$ be a $p$-dimensional $C^\infty$ manifold. A $C^\infty$ mapping $f: M^N \rightarrow W^P$ is called a $k$-mersion if its rank is greater than or equal to $k$ everywhere. The set of $k$-mersions, endowed with the $C^1$ topology, is denoted $R(M^N, W^P; k)$. A $k$-bundle map $\psi: TM^N \rightarrow TW^P$ between the tangent spaces of $M^N$ and $W^P$ is a continuous fibre preserving map whose restriction to any fibre is a linear map of rank at least $k$. The set of $k$-bundle maps endowed with the compact-open topology is denoted $T(M^N, W^P; k)$. Theorem. Let $M^N$ and $W^P$ be $C^\infty$ manifolds with the boundary of $W^P$ empty. If either $M^N$ has no compact components whose boundary is empty or $k < p$, then the mapping $d: R(M^N, W^P; k) \rightarrow T(M^N, W^P; k)$ defined by $d(f) = df$ is a weak homotopy equivalence. The proof largely depends on showing that if a manifold $V^N$ is obtained from a manifold $U^N$ by the adjunction of a handle of index $\lambda$, then, if $\lambda < n$ or $k < p$, the restriction map $i^*: R(W^P, W^P; k) \rightarrow R(U^N, W^P; k)$ given by $i^*(g) = g|U^N$ is a fibering. (Received September 20, 1967.)

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On bounded complete additive classes.

The following notation and terminology is due to E. A. Walker, Abstract 64T-409, these Notices 11 (1964), 598. The bounded complete additive classes \( \mathcal{B}(\mathcal{F}) \) corresponding to the filters \( \mathcal{F} \) with a given property \( (X) \) are determined. For \( (X) \) each of the following properties is considered: (1) \( \mathcal{F} \) is multiplicative, and \( I \in \mathcal{F} \) implies \( \bigcap_{r \in I} r \in \mathcal{F} \). (2) \( \mathcal{F} \) is bounded complete, i.e., for each \( L \in \mathcal{F} \) there corresponds \( K \in \mathcal{F} \) (depending only on \( L \)) with the property: If \( I + J/J \) and \( R/I \) are weakly annihilated by \( L \), then there exist \( r_1, \ldots, r_n \in R \) (depending on \( J \)) such that \( \bigcap_{i=1}^{n} (K: r_i) \subseteq J \). (3) \( \mathcal{F} \) is weakly complete. (4) \( \mathcal{F} \) is multiplicative. If \( R \) is commutative, then these four properties are equivalent. Theorem. \( \mathcal{F} \rightarrow \mathcal{B}(\mathcal{F}) \) is a natural one-one correspondence between the bounded complete filters of \( R \) and the bounded complete Serre classes of left \( R \)-modules, where \( R \) is any associative ring with unit. (Received September 18, 1967.)

67T-691. WITHDRAWN.

Automatic problem formulation with applications to fluid mechanics.

The techniques described in Applications of computers to the formulation of problems in curvilinear coordinate systems by James C. Howard in NASA TN D-3939, and summarized in Abstract 636-129, these Notices 13 (1966), 615 have been extended to the study of problems in fluid mechanics. It is shown how a tensor formulation of the relevant equations can be used to facilitate automatic formulation of aerodynamic, hydrodynamic, and hemodynamic flow problems. Because of the invariant nature of the formulation with respect to coordinate transformations, these techniques can be used as the basis for a general formulation procedure, and as a means of reducing complicated formulation problems to routine computer operations. One of the advantages of the method is that it can be used to relieve the researcher of the task of deriving equations in unfamiliar curvilinear coordinate systems, and as a means of reducing the possibility of errors. Once the equations have been derived, the computer can be used to process them in the conventional manner, subject to the satisfaction of any initial or boundary constraints imposed by the researcher. (Received June 19, 1967.)

Convergence-preservation by a generalized Hausdorff mean.

Let \( H^{(s)}(d) \) denote the generalized Hausdorff mean defined in Abstract 67T-99 these Notices 14 (1967), 158. Let \( a_n = 1 - s_n/n \) and denote by \( BV \) the space of sequences \( d \) such that \( d_n = \int_{[0,1]} g \, dg \), \( n = 0, 1, 2, \ldots \), and \( g \) is of bounded variation on \( [0, 1] \). Theorem 1. If \( \sum a_n \) is convergent, then \( H^{(s)}(d) \) is conservative if and only if \( d \in BV \). Theorem 2. If \( d \in BV \), \( H^{(s)}(d) \) is conservative if \( a_{n+1} \leq a_n/(n+1) \), \( n = 1, 2, 3, \ldots \), and multiplicative if \( a_{n+1} \geq a_n/(n+1) \), \( n = 1, 2, 3, \ldots \). Theorem 3. There is a \( d \in BV \) and a mean \( H^{(s)}(d) \) which is not conservative. (Received September 22, 1967.)
Concerning the paracompact $p$-spaces of Arhangel'skii.

Properties of paracompact $p$-spaces are examined against the background of the classic literature on metrization, features of local or global separability, connectivity, screenability, and normalcy thus entering the consideration. Underlying aims are to test further the applicability of methods of base of countable order theory for analysis of non-first-countable structure, to weigh the issue of the appropriateness for the paracompact cases of Arhangel'skii's abstraction, and to identify links of these more general spaces with the metrizable spaces. Roughly expressed, it appears that in general one obtains rather what he might expect on the basis of the assumption that Arhangel'skii has identified the contextually right class of paracompact spaces. Particularly to be observed are parallels of high degrees of precision with the classic Alexandroff-Urysohn metrization theorem, the Nagata-Smirnov theorem, and -- see Abstract 648-188, these Notices 14 (1967), 687 -- the signal metrization theorem of Arhangel'skii. Furthermore, the Čech complete paracompact spaces admit of characterization as the paracompact $\mu$-complete spaces, a theorem with various prototypes. Certain of the theorems, applied to the special situation of metrization, improve nontrivially on the classic results. (This work was supported by the United States Atomic Energy Commission.) (Received September 26, 1967.)

Open continuous mappings of $p$-spaces.

The spaces under consideration here are assumed to have $T_2$-bicompactifications. An aim is to delineate further the extent of the parallel character of the $\mu$-space and base of countable order concepts, in such a way as to indicate something of the bearing of the latter topic on that of bicompactification. Theorem 1. Any inductively open continuous (uniformly $\mu$-complete inductively open continuous) image of a $\mu$-space is an open continuous (uniformly $\mu$-complete open continuous) image of a $T_2$ paracompact $p$-space of identical weight. Theorem 2. Any $\mu$-space which can be thrown continuously onto a complete $\mu$-space by a uniformly $\mu$-complete open mapping is $\mu$-complete. Theorem 3. Every $\mu$-complete space is an open continuous image of a paracompact Čech complete space of the same weight. Remarks. A definition of $\mu$-space has been presented to the Society (see Abstract 648-188, these Notices 14 (1967), 687). Complete $\mu$-space and uniformly $\mu$-complete mapping are defined with respect to Stone-Čech bicompactifications, and involve generalizations of Čech's concept of topological completeness. The spaces of Abstract 66T-411, these Notices 13 (1966), 644 are complete $\mu$-spaces. (This work was supported by the United States Atomic Energy Commission.) (Received September 26, 1967.)

On powers of groups and related questions.

Call $G$ the $t^*$-product of normal subgroups $M$ and $N$ if there is a system $T$ of generators for $G$ such that orders of elements in $T \mod M$ and $T \mod N$ are mutually prime. If $G^m$ denotes the group generated by the powers $g^m$ and $G_m$ the group generated by all solutions $x \in G$ of $x^m = 1$, then $G^{[m,n]}$ is the $t^*$-product of $G^m$ and $G^n$, and $G^{[m,n]}$ is the $t^*$-product of $G_m$ and $G_n$. Theorem. Let $|f(p)|$ be a system of formations such that for all $p$ the $t^*$-product of groups in $f(p)$ belongs to $f(p)$. If $F$ denotes
the formation locally defined by the system $f(p)$, then $t^*$-products of $F$-groups belong to $F$. Corollary. If $F$ is a saturated formation such that $G/F(G)$ is nilpotent for all $F$-groups $G$, then $t^*$-products of $F$-groups belong to $F$. (Received September 26, 1967.)


A homogeneous quadratic ring $R$ is a quadratic ring (Abstract 67T-351, these Notices 14 (1967), 523) in which multiplication is linear homogeneous. With respect to its invariant set $X$, $R$ is a linear algebra. The inner product $(z_1, z_2) = (1/2)(z_1z_2 + z_2z_1)$, is symmetric and linear homogeneous. If the conjugate operation $T$ of $R$ preserves sums, the distributive laws hold and $(z_1, z_2) = (1/2)[N(z_1 + z_2) - N(z_1) - N(z_2)]$. The outer product $z_1 \times z_2 = (1/2)(z_1z_2 - z_2z_1)$ is linear homogeneous and obeys the distributive laws. A quadratic ring $R$ whose conjugate operation $T$ preserves sums admits a direct involutorial automorphism iff $z_1 \times z_2 = z_1 \times z_2$; it admits a reverse involutorial automorphism iff $z_1 \times z_2 = -z_1 \times z_2$. If $T$ preserves sums and $R$ is homogeneous, then $R$ possesses the translation property of the norm iff $N(z_1z_2) - N(z_1)N(z_2) = N(v_1v_2) - N(v_1)N(v_2)$. If $T$ preserves sums and $R$ is homogeneous, then $R$ possesses the translation property iff (a) $v_1v_2 = -v_1v_2$ and $(v_1, v_1 \times v_2) = 0$, for every two pure elements, or (b) $z_1 \times z_2 = -z_1 \times z_2$ and $v_1(v_1 \times v_2) = -(v_1 \times v_2)v_1$, for $z_1 = x_1 + v_1, z_2 = x_2 + v_2$. A homogeneous quadratic ring $R$ with a direct involutorial automorphism possesses the translation property iff it is commutative. If $R$ has a reverse involutorial automorphism, it has the translation property iff $v_1(v_1 \times v_2) = -(v_1 \times v_2)v_1$ for pure elements $v_1$ and $v_2$. (Received September 25, 1967.)

67T-698. DAG BELSNES and STAL AANDERAA, University of Oslo, Oslo 3, Norway. Decision problems for tag systems.

Theorem. Given any recursive predicate $R(x, y, z)$, there are effective procedures for constructing tag systems $T_z$, words $w_x$ and integers $u_{z,w}$ such that (1) $(\forall y) R(x, y, z)$ is true iff the word $w_x$ is immortal in the tag system $T_z$ (i.e. $T_z$ starting operation on $w_x$ will never terminate) and (2) the word $w$ in $T_z$ is immortal iff $u_{z,w} \neq 0$ and $(\forall y) R(u_{z,w} - 1, y, z)$ is true. Corollary I. The immortality problem (the unrestricted halting problem) for tag systems is recursively undecidable of degree $0^\text{"}$. Corollary II. For each recursively enumerable degree $d$, there is a tag system whose halting problem (word problem) is of degree $d$. The theorem and the corollaries also hold for lag system, monogenic Post normal systems, SS machines and Markov algorithms. This solves some open problems stated by Hooper in J. Symbolic Logic (2) 31 (1966), 219-234. (Received September 25, 1967.)
67T-699. R. W. CHANEY, University of California, Santa Barbara, California 93106. Sets in discrete abelian groups which support Fourier-Stieltjes transforms only of absolutely continuous measures.

Let $G$ be an infinite compact abelian group and let $\Gamma$ be the character group of $G$. A subset $E$ of $\Gamma$ is an AC set in case every Radon measure on $G$ whose Fourier-Stieltjes transform vanishes off $E$ is an absolutely continuous measure. If $A \subseteq \Gamma$, a trigonometric polynomial $p$ on $G$ is an $A$-polynomial if $\hat{p}$ vanishes off $A$. These statements about a subset $E$ of $\Gamma$ are equivalent: (i) $E$ is an AC set; (ii) if $|p_n|$ is a uniformly bounded sequence of trigonometric polynomials on $G$ which converges in $L_1$-norm to 0 then there are a sequence $|g_m|$ of finite averages far out in $|p_n|$ and a sequence $|h_m|$ of $E'$-polynomials ($E'$ is the complement of $E$) such that $|g_m + h_m|$ converges to 0 uniformly on $G$.

This result leads to other equivalents of (i); these other statements all involve the quotient map from the space $C(G)$ of continuous functions on $G$ onto a certain quotient space of $C(G)$. Also presented are examples of sets which are not AC sets and examples of infinite sets which are AC sets. (Received September 25, 1967.)

67T-700. DAG BELSNES, University of Oslo, Oslo 3, Norway. The immortality problem for nonerasing Turing machines.

Consider the immortality problem for nonerasing Turing machines (see Hooper, J. Symbolic Logic (2) 31 (1966), 219-234). Three cases arise whether (a) the tape can contain any infinite word, (b) the tape can contain any ultimately periodic word, or (c) the tape has to contain at every moment only a finite number of nonblanks. In case (a) and (b), a uniform algorithm is found which for any given nonerasing Turing machine $M$, produces an instantaneous description (ID) corresponding to an ultimately periodic word on which $M$ never halts, or if no immortal ID exists, the algorithm tells so. In case (c) the theorem and the corollaries stated in Abstract 67T-698 hold for nonerasing Turing machines. (Received September 25, 1967.)


The maximum of an arbitrary linear fractional function over a parallelopiped is determined explicitly in terms of the general parameters involved. (Received September 26, 1967.)

Line 11: "... all the instances..." should read "... last two instances..."


The title of the abstract should read "Generalized paths".

Lines 8 and 9 should read "... with \( \sigma^{-1}(1) < ... < \sigma^{-1}(r), \sigma^{-1}(r + 1) < ... < \sigma^{-1}(r + s) \).

Instead of "... with \( \sigma(1) < ... < \sigma(r), \sigma(r + 1) < ... < \sigma(r + s) \)."


Line 4: "If a medial semigroup..." should read "If a medial archimedian semigroup..."


Lines 2 and 3: Replace "\( H(a) = (1 - 2a)(\pi/2) - \arctan(\pi/2) \)\( (1 - a/a)^{1/2} / (4a(1 - a))^{1/2} \)" by "\( H(a) = (1 - 2a)(\theta_0 - \arctan(\pi/2) \)\( (1 - a/a)^{1/2} / (4a(1 - a))^{1/2} \)".

Line 8: Replace "\( u = 0 \mid r^{\delta - \epsilon} \)" by "\( u = 0 \mid r^{\delta - \epsilon} \)".


Line 8: Theorem 4 should read "If \( T(S) \) is a lattice then S is a chain and if S is a lower complete chain then \( T(S) \) is a lattice.


Line 8: Replace "\( (S)^{\delta} \)" by "\( (S)^{\delta} \)".
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3. Frequency of issue: Eight issues per year
4. Location of known offices of publication: P.O. Box 6248, Providence, R. I. 02904
5. Location of the headquarters or general business offices of the publishers: P.O. Box 6248, Providence, R. I. 02904
6. Names and addresses of publisher, editor, and managing editor:
   Publisher: American Mathematical Society, P.O. Box 6248, Providence, R. I. 02904
   Editors: Everett Pitcher and Gordon L. Walker, P.O. Box 6248, Providence, R. I. 02904
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