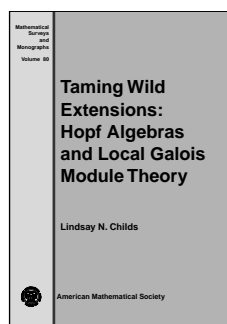# New Publications Offered by the AMS

Algebra and Algebraic Geometry

Taming Wild Extensions: Hopf Algebras and Local Galois Module Theory

Lindsay N. Childs, *State University of New York at Albany*

This book studies Hopf algebras over valuation rings of local fields and their application to the theory of wildly ramified extensions of local fields. The results, not previously published in book form, show that Hopf algebras play a natural role in local Galois module theory.

Included in this work are expositions of short exact sequences of Hopf algebras; Hopf Galois structures on separable field extensions; a generalization of Noether's theorem on the Galois module structure of tamely ramified extensions of local fields to wild extensions acted on by Hopf algebras; connections between tameness and being Galois for algebras acted on by a Hopf algebra; constructions by Larson and Greither of Hopf orders over valuation rings; ramification criteria of Byott and Greither for the associated order of the valuation ring of an extension of local fields to be Hopf order; the Galois module structure of wildly ramified cyclic extensions of local fields of degree p and p^2; and Kummer theory of formal groups.

Contents: Introduction; Hopf algebras and Galois extensions; Hopf Galois structures on separable field extensions; Tame extensions and Noether's theorem; Hopf algebras of rank p; Larson orders; Cyclic extensions of degree p; Non-maximal orders; Ramification restrictions; Hopf algebras of rank p^2; Cyclic Hopf Galois extensions of degree p^2; Formal groups; Principal homogeneous spaces and formal groups; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 80

July 2000, 215 pages, Hardcover, ISBN 0-8218-2131-8, LC 00-029301, 2000 *Mathematics Subject Classification*: 11R33; 11S15, 11S31, 12F10, 14L05, 14L15, 16W30, **Individual member $32**, List $54, Institutional member $43, Order code SURV/80N
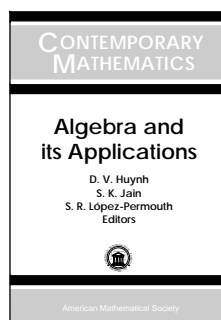
Algebra and Its Applications

D. V. Huynh, **S. K. Jain**, and **S. R. López-Permouth**, *Ohio University, Athens*, Editors

Among all areas of mathematics, algebra is one of the best suited to find applications within the frame of our booming technological society. The thirty-eight articles in this volume encompass the proceedings of the International Conference on Algebra and Its Applications (Athens, OH, 1999), which explored the applications and interplay among the disciplines of ring theory, linear algebra, and coding theory.

The presentations collected here reflect the dialogue between mathematicians involved in theoretical aspects of algebra and mathematicians involved in solving problems where state-of-the-art research tools may be used and applied.

This Contemporary Mathematics series volume communicates the potential for collaboration among those interested in exploring the wealth of applications for abstract algebra in fields such as information and coding. The expository papers would serve well as supplemental reading in graduate seminars.

Contents: G. Abrams and **J. J. Simón**, Isomorphisms between infinite matrix rings: A survey; **T. Albu** and **M. L. Teply**, The double infinite chain condition and generalized deviations of posets and modules; **R. B. Bapat** and **D. M. Kulkarni**, Minors of some matrices associated with a tree; **G. F. Birkenmeier**, **J. Y. Kim**, and **J. K. Park**, On quasi-Baer rings; **M. Brešar**, Functional identities: A survey; **G. Brookfield**, The Grothendieck group and the extensional structure of Noetherian module categories; **J. Dauns** and **Y. Zhou**, Some non-classical finiteness conditions of modules; **G. D'Este**, Free modules obtained by means of infinite direct products; **E. E. Enochs** and **O. M. G. Jenda**, Gorenstein injective, projective, and flat dimensions over Cohen-Macaulay rings; **A. Facchini** and **D. Herbera**, Projective modules over semilocal rings; **S. M. Fallat** and **C. R. Johnson**, Determinantal inequalities: Ancient history and recent advances; **K. R. Fuller**, Ring extensions and duality; **J. L. García** and **L. Marín**, Some properties of tensor-idempotent rings; **K. R. Goodearl** and **J. T. Stafford**, The graded version of Goldie's theorem; **M. Greferath**, On Artinian and Noetherian projective lattice geometries; **B. Huisgen-Zimmermann**, The phantom menace in representation theory; **L. Kadison** and **A. A. Stolin**, Separability and Hopf algebras;

P. Kanwar, Quadratic residue codes over the integers modulo q^m; **D. Keskin**, Characterizations of right perfect rings by ⊕-supplemented modules; **P. Körtesi** and **J. Szigeti**, The adjacency matrix of a directed graph over the Grassmann algebra; **L. A. Kurdachenko** and **I. Ya. Subbotin**, On Artinian modules over hyperfinite groups; **T. Y. Lam** and **A. Leroy**, Principal one-sided ideals in Ore polynomial rings; **L. S. Levy**, Modules over hereditary Noetherian prime rings (Survey); **A. Li**, Prime elements of birational extensions of a Noetherian UFD; **C. Lomp**, On the splitting of the dual Goldie torsion theory; **J. J. McDonald** and **M. Neumann**, The Soules approach to the inverse eigenvalue problem for nonnegative symmetric matrices of order $n \le 5$; **C. J. Moreno**, Harmonic analysis on finite rings and applications; **B. L. Osofsky**, A lattice invariant for modules, II; **A. Ç. Özcan**, Modules having *-radical; **C. J. Pappacena**, The "generalized class group" of a left Noetherian ring; **J. L. Gómez Pardo** and **P. A. Guil Asensio**, Indecomposable decompositions of ℵ-Σ-CS-modules; **L. H. Rowen** and **Y. Segev**, The multiplicative group of a division algebra of degree 5 and Wedderburn's factorization theorem; **C. Santa-Clara** and **P. F. Smith**, Modules which are self-injective relative to closed submodules; **I. Siap** and **D. K. Ray-Chaudhuri**, On r-fold complete weight enumerators of r linear codes; **A. I. Singh** and **M. A. Swardson**, Levels of quotient rings of rings of continuous functions; **P. F. Smith**, Commutative domains whose finitely generated projective modules have an injectivity property; **R. Wisbauer**, Decompositions of modules and comodules; **J. M. Zelmanowitz**, Density for polyform modules.

Contemporary Mathematics

September 2000, approximately 554 pages, Softcover, ISBN 0-8218-1950-X, 2000 *Mathematics Subject Classification*: 15–XX, 16–XX, 94–XX, **Individual member $65**, List $109, Institutional member $87, Order code CONM-JAINN
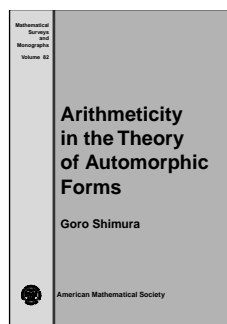
Arithmeticity in the Theory of Automorphic Forms

Goro Shimura, *Princeton University, NJ*

The main objects of study in this book are Eisenstein series and zeta functions associated with Hecke eigenforms on symplectic and unitary groups. After preliminaries—including a section, "Notation and Terminology"—the first part of the book deals with automorphic forms on such groups. In particular, their rationality over a number field is defined and discussed in connection with the group action; also the reciprocity-law for the values of automorphic functions at CM-points is proved. Next, certain differential operators that raise the weight are investigated in higher dimension. The notion of nearly holomorphic functions is introduced, and their arithmeticity is defined. As applications of these, the arithmeticity of the critical values of zeta functions and Eisenstein series is proved.

Though the arithmeticity is given as the ultimate main result, the book discusses many basic problems that arise in number-theoretical investigations of automorphic forms but that cannot be found in expository forms. Examples of this include the space of automorphic forms spanned by cusp forms and certain Eisenstein series, transformation formulas of theta

series, estimate of the Fourier coefficients of modular forms, and modular forms of half-integral weight. All these are treated in higher-dimensional cases. The volume concludes with an Appendix and an Index.

This item will also be of interest to those working in number theory.

Contents: Introduction; Automorphic forms and families of abelian varieties; Arithmeticity of automorphic forms; Arithmetic of differential operators and nearly holomorphic functions; Eisenstein series of simpler types; Zeta functions associated with Hecke eigenforms; Analytic continuation and near holomorphy of Eisenstein series of general types; Arithmeticity of the critical values of zeta functions and Eisenstein series of general types; Appendix; References; Index.

Mathematical Surveys and Monographs, Volume 82

August 2000, 302 pages, Hardcover, ISBN 0-8218-2671-9, LC 00-032273, 2000 *Mathematics Subject Classification*: 11Fxx, 14K22, 14K25, 32Nxx, 32A99, 32W99, **Individual member $41**, List $69, Institutional member $55, Order code SURV/82N
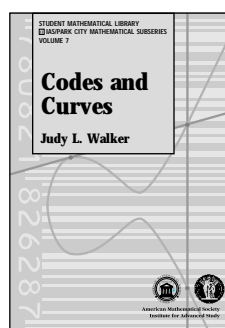
Codes and Curves

Judy L. Walker, *University of Nebraska, Lincoln*

When information is transmitted, errors are likely to occur. This problem has become increasingly important as tremendous amounts of information are transferred electronically every day. Coding theory examines efficient ways of packaging data so that these errors can be detected, or even corrected.

The traditional tools of coding theory have come from combinatorics and group theory. Since the work of Goppa in the late 1970s, however, coding theorists have added techniques from algebraic geometry to their toolboxes. In particular, by re-interpreting the Reed-Solomon codes as coming from evaluating functions associated to divisors on the projective line, one can see how to define new codes based on other divisors or on other algebraic curves. For instance, using modular curves over finite fields, Tsfasman, Vladut, and Zink showed that one can define a sequence of codes with asymptotically better parameters than any previously known codes.

This monograph is based on a series of lectures the author gave as part of the IAS/PCMI program on arithmetic algebraic geometry. Here, the reader is introduced to the exciting field of algebraic geometric coding theory. Presenting the material in the same conversational tone of the lectures, the author covers linear codes, including cyclic codes, and both bounds and asymptotic bounds on the parameters of codes. Algebraic geometry is introduced, with particular attention given to projective curves, rational functions and divisors. The construction of algebraic geometric codes is given, and the Tsfasman-Vladut-Zink result mentioned above is discussed.

No previous experience in coding theory or algebraic geometry is required. Some familiarity with abstract algebra, in particular finite fields, is assumed. However, this material is reviewed in two appendices. There is also an appendix containing projects that explore other codes not covered in the main text.

Contents: Introduction to coding theory; Bounds on codes; Algebraic curves; Nonsingularity and the genus; Points, functions, and divisors on curves; Algebraic geometry codes; Good codes from algebraic geometry; Abstract algebra review; Finite fields; Projects; Bibliography.

Student Mathematical Library, Volume 7

July 2000, 66 pages, Softcover, ISBN 0-8218-2628-X, LC 00-038112, 2000 *Mathematics Subject Classification*: 11T71, 94B27; 11D45, 11G20, 14H50, 94B05, 94B65, **All AMS members $12**, List $15, Order code STML/7N

Analysis
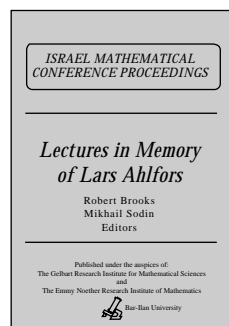
Lectures in Memory of Lars Ahlfors

Robert Brooks, *Technion— Israel Institute of Technology, Haifa, Israel*, and **Mikhail Sodin**, *Tel Aviv University, Israel*, Editors

A publication of Bar-Ilan University.

This book presents lectures given by leading specialists on the work of Lars Ahlfors. It comprises an overview of his essential contributions to complex analysis. Written from a modern perspective in contemporary language, this volume bridges the gap between Ahlfors's achievements and today's developments. It offers a good introduction for the researcher and for others who would like to learn more about this area of mathematics.

Distributed worldwide by the AMS.

Contents: R. Brooks, Lars Ahlfors (1907–1996); **W. Abikoff**, Geometric finiteness and rigidity of Kleinian groups; **R. Brooks**, Some geometric aspects of the work of Lars Ahlfors; **A. Eremenko**, Ahlfors' contribution to the theory of meromorphic functions; **H. M. Farkas**, Weierstrass points and the theta divisor; **S. L. Krushkal**, Spaces of Riemann surfaces; **M. Sodin**, Lars Ahlfors' thesis; **U. Srebro**, Extremal lengths and quasiconformal maps.

Israel Mathematical Conference Proceedings, Volume 14

July 2000, 158 pages, Softcover, 2000 *Mathematics Subject Classification*: 14H55, 30C65, 30C85, 30D15, 30D35, 30F45, 30F60, **Individual member $42**, List $70, Institutional member $56, Order code IMCP/14N
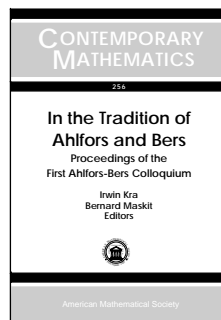
In the Tradition of Ahlfors and Bers
Proceedings of the First Ahlfors-Bers Colloquium

Irwin Kra and **Bernard Maskit**, *State University of New York at Stony Brook*, Editors

The papers in this collection were presented at the First Ahlfors-Bers Colloquium—a conference held in the tradition of Lars Ahlfors and Lipman Bers. These conferences have been perpetuated to honor and carry on their work in the field of complex analysis, which so influenced their students, colleagues, and a new generation of mathematicians.

The papers cover complex analysis, Riemann surfaces, Teichmüller theory and hyperbolic manifolds: most of the works include original contributions to the field, and others survey various aspects of the field, including papers by Lennart Carleson, Clifford Earle, and Dennis Hejhal on the contributions of Lars Ahlfors.

Contents: A. Basmajian, Quasiconformal mappings and geodesics in the hyperbolic plane; **L. Carleson**, Lars Ahlfors and the Painlevé problem; **C. J. Earle**, The Ahlfors mollifiers; **C. J. Earle**, **F. P. Gardiner**, and **N. Lakic**, Asymptotic Teichmüller space, Part I: The complex structure; **C. J. Earle** and **S. Mitra**, Variation of moduli under holomorphic motions; **A. L. Epstein**, Effectiveness of Teichmüller modular groups; **H. M. Farkas** and **I. Kra**, Special sets of points on compact Riemann surfaces; **H. M. Farkas** and **I. Kra**, Three term theta identities; **D. M. Gallo**, Some remarks on the monodromy map; **F. P. Gardiner** and **L. Keen**, Coverings of Cantor sets; **F. P. Gardiner** and **N. Lakic**, Local boundary dilatation; **F. W. Gehring** and **K. Hag**, The Apollonian metric and quasiconformal mappings; **J. Gilman**, Complexity of a Turing machine discreteness algorithm; **D. A. Hejhal**, Kernel functions, Poincaré series, and LVA; **J. Huisman**, On components of spaces of $PSL_2(\mathbb{C})$-representations of extended quasifuchsian groups; **T. Jorgensen**, Composition and length of hyperbolic motions; **F. Luo**, Automorphisms of Thurston's space of measured laminations; **B. Maskit**, On spaces of classical Schottky groups; **H. A. Masur** and **Y. N. Minsky**, Unstable quasi-geodesics in Teichmüller space; **K. Matsuzaki**, Convergence of the Hausdorff dimension of the limit sets of Kleinian groups; **R. Riley**, Nielsen's algorithm to decide whether a group is Fuchsian; **H. Sato**, One-parameter families of extreme discrete groups for Jørgensen's inequality; **S. A. Wolpert**, Automorphic coefficient sums and the quantum ergodicity question.

Contemporary Mathematics, Volume 256

June 2000, 296 pages, Softcover, ISBN 0-8218-1371-4, LC 00-035574, 2000 *Mathematics Subject Classification*: 30–06; 11F12, 30C62, 30C70, 30F35, 30F40, 30F60, 32G15, 57M50, **Individual member $39**, List $65, Institutional member $52, Order code CONM/256N
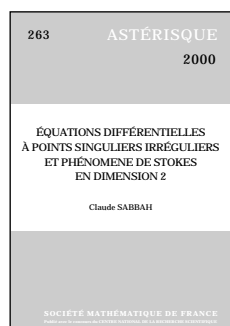
Équations Différentielles à Points Singuliers Irréguliers et Phénomène de Stokes en Dimension 2

Claude Sabbah, *Ecole Polytechnique, Palaiseau, France*

A publication of Société Mathématique de France.

The asymptotic theory of holomorphic linear differential equations of one variable is well understood and has recently been renewed by the theory of multisummation. However, the asymptotic theory of holonomic differential systems of many complex variables is still not completely developed. This volume tries to fill the gap by introducing the fundamental notions and by showing some consequences of such a theory.

The notion of a good formal structure for a meromorphic vector bundle with a flat connection on a complex analytic surface is introduced. The existence of such a good formal structure on the pull-back by a suitable sequence of complex blowing-up of a meromorphic connection is conjectured. Some consequences of this conjecture are given: semi-continuity of the Malgrange-Komatsu irregularity index for an integrable family of meromorphic connections on a complex curve, and the construction and some properties of the Stokes fibration. The proof of the conjecture is given, among others, for bundles of rank ≤ 5.

The existence of a lifting of a good formal structure at the level of asymptotic expansions in bisectors is also shown. Applications are given to complex conjugation of holonomic $\mathcal{D}$-modules. The text is in French.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; I. Structure formelle des connexions méromorphes; II. Structure analytique des connexions méromorphes; III. Bonne structure formelle après éclatements; Appendice; Bibliographie; Index.

Astérisque, Number 263

February 2000, 190 pages, Softcover, ISBN 2-85629-085-X, 2000 *Mathematics Subject Classification*: 32C38, 35A20, 35A27, **Individual member $50**, List $55, Order code AST/263N
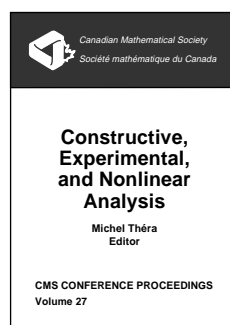
Constructive, Experimental, and Nonlinear Analysis

Michel Théra, *University of Limoges, France*, Editor

This volume presents twenty original refereed papers on different aspects of modern analysis, including analytic and computational number theory, symbolic and numerical computation, theoretical and computational optimization, and recent development in nonsmooth and functional analysis with applications to control theory. These papers originated largely from a conference held in conjunction with a 1999 Doctorate Honoris Causa awarded to Jonathan Borwein at Limoges. In addition to providing a snapshot of research in the field of modern analysis, the papers suggest some of the directions this research is following at the beginning of the millennium.

Contents: **H. H. Bauschke**, **F. Deutsch**, **H. Hundal**, and **S.-H. Park**, Fejér monotonicity and weak convergence of an accelerated method of projections; **J. Benoist** and **J.-B. Hiriart-Urruty**, General "squeeze theorems" in nonsmooth analysis; **B. C. Berndt** and **D. C. Bowman**, Ramanujan's short unpublished manuscript on integrals and series related to Euler's constant; **P. Borwein**, An efficient algorithm for the Riemann zeta function; **E. B. Burger** and **A. J. van der Poorten**, On periods of elements from real quadratic number fields; **R. Deville** and **C. Finet**, Vector-valued perturbed minimization principles; **P. Flajolet** and **B. Vallée**, Continued fractions, comparison algorithms, and fine structure constants; **M. Gabour**, **S. Reich**, and **A. J. Zaslavski**, A class of dynamical systems with a convex Lyapunov function; **M. Geoffroy** and **M. Lassonde**, On a convergence of lower semicontinuous functions linked with the graph convergence of their subdifferentials; **J. R. Giles** and **J. D. Vanderwerff**, Rotundity related to Lipschitz separation; **A. Ioffe**, Codirectional compactness, metric regularity and subdifferential calculus; **V. Jeyakumar** and **M. J. Nealon**, Complete dual characterizations of optimality for convex semidefinite programming; **A. Jofré**, A second-welfare theorem in nonconvex economies; **A. Kaplan** and **R. Tichatschke**, Auxiliary problem principle and the approximation of variational inequalities with non-symmetric multi-valued operators; **J. Maeght**, **D. Noll**, and **S. Boyd**, Dynamic emission tomography–Regularization and inversion; **J. E. Martinez-Legaz** and **I. Singer**, Semi-spaces and bases of convexity systems in complete lattices; **B. S. Mordukhovich** and **B. Wang**, On variational characterizations of Asplund spaces; **J.-P. Penot**, Transposition of relations; **B. Ricceri**, On a classical existence theorem for nonlinear elliptic equations; **L. Thibault**, Limiting convex subdifferential calculus with applications to integration and maximal monotonicity of subdifferential.

Conference Proceedings, Canadian Mathematical Society, Volume 27

July 2000, approximately 302 pages, Softcover, ISBN 0-8218-2167-9, LC 00-038997, 2000 *Mathematics Subject Classification*: 11Y16, 11J70, 11Y65, 35J20, 41A65, 44A12, 46B20, 47A15, 49J52, 49K15, 49K24, 58C20, 65K10, 90C25, 90C48, **Individual member $42**, List $70, Institutional member $56, Order code CMSAMS/27N
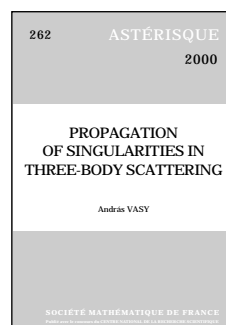
Propagation of Singularities in Three-Body Scattering

András Vasy, *University of California, Berkeley*

A publication of Société Mathématique de France.

The author considers a compact manifold with boundary X equipped with a scattering metric g and with a collection C_i of disjoint closed embedded submanifolds of ∂X. Let Δ be the (positive) Laplacian of g, V a C^∞ function on X satisfying certain conditions on ∂V.

Continued

He analyzes the propagation of singularities of generalized eigenfunctions of $H = \Delta + V$, showing that this is essentially a hyperbolic problem which has much in common with the Dirichlet and transmission problems for the wave operator, though additional features arise due to the presence of bound states of the 'two-body operators'.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Differential operators; Definition of the three-body scattering calculus; Restriction to the boundary; Composition of operators; The normal operator; Commutators; Mapping properties; Wavefront set; Functional calculus; The Hamiltonian; The Mourre estimate; The basic commutator estimate; Propagation of singularities in normal directions; Propagation of singularities in tangential directions; Bound states with strictly negative energy; Radial sets; The resolvent; The scattering matrix; Construction of plane waves near the initial point; Absence of positive eigenvalues; Positive operators; Bibliography.

Astérisque, Number 262

February 2000, 151 pages, Softcover, ISBN 2-85629-082-5, 2000 *Mathematics Subject Classification*: 35P25, 81U10, 58J50, **Individual member $30**, List $33, Order code AST/262N

Applications
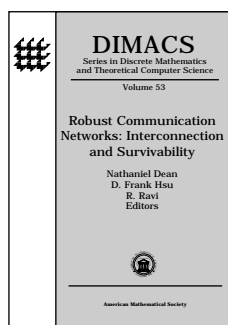
Robust Communication Networks: Interconnection and Survivability

Nathaniel Dean, *Rice University, Houston, TX*, **D. Frank Hsu**, *Fordham University, Bronx, NY*, and **R. Ravi**, *Carnegie Mellon University, Pittsburgh, PA*, Editors
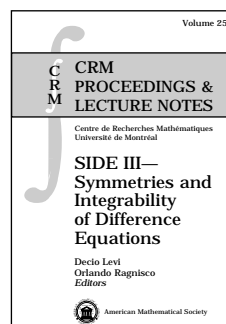
This volume contains the proceedings of a DIMACS Workshop on Robust Communication Networks held as part of the Special Year on Networks. Theoreticians and practitioners presented papers on the roles of architectural interconnection and survivability in the design, construction, operation, and application of robust communication networks. Due to the advent of VSLI and fiber optics technologies, it has become possible and feasible to design and construct large scale, high performance, high speed wireline and wireless communication networks that are also robust. This opens many challenging issues and problems for both the theory community and practitioners. Of particular interest is how these technological advances lead the way to new and challenging mathematical frontiers and set the direction for future research on and implementation of robust communication networks. The nine papers chosen for this volume represent the state of the art from a variety of perspectives.

Contents: **A. Bley**, **M. Grötschel**, and **R. Wessäly**, Design of broadband virtual private networks: Model and heuristics for the B-WiN; **J. Cohen**, **P. Fraigniaud**, and **M. Mitjana**, Minimal contention-free matrices with application to multicasting; **S. K. Das**, **S. R. Öhring**, and **M. Ibel**, Communication aspects of fat-tree-based interconnection networks for multicomputers; **L. Gao**, **B. Li**, and **F. Chen**, Optimal placement of repair servers for reliable multicast; **P. Krishnan**, **D. Raz**, and **Y. Shavitt**, Transparent en-route cache location for regular networks; **Y. Mansour** and **D. Peleg**, An approximation algorithm for minimum-cost network design; **Y. Yang**, Nonblocking and almost nonblocking multicast switching networks; **S. Q. Zheng**, Constructing optical networks using combinatorial designs; **S. G. Ziavras** and **Q. Wang**, Robust interprocessor connections for very-high performance.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 53

July 2000, 167 pages, Hardcover, ISBN 0-8218-1546-6, LC 00-029958, 2000 *Mathematics Subject Classification*: 68–06, 68M10, 68M12, 68M14, 68M15, 68R05, 68R10, 68W10, 68W15, 68W20, **Individual member $23**, List $39, Institutional member $31, Order code DIMACS/53N

Differential Equations

SIDE III—Symmetries and Integrability of Difference Equations

Decio Levi, *University of Rome I, Italy*, and **Orlando Ragnisco**, *University of Rome III, Italy*, Editors

This volume contains the proceedings of the third meeting on "Symmetries and Integrability of Difference Equations" (SIDE III). The collection includes original results not published elsewhere and articles that give a rigorous but concise overview of their subject, and provides a complete description of the state of the art. Research in the field of difference equations—often referred to more generally as discrete systems—has undergone impressive development in recent years. In this collection the reader finds the most important new developments in a number of areas, including: Lie-type symmetries of differential-difference and difference-difference equations, integrability of fully discrete systems such as cellular automata, the connection between integrability and discrete geometry, the isomonodromy approach to discrete spectral problems and related discrete Painlevé equations, difference and q-difference equations and orthogonal polynomials, difference equations and quantum groups, and integrability and chaos in discrete-time dynamical systems.

The proceedings will be valuable to mathematicians and theoretical physicists interested in the mathematical aspects and/or in the physical applications of discrete nonlinear dynamics, with special emphasis on the systems that can be integrated by analytic methods or at least admit special explicit solutions. The research in this volume will also be of interest to engineers working in discrete dynamics as well as to theoretical biologists and economists.

This item will also be of interest to those working in mathematical physics.

Contents: M. S. Alber, R. Camassa, and M. Gekhtman, Billiard weak solutions of nonlinear PDE's and Toda flows; N. M. Atakishiyev, Fourier-Gauss transforms of some q-spectral functions; M. Błaszak and A. Szum, Integrable differential-difference systems in $(2 + 1)$-dimensions and their Hamiltonian structure; L. V. Bogdanov and B. G. Konopelchenko, Möbius invariant integrable lattice equations associated with the generalized KP hierarchy; M. Boiti, F. Pempinelli, A. K. Pogrebkov, and B. Prinari, Wave soliton solutions on a generic background for KPI equation; C. Brezinski, Difference and differential equations and convergence acceleration algorithms; A. S. Cârstea, On the dynamics of rational solutions for 1-D Volterra system; C. Cresswell, Monodromy data for the discrete first Painlevé hierarchy; G. Dattoli, Differential identities, generalized polynomials and applications in physics and mathematics; A. Doliwa, Lattice geometry of the Hirota equation; A. Doliwa and P. M. Santini, Integrable discrete geometry: The quadrilateral lattice, its transformations and reductions; J. C. Eilbeck, V. Z. Enolskii, and D. V. Leykin, On the Kleinian construction of abelian functions of canonical algebraic curves; P. G. Estévez and P. A. Clarkson, Discrete equations and the singular manifold method; Yu. Fedorov, Discrete versions of some algebraic integrable systems related to generalized Jacobians; M. L. Gandarias, New potential symmetries; D. G. Oteiza, S. Lafortune, and P. Winternitz, Symmetry classification of systems of differential-difference equations; I. T. Habibullin and A. N. Vil'danov, Integrable boundary conditions for nonlinear lattices; J. Harnad and J. McKay, Modular invariants and generalized Halphen systems; R. H. Heredero, D. Levi, and P. Winternitz, Symmetry preserving discretization of the Burgers equation; J. Hietarinta and C. Viallet, Singularity confinement and degree growth; R. Hirota and M. Iwao, Time-discretization of soliton equations; A. N. W. Hone, V. B. Kuznetsov, and O. Ragnisco, Bäcklund transformations for the Hénon-Heiles and Garnier systems; N. Joshi, Irregular singular behaviour in the first discrete Painlevé equation; N. A. Kudryashov and A. Pickering, Rational and special solutions of the P_{II} hierarchy; S. Lafortune, B. Grammaticos, and A. Ramani, Linearisable systems and the Gambier approach; W. Lay, Difference equations of Poincaré-Perron type and central two-point connection problems; I. Loutsenko and V. Spiridonov, Self-similarity in spectral problems and q-special functions; L. Martina, Lie point symmetries of discrete and continual $SU(\infty)$ Toda field theory; K.-i. Maruno, K. Kajiwara, and M. Oikawa, A note on integrable systems related to discrete time Toda lattice; T. Miwa and Y. Takeyama, The integral formula for the solutions of the quantum Knizhnik-Zamolodchikov equation associated with $U_q(\hat{sl}_n)$ for $|q| = 1$; L. M. Nieto, J. Negro, F. J. Herranz, and A. Ballesteros, Symmetries of the discrete Schrödinger equation and its quantum deformations; Y. Ohta, Determinant and Pfaffian solutions for discrete soliton equations; V. G. Papageorgiou, Difference isomonodromy problems and discrete Painlevé equations; A. P. Protogenov and V. A. Verbus, Discrete equations of motion for A_{k-1} algebra; G. R. W. Quispel and D. Levi, Discrete Painlevé equations from nonisospectral soliton equations; A. Ramani, B. Grammaticos, and S. Lafortune, A study of the continuous and discrete Gambier systems; W. K. Schief and B. G. Konopelchenko, Discrete surfaces of revolution; M. Senthilvelan, Kac-Moody-Virasoro algebras and integrability of certain higher dimensional nonlinear evolutionary equations; A. Turbiner, Different faces of harmonic oscillator; W. Van Assche, Nonsymmetric linear difference equations for multiple orthogonal polynomials; V. L. Vereschagin, Asymptotics for solution to the Cauchy problem for Volterra lattice with step-like initial values; C. Viallet, Complexity and integrability.

CRM Proceedings & Lecture Notes, Volume 25

July 2000, 444 pages, Softcover, ISBN 0-8218-2128-8, LC 00-038087, 2000 *Mathematics Subject Classification*: 22Exx, 33–XX, 42Cxx, 39Axx, 53–XX, **Individual member $59**, List $99, Institutional member $79, Order code CRMP/25N
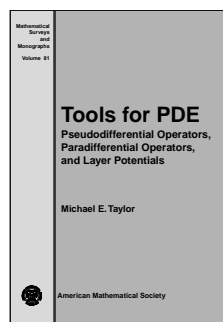
Tools for PDE
Pseudodifferential Operators, Paradifferential Operators, and Layer Potentials

Michael E. Taylor, *University of North Carolina, Chapel Hill*

This book develops three related tools that are useful in the analysis of partial differential equations (PDEs), arising from the classical study of singular integral operators: pseudodifferential operators, paradifferential operators, and layer potentials.

A theme running throughout the work is the treatment of PDE in the presence of relatively little regularity. The first chapter studies classes of pseudodifferential operators whose symbols have a limited degree of regularity; the second chapter shows how paradifferential operators yield sharp estimates on the action of various nonlinear operators on function spaces. The third chapter applies this material to an assortment of results in PDE, including regularity results for elliptic PDE with rough coefficients, planar fluid flows on rough domains, estimates on Riemannian manifolds given weak bounds on Ricci tensor, div-curl estimates, and results on propagation of singularities for wave equations with rough coefficients. The last chapter studies the method of layer potentials on Lipschitz domains, concentrating on applications to boundary problems for elliptic PDE with variable coefficients.

Michael Taylor is the author of several well-known books on topics in PDEs and pseudodifferential operators. His "Noncommutative Harmonic Analysis", Volume 22 in the Mathematical Surveys and Monographs series published by the AMS, is a good introduction to the use of Lie groups in linear analysis and PDEs.

The present book, *Tools for PDE*, is suitable as a text for advanced graduate students preparing to concentrate in PDE and/or harmonic analysis.

Contents: Pseudodifferential operators with mildly regular symbols; Paradifferential operators and nonlinear estimates; Applications to PDE; Layer potentials on Lipschitz surfaces; Bibliography; List of symbols; Index.

Mathematical Surveys and Monographs, Volume 81

August 2000, 257 pages, Hardcover, ISBN 0-8218-2633-6, LC 00-036248, 2000 *Mathematics Subject Classification*: 35S05, 35S50, 42B20, **All AMS members $47**, List $59, Order code SURV/81N

General and Interdisciplinary

The History of Mathematics from Antiquity to the Present: A Selective Annotated Bibliography, edited by Joseph W. Dauben

Revised Edition on CD-ROM edited by Albert C. Lewis, in cooperation with the International Commission on the History of Mathematics

Albert C. Lewis, *Purdue University, West Lafayette, IN*, Editor

Thirty-eight experts from ten countries have critically annotated a selection of the literature within their respective specialties in the history of mathematics. The result is a comprehensive guide designed as a starting point for anyone wishing to learn more about any area of the history of mathematics. The 4,800 entries are arranged by subject, and each includes full bibliographical information. Annotations and introductory notes provide evaluation and context to help a user decide where to go next.

As mathematics has had a long and rich history, the study of that history is broad ranging. This guide covers the history framed in all time periods and regions of the world beginning with the ancient Egyptian, Greek, Chinese, Islamic, Indian, African, and Mesopotamian civilizations. It focuses on the branches of mathematics but necessarily gives substantial attention to the relationship mathematics has had with navigation, mapmaking, logic, philosophy, computing, and all the branches of physics. It also devotes special sections to such topics as institutions, societies, women in mathematics, and how mathematics has been taught.

The success of the first edition in print showed the value of such a guide. It covered the literature up to 1982 and was published in 1985. This revised and updated edition, still very selective, has twice as many entries as the first, reflecting the enormous growth in the literature since that time. And the CD-ROM format makes navigating and searching the bibliography easier and faster.

The CD-ROM's content is in PDF format with bookmarks, enabling browsers to link from the table of contents directly to sections of interest. Links from the author and subject index items to individual entries enable users to go directly to specific items of interest. Adobe™Acrobat®Reader 4.0 with Search, provided for Macintosh®, Windows®, and UNIX®, makes it possible for users to search text throughout the CD using PDF: the search term is highlighted, and you can move from hit to hit across files. This edition is unique in that it also offers a listing of World Wide Web resources, and live links within the text to selected Web sites.

Overall, this revised edition of *The History of Mathematics from Antiquity to the Present: A Selective Annotated Bibliography* on CD-ROM now makes it easier for both browsers and researchers to locate and search for the extended number of cited works that have been selected and annotated for this bibliography.

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Contents: General reference works; Source materials; General histories of mathematics; The history of mathematics: Chronological periods; The history of mathematics: Sub-disciplines; The history of mathematics: Selected topics; Author index; Subject index.

July 2000, CD-ROM, ISBN 0-8218-0844-3, **All AMS members $39**, List $49, Order code HMAPN
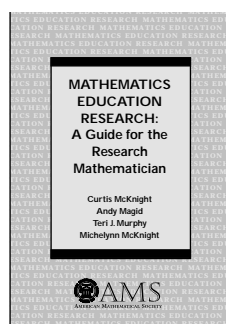
Mathematics Education Research: A Guide for the Research Mathematician

Curtis McKnight, **Andy Magid**, and **Teri J. Murphy**, *University of Oklahoma, Norman*, and **Michelynn McKnight**, *Norman, OK*

Mathematics education research in undergraduate mathematics has increased significantly in the last decade and shows no signs of abating in the near future. Thus far, this research has often been associated with innovations in curriculum such as calculus reform, statistics education, and the use of computational and graphing technology in instruction.

Carefully conducted mathematics education research is something far more fundamental and widely useful than might be implied by its use by advocates of innovation in undergraduate mathematics education. Most simply, mathematics education research is inquiry by carefully developed research methods aimed at providing evidence about the nature and relationships of many mathematics learning and teaching phenomena. It seeks to clarify the phenomena, illuminate them, explain how they are related to other phenomena, and explain how this may be related to undergraduate mathematics course organization and teaching.

This book—the collaborative effort of a research mathematician, mathematics education researchers who work in a research mathematics department and a professional librarian—introduces research mathematicians to education research. The work presents a non-jargon introduction for educational research, surveys the more commonly used research methods, along with their rationales and assumptions, and provides background and careful discussions to help research mathematicians read or listen to education research more critically.

This guide is of practical interest to university-based research mathematicians. It introduces the methodology of quantitative and qualitative research in education, provides critical guidelines for assessing the reliability and validity of mathematics education research, and explains how to use online database

resources to locate education research. The book will also be valuable to graduate students in mathematics who are planning academic careers, and to mathematics department chairs and their deans.

Contents: Evidence-based pedagogy; Recognizing research; *Quantitative research:* Critiquing quantitative research; Reliability and validity in quantitative research; A survey of statistical methods; *Qualitative research:* Critiquing qualitative research; Reliability and validity in qualitative research; A survey of qualitative methods; *Using mathematics education research appropriately:* Teaching experiments, quasi-experimental research, and threats to validity; Evaluation, assessment, and research; Finding research: The literature search; From consumer to producer; References.

July 2000, 106 pages, Softcover, ISBN 0-8218-2016-8, LC 00-035550, 2000 *Mathematics Subject Classification*: 97C99; 97–XX, **All AMS members $16**, List $20, Order code MERN
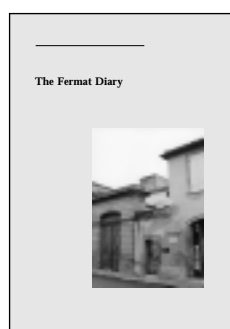
The Fermat Diary

C. J. Mozzochi, *Princeton, NJ*

This book concentrates on the final chapter of the story of perhaps the most famous mathematics problem of our time: Fermat's Last Theorem. The full story begins in 1637, with Pierre de Fermat's enigmatic marginal note in his copy of Diophantus's *Arithmetica*. It ends with the spectacular solution by Andrew Wiles some 350 years later. *The Fermat Diary* provides a record in pictures and words of the dramatic time from June 1993 to August 1995, including the period when Wiles completed the last stages of the proof and concluding with the mathematical world's celebration of Wiles's result at Boston University.

This diary takes us through the process of discovery as reported by those who worked on the great puzzle: Gerhard Frey who conjectured that Shimura-Taniyama implies Fermat; Ken Ribet who followed a difficult and speculative plan of attack suggested by Jean-Pierre Serre and established the statement by Frey; and Andrew Wiles who announced a proof of enough of the Shimura-Taniyama conjecture to settle Fermat's Last Theorem, only to announce months later that there was a gap in the proof. Finally, we are brought to the historic event on September 19, 1994, when Wiles, with the collaboration of Richard Taylor, dramatically closed the gap. The book follows the much-in-demand Wiles through his travels and lectures, finishing with the Conference on Fermat's Last Theorem at Boston University.
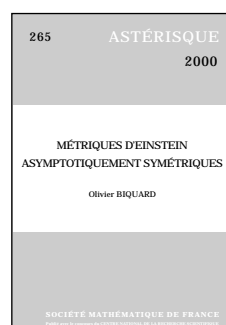
There are many important names in the recent history of Fermat's Last Theorem. This book puts faces and personalities to those names. Mozzochi also uncovers the details of certain key pieces of the story. For instance, we learn in Frey's own words the story of his conjecture, about his informal discussion and later lecture at Oberwolfach and his letter containing the actual statement. We learn from Faltings about his crucial role in the weeks before Wiles made his final announcement. Shimura explains his position concerning the evolution of the Shimura-Taniyama conjecture. Mozzochi also conveys the atmosphere of the mathematical community—and the Princeton Mathematics Department in particular—during this important period in mathematics.

This eyewitness account and wonderful collection of photographs capture the marvel and unfolding drama of this great mathematical and human story.

Contents: February 10, 1994; September 19, 1994; August 9, 1995; Cast of characters; List of photographs; Acknowledgements and notes; Appendices; Murty's review; Bibliography; Index.

September 2000, approximately 200 pages, Hardcover, ISBN 0-8218-2670-0, LC 00-030629, 2000 *Mathematics Subject Classification*: 11D41, **All AMS members $23**, List $29, Order code FERMATDN

Geometry and Topology

265 ASTÉRISQUE 2000

MÉTRIQUES D'EINSTEIN ASYMPTOTIQUEMENT SYMÉTRIQUES

Olivier BIQUARD

SOCIÉTÉ MATHÉMATIQUE DE FRANCE

Métriques d'Einstein Asymptotiquement Symétriques

Olivier Biquard, *Ecole Polytechnique, Palaiseau, France*

A publication of Société Mathématique de France.

In this book, the author studies asymptotically symmetric Einstein metrics: asymptotically symmetric means that the curvature at infinity is asymptotic to the curvature of a rank one symmetric space of noncompact type (that is, a hyperbolic space). Two constructions of such metrics are given. The first one relies on analysis to prove that the Einstein deformations of complex, quaternionic or octonionic symmetric spaces are in 1-1 correspondence with certain Carnot-Carathéodory metrics on the boundary at infinity. In the quaternionic or octonionic cases, the author obtains new objects at infinity which he calls quaternionic (or octonionic) contact structures. The second construction is twistorial: given a real analytic quaternionic contact structure, the author proves that it is the boundary at infinity of a unique quaternionic-Kähler (and therefore Einstein), asymptotically symmetric metric, defined in a neighborhood of infinity. The geometry of quaternionic contact structures is studied, while octonionic contact structures remain very mysterious objects. The text is in French.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Déformations d'Einstein des métriques hyperboliques; Structures de contact quaternioniennes; Métriques quaternion-kählériennes; Bibliographic.

Astérisque, Number 265

March 2000, 115 pages, Softcover, ISBN 2-85629-083-3, 2000 *Mathematics Subject Classification*: 53C25, 53C15, 32L25, 58J60, **Individual member $30**, List $33, Order code AST/265N
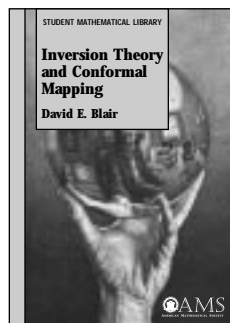
Inversion Theory and Conformal Mapping

David E. Blair, *Michigan State University, East Lansing*

It is rarely taught in undergraduate or even graduate curricula that the only conformal maps in Euclidean space of dimension greater than two are those generated by similarities and inversions in spheres. This is in stark contrast to the wealth of conformal maps in the plane. This fact is taught in most complex analysis courses.

The principal aim of this text is to give a treatment of this paucity of conformal maps in higher dimensions. The exposition includes both an analytic proof, due to Nevanlinna, in general dimension and a differential geometric proof in dimension three. For completeness, enough complex analysis is developed to prove the abundance of conformal maps in the plane. In addition, the book develops inversion theory as a subject, along with the auxiliary theme of circle-preserving maps. A particular feature is the inclusion of a paper by Carathéodory with the remarkable result that any circle-preserving transformation is necessarily a Möbius transformation, not even the continuity of the transformation is assumed.

The text is at the advanced undergraduate level and is suitable for a capstone course, topics course, senior seminar or as an independent study text. Students and readers with university courses in differential geometry or complex analysis bring with them background to build on, but such courses are not essential prerequisites.

M. C. Escher's Hand with Reflecting Sphere ©2000 Cordon Art B.V. - Baarn - Holland. All rights reserved.

Contents: Classical inversion theory in the plane; Linear fractional transformations; Advanced calculus and conformal maps; Conformal maps in the plane; Conformal maps in Euclidean space; The classical proof of Liouville's theorem; When does inversion preserve convexity?; Bibliography; Index.

Student Mathematical Library
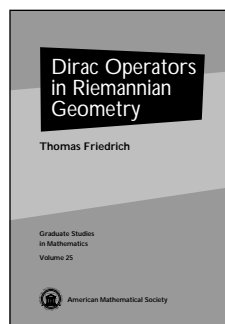
Dirac Operators in Riemannian Geometry

Thomas Friedrich, *Institut für Mathematik, Humboldt-Universität, Berlin, Germany*

From a review of the German edition: This work is to a great extent a written version of lectures given by the author. As a consequence of this fact, the text contains full, detailed and elegant proofs throughout, all calculations are carefully performed, and considerations are well formulated and well motivated. This style is typical of the author. It is a pleasure to read the book; any beginning graduate student should have access to it.

—Mathematical Reviews

For a Riemannian manifold M, the geometry, topology and analysis are interrelated in ways that are widely explored in modern mathematics. Bounds on the curvature can have significant implications for the topology of the manifold. The eigenvalues of the Laplacian are naturally linked to the geometry of the manifold. For manifolds that admit spin (or $\text{spin}^{\mathbb{C}}$) structures, one obtains further information from equations involving Dirac operators and spinor fields. In the case of four-manifolds, for example, one has the remarkable Seiberg-Witten invariants.

In this text, Friedrich examines the Dirac operator on Riemannian manifolds, especially its connection with the underlying geometry and topology of the manifold. The presentation includes a review of Clifford algebras, spin groups and the spin representation, as well as a review of spin structures and $\text{spin}^{\mathbb{C}}$ structures. With this foundation established, the Dirac operator is defined and studied, with special attention to the cases of Hermitian manifolds and symmetric spaces. Then, certain analytic properties are established, including self-adjointness and the Fredholm property.

An important link between the geometry and the analysis is provided by estimates for the eigenvalues of the Dirac operator in terms of the scalar curvature and the sectional curvature. Considerations of Killing spinors and solutions of the twistor equation on M lead to results about whether M is an Einstein manifold or conformally equivalent to one. Finally, in an appendix, Friedrich gives a concise introduction to the Seiberg-Witten invariants, which are a powerful tool for the study of four-manifolds. There is also an appendix reviewing principal bundles and connections.

This detailed book with elegant proofs is suitable as a text for courses in advanced differential geometry and global analysis, and can serve as an introduction for further study in these areas. This edition is translated from the German edition published by Vieweg Verlag.

Contents: Clifford algebras and spin representation; Spin structures; Dirac operators; Analytical properties of Dirac operators; Eigenvalue estimates for the Dirac operator and twistor spinors; Seiberg-Witten invariants; Principal bundles and connections; Bibliography; Index.

Graduate Studies in Mathematics, Volume 25
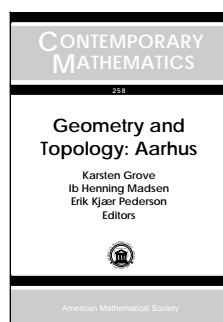
Geometry and Topology: Aarhus

Karsten Grove, *University of Maryland, College Park,* **Ib Henning Madsen**, *Aarhus University, Denmark*, and **Erik Kjær Pedersen**, *State University of New York at Binghamton*, Editors

This volume includes both survey and research articles on major advances and future developments in geometry and topology. Papers include those presented as part of the 5th Aarhus Conference—a meeting of international participants held in connection with ICM Berlin in 1998—and related papers on the subject.

This collection of papers is aptly published in the Contemporary Mathematics series, as the works represent the state of research and address areas of future development in manifold theory and geometry. The survey articles in particular would serve well as supplemental resources in related graduate courses.

Contents: A. Baker and **C. Özel**, Complex cobordism of Hilbert manifolds with some applications to flag varieties of loop groups; **B. Booss-Bavnbek**, Unique continuation property of Dirac operators, revisited; **V. M. Buchstaber** and **T. E. Panov**, Torus actions determined by simple polytopes; **S. E. Cappell**, **R. Lee**, and **E. Y. Miller**, The Torelli group action on representation spaces; **A. L. Carey** and **B.-L. Wang**, Notes on Seiberg-Witten-Floer theory; **R. L. Cohen**, **J. D. S. Jones**, and **G. B. Segal**, Stability for holomorphic spheres and Morse theory; **T. H. Colding** and **W. P. Minicozzi II**, Embedded minimal surfaces without area bounds in 3-manifolds; **B. I. Dundas**, The cyclotomic trace for symmetric monoidal categories; **J.-H. Eschenburg**, Isoparametric submanifolds and symmetric spaces; **R. Geoghegan**, **A. Nicas**, and **D. Schütz**, Obstructions to homotopy invariance in parametrized fixed point theory; **M. de Gosson**, Lagrangian path intersections and the Leray index; **B. Gray**, Associativity in two-cell complexes; **L. Guijarro**, Nonnegative curvature and normal holonomy in open manifolds; **I. Hambleton** and **E. K. Pedersen**, Compactifying infinite group actions; **M. Joachim** and **T. Schick**, Positive and negative results concerning the Gromov-Lawson-Rosenberg conjecture; **F. E. A. Johnson**, Stable modules and the structure of Poincaré 3-complexes; **Y.-H. Kiem**, The equivariant cohomology ring of the moduli space of vector bundles over a Riemann surface; **J. R. Klein**, Poincaré embeddings of spheres; **K. Kuwae**, **Y. Machigashira**, and **T. Shioya**, Beginning of analysis on Alexandrov spaces; **J. Lohkamp**, Negative curvature and symplectic submanifolds; **W. Lück** and **D. Meintrup**, On the universal space for group actions with compact isotropy; **I. Madsen** and **C. Schlichtkrull**, The circle transfer and K-theory; **M. Morimoto**, **T. Sumi**, and **M. Yanagihara**, Finite groups possessing gap modules; **K. Pawałowski**, Smith equivalence of group modules and the Laitinen conjecture. A survey; **E. K. Pedersen**, Controlled algebraic K-theory, a survey; **L. R. Taylor**, Taut codimension one spheres of odd order; **B. Williams**, Bivariant Riemann Roch theorems.

Contemporary Mathematics, Volume 258

July 2000, 393 pages, Softcover, ISBN 0-8218-2158-X, LC 00-038943, 2000 *Mathematics Subject Classification*: 53–XX, 55–XX, 57–XX, **Individual member $53**, List $89, Institutional member $71, Order code CONM/258N

Décomposition des Difféomorphismes du Tore en Applications Déviant la Verticale

Patrice Le Calvez, *University of Parix XIII, Villetaneuse, France*

A publication of Société Mathématique de France.

Every diffeomorphism F of the two-dimensional torus $\mathbf{T}^2$ can be written as a composition of positive and negative twist maps. If one considers such a decomposition and a given lift f of F to the plane, one can construct naturally a vector field on a manifold diffeomorphic to $\mathbf{T}^2 \times \mathbf{R}^{2n-2}$, where $2n$ is the number of maps which appear in the decomposition and becomes big when f is far from the identity. There is a one-to-one correspondence between the set of singularities of this vector field and the set of fixed points of F which are lifted to fixed points of f. The study of this vector field was begun in a earlier work, mainly in the case when there is no singularity. In this work the authors present the general case when these singularities may exist, and deduce general properties about fixed points and periodic orbits of diffeomorphisms of the torus homotopic to the identity.

John Franks has proved that an area-preserving homeomorphism of the closed annulus $\mathbf{T}^1 \times [0, 1]$ or the open annulus $\mathbf{T}^1 \times]0, 1[$ which has a fixed point possesses an infinite number of periodic orbits. The Appendix, written in collaboration with J.-M. Gambaudo, provides a different proof of this result for the diffeomorphisms of the closed annulus. The text is in French.

This item will also be of interest to those working in analysis.

Contents: Introduction; Notations, définitions, rappels; Fonctions d'enlacement; Décomposition dominée du fibré tangent, variétés intégrales; Éléments critiques des champs de vecteurs ξ et $\tilde{\xi}$; Existence de tores fixes d'enlacement 0; Propriétés des tores fixes; Bifurcation des tores fixes; Étude des itérés; Fonction d'enlacement définie par un point fixe ou une orbite périodique; Construction de cercles fantômes; **J.-M. Gambaudo** and **P. Le Calvez**, Appendice: Infinité d'orbites périodiques pour les difféomorphismes conservatifs; Bibliographie; Index.

Memoires de la Société Mathématique de France, Number 79

January 2000, 148 pages, Softcover, ISBN 2-85629-080-9, 2000 *Mathematics Subject Classification*: 37–XX, **Individual member $30**, List $33, Order code SMFMEM/79N
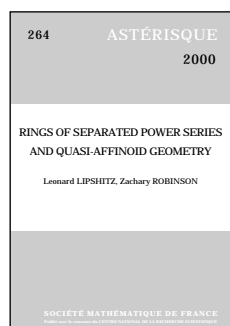
Rings of Separated Power Series and Quasi-Affinoid Geometry

Leonard Lipshitz, *Purdue University, West Lafayette, IN*, and **Zachary Robinson**, *East Carolina University, Greenville, NC*

A publication of Société Mathématique de France.

The papers in this volume present a theory of rigid analytic geometry over an ultrametric field K that generalizes the classical, affinoid, theory to the setting of relative rigid analytic geometry over an "open" polydisc. The theory is based on the commutative algebra of power series rings $S_{m,n}$ that is developed in the first paper in this volume, *Rings of Separated Power Series*. Quasi-affinoid algebras (quotients $S_{m,n}/I$) share many properties with affinoid algebras (quotients T_m/I of a ring of strictly convergent power series.) Among the principal results are the Nullstellensatz for quasi-affinoid algebras A and the Universal Property for a broad class of open subdomains of Max A, the R-subdomains.

The second paper, *Model Completeness and Subanalytic Sets*, obtains a structure theory for images of analytic maps based on any subcollection of $S = \cup S_{m,n}$ that satisfies certain closure properties; for example $T = \cup T_m$. The argument exploits the existential definability of the Weierstrass data as well as a difference between affinoid and quasi-affinoid rigid analytic geometry; namely, that a quasi-affinoid variety Max A in general may be covered by finitely many disjoint quasi-affinoid subdomains, just as the valuation ring K° is the union of its maximal ideal $K^{\circ\circ}$ and its multiplicative units. A crucial role is played by the theory of generalized rings of fractions developed in the first paper. The third paper, *Quasi-Affinoid Varieties*, defines the category of $S_{m,n}$-analytic varieties $X = $ Max A and establishes the acyclicity of quasi-affinoid covers. The proofs employ results from the first paper; in particular, the fact that the assignment $U \mapsto \mathcal{O}_X(U)$ is a presheaf of A-algebras for R-subdomains U of X. The quantifier elimination of the second paper is used to relate quasi-affinoid and affinoid covers, a key step in the proof of the Acyclicity Theorem.

The last paper, *A Rigid Analytic Approximation Theorem*, gives a global Artin Approximation theorem between a "Henselization" $H_{m,n}$ of a ring T_{m+n} of strictly convergent power series and its "completion" $S_{m,n}$, thus linking the algebraic properties of affinoid and quasi-affinoid algebras.
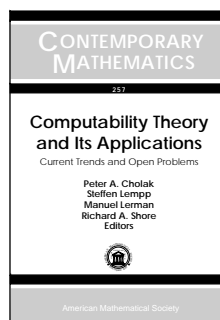
Contents: Introduction; Rings of separated power series; Model completeness and subanalytic sets; Quasi-affinoid varieties; A rigid analytic approximation theorem, by Zachary Robinson; Index.

Logic and Foundations

Computability Theory and Its Applications
Current Trends and Open Problems

Peter A. Cholak, *University of Notre Dame, IN*, **Steffen Lempp**, *University of Wisconsin, Madison*, **Manuel Lerman**, *University of Connecticut, Storrs*, and **Richard A. Shore**, *Cornell University, Ithaca, NY*, Editors

This collection of articles presents a snapshot of the status of computability theory at the end of the millennium and a list of fruitful directions for future research. The papers represent the works of experts in the field who were invited speakers at the AMS-IMS-SIAM 1999 Summer Conference on Computability Theory and Applications, which focused on open problems in computability theory and on some related areas in which the ideas, methods, and/or results of computability theory play a role.

Some presentations are narrowly focused; others cover a wider area. Topics included from "pure" computability theory are the computably enumerable degrees (M. Lerman), the computably enumerable sets (P. Cholak, R. Soare), definability issues in the c.e. and Turing degrees (A. Nies, R. Shore) and other degree structures (M. Arslanov, S. Badaev and S. Goncharov, P. Odifreddi, A. Sorbi). The topics involving relations between computability and other areas of logic and mathematics are reverse mathematics and proof theory (D. Cenzer and C. Jockusch, C. Chong and Y. Yang, H. Friedman and S. Simpson), set theory (R. Dougherty and A. Kechris, M. Groszek, T. Slaman) and computable mathematics and model theory (K. Ambos-Spies and A. Kučera, R. Downey and J. Remmel, S. Goncharov and B. Khoussainov, J. Knight, M. Peretyat'kin, A. Shlapentokh).

Contents: **K. Ambos-Spies** and **A. Kučera**, Randomness in computability theory; **M. Arslanov**, Open questions about the n-c.e. degrees; **S. Badaev** and **S. Goncharov**, The theory of numberings: Open problems; **D. Cenzer** and **C. G. Jockusch, Jr.**, Π_1^0 classes—Structure and applications; **P. A. Cholak**, The global structure of computably enumerable sets; **C. T. Chong** and **Y. Yang**, Computability theory in arithmetic: Provability, structure and techniques; **R. Dougherty** and **A. S. Kechris**, How many Turing degrees are there?; **R. Downey** and **J. B. Remmel**, Questions in computable algebra and combinatorics; **H. Friedman** and **S. G. Simpson**, Issues and problems in reverse mathematics; **S. Goncharov** and **B. Khoussainov**, Open problems in the theory of constructive algebraic systems; **M. Groszek**, Independence results from ZFC in computability theory: Some open problems; **J. F. Knight**, Problems related to arithmetic; **M. Lerman**, Embeddings into the computably enumerable degrees; **A. Nies**, Definability in the c.e. degrees: Questions and results; **P. Odifreddi**, Strong reducibilities, again; **M. Peretyat'kin**, Finitely axiomatizable theories and Lindenbaum algebras of semantic classes; **A. Shlapentokh**, Towards an analog of Hilbert's tenth problem for a number field;

R. A. Shore, Natural definability in degree structures; **T. A. Slaman**, Recursion theory in set theory; **R. I. Soare**, Extensions, automorphisms, and definability; **A. Sorbi**, Open problems in the enumeration degrees.
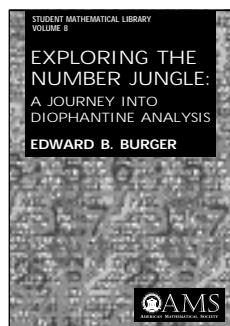
Contemporary Mathematics, Volume 257

July 2000, 320 pages, Softcover, ISBN 0-8218-1922-4, LC 00-036278, 2000 *Mathematics Subject Classification*: 03C57, 03D25, 03D28, 03D30, 03D45, 03D80, 03E15, 03E35, 03F35, 03H15, **Individual member $47**, List $79, Institutional member $63, Order code CONM/257N

Number Theory

Independent Study

Recommended Text

Exploring the Number Jungle: A Journey into Diophantine Analysis

Edward B. Burger, *Williams College, Williamstown, MA*

Welcome to diophantine analysis—an area of number theory in which we attempt to discover hidden treasures and truths within the jungle of numbers by exploring rational numbers. Diophantine analysis comprises two different but interconnected domains—diophantine approximation and diophantine equations. This highly readable book brings to life the fundamental ideas and theorems from diophantine approximation, geometry of numbers, diophantine geometry and p-adic analysis. Through an engaging style, readers are active participants in a journey through these areas of number theory.

Each mathematical theme is presented in a self-contained manner and is motivated by very basic notions. The reader becomes an active participant in the explorations, as each module includes a sequence of numbered questions to be answered and statements to be verified. Many hints and remarks are provided to be freely used and enjoyed. Each module then closes with a Big Picture Question that invites the reader to step back from all the technical details and take a panoramic view of how the ideas at hand fit into the larger mathematical landscape. This book enlists the reader to build intuition, develop ideas and prove results in a very user-friendly and enjoyable environment.

Little background is required and a familiarity with number theory is not expected. All that is needed for most of the material is an understanding of calculus and basic linear algebra together with the desire and ability to prove theorems. The minimal background requirement combined with the author's fresh approach and engaging style make this book enjoyable and accessible to second-year undergraduates, and even advanced high school students. The author's refreshing new spin on more traditional discovery approaches makes this book appealing to any mathematician and/or fan of number theory.

Contents: A bit of foreshadowing and some rational rationale; Building the rationals via Farey sequences; Discoveries of Dirichlet and Hurwitz; The theory of continued fractions; Enforcing the law of best approximates; Markoff's spectrum and numbers; Badly approximable numbers and quadratics; Solving

the alleged "Pell" equation; Liouville's work on numbers algebraic and not; Roth's stunning result and its consequences; Pythagorean triples through diophantine geometry; A quick tour through elliptic curves; The geometry of numbers; Simultaneous diophantine approximation; Using geometry to sum some squares; Spinning around irrationally and uniformly; A whole new world of p-adic numbers; A glimpse into p-adic analysis; A new twist on Newton's method; The power of acting locally while thinking globally; Selected big picture question commentaries; Hints and remarks; Further reading; Acknowledgments; Index.

Student Mathematical Library

August 2000, approximately 144 pages, Softcover, ISBN 0-8218-2640-9, 2000 *Mathematics Subject Classification*: 11–01, 11J25, 11H06, 11G05, 11J70, 11J82, 11D45, 11J06, 11F85, **All AMS members $16**, List $20, Order code STML-BURGERN

Galois Cohomology of Elliptic Curves

J. Coates, *Cambridge University, England*, and **R. Sujatha**, *Tata Institute of Fundamental Research, Mumbai, India*

A publication of Tata Institute of Fundamental Research.

This book is based on the material presented in four lectures given by J. Coates at the Tata Institute of Fundamental Research. The original notes were modified and expanded in a joint project with R. Sujatha.

The book discusses some aspects of the Iwasawa theory of elliptic curves over algebraic fields. Let E be an elliptic curve defined over an algebraic number field F. The fundamental idea of the Iwasawa theory is to study deep arithmetic questions about E/F, via the study of coarser questions about the arithmetic of E over various infinite extensions of F. A precise formulation of this theory exists only when the infinite extension is a p-adic Lie extension for some fixed prime number p. It provides the only general method known at present for studying exact arithmetic formulae such as the Birch and Swinnerton-Dyer conjecture for elliptic curves. These notes mainly discuss the simplest non-trivial example of this theory when the infinite extension in question is the cyclotomic $\mathbb{Z}_p$-extension of F. Only algebraic (as opposed to analytic) aspects of the theory are considered in the notes. However, a number of numerical examples are presented in detail, illustrating the general theory beautifully. In addition, the notes outline some of the basic results in Galois cohomology which are used repeatedly in the study of the relevant Iwasawa modules. The Appendix addresses some aspects of the cohomology of elliptic curves which turn out to be very useful in Iwasawa theory.

Distributed worldwide except in India, Bangladesh, Bhutan, Maldavis, Nepal, Pakistan, and Sri Lanka.

Contents: Notation; Basic results from Galois cohomology; The Iwasawa theory of the Selmer group; The Euler characteristic formula; Numerical examples over the cyclotomic $\mathbb{Z}_{\mathbf{p}}$-extension of $\mathbb{Q}$; Numerical examples over $\mathbb{Q}(\mu_p \infty)$; Appendix; Bibliography.

Tata Institute of Fundamental Research

March 2000, 100 pages, Softcover, ISBN 81-7319-293-6, 2000 *Mathematics Subject Classification*: 11R34, **All AMS members $20**, List $25, Order code TIFR/2N

Probability
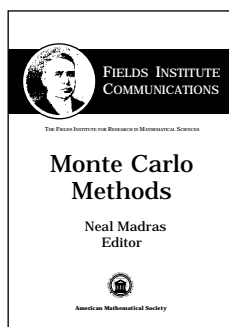
Monte Carlo Methods

Neal Madras, *York University, Toronto, ON, Canada*, Editor

This volume contains the proceedings of the Workshop on Monte Carlo Methods held at The Fields Institute for Research in Mathematical Sciences (Toronto, 1998). The workshop brought together researchers in physics, statistics, and probability. The papers in this volume—of the invited speakers and contributors to the poster session—represent the interdisciplinary emphasis of the conference.

Monte Carlo methods have been used intensively in many branches of scientific inquiry. Markov chain methods have been at the forefront of much of this work, serving as the basis of many numerical studies in statistical physics and related areas since the Metropolis algorithm was introduced in 1953. Statisticians and theoretical computer scientists have used these methods in recent years, working on different fundamental research questions, yet using similar Monte Carlo methodology.

This volume focuses on Monte Carlo methods that appear to have wide applicability and emphasizes new methods, practical applications and theoretical analysis. It will be of interest to researchers and graduate students who study and/or use Monte Carlo methods in areas of probability, statistics, theoretical physics, or computer science.

This item will also be of interest to those working in applications.

Contents: B. A. Berg, Introduction to multicanonical Monte Carlo simulations; **F. Bunea** and **J. Besag**, MCMC in $I \times J \times K$ contingency tables; **J. A. Fill**, **M. Machida**, **D. J. Murdoch**, and **J. S. Rosenthal**, Extension of Fill's perfect rejection sampling algorithm to general chains; **K. Jansen**, Taming zero modes in lattice QCD with the polynomial hybrid Monte Carlo algorithm; **A. D. Kennedy**, Monte Carlo algorithms and non-local actions; **X.-L. Meng**, Towards a more general Propp-Wilson algorithm: Multistage backward coupling; **A. Mira** and **C. J. Geyer**, On non-reversible Markov chains; **D. J. Murdoch**, Exact sampling for Bayesian inference: Unbounded state spaces; **G. O. Roberts** and **J. S. Rosenthal**, Recent progress on computable bounds and the simple slice sampler; **S. G. Whittington**, MCMC methods in statistical mechanics: Avoiding quasi-ergodic problems; **D. B. Wilson**, Layered multishift coupling for use in perfect sampling algorithms (with a primer on CFTP); **H. Ljung**, Introduction to semi Markov chain Monte Carlo; **A. R. Dabrowski**, **G. Lamothe**, and **D. R. McDonald**, Accelerated simulation of ATM switching fabrics; **A. R. Runnalls**, Some stratagems for the estimation of time series using the Metropolis method; **T. Vrbová**, Monte Carlo study of adsorption of interacting self-avoiding walks.

Fields Institute Communications, Volume 26

August 2000, 228 pages, Hardcover, ISBN 0-8218-1992-5, LC 00-039810, 2000 *Mathematics Subject Classification*: 65C05, 60–06; 60J05, 60J10, 65C60, 81T80, 82B80, **Individual member $41**, List $69, Institutional member $55, Order code FIC/26N
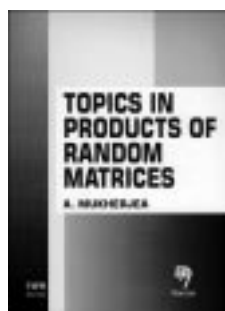
Topics in Products of Random Matrices

Arunava Mukherjea, *University of South Florida, Tampa*

A publication of Tata Institute of Fundamental Research.

This book contains detailed results on convergence in distribution for products of independent and identically distributed random matrices and also for their normalized versions. Conditions for the limit distribution to be absolutely continuous or continuous singular are discussed and the limit distributions have also been computed for various specific examples. Infinite dimensional matrices are also considered, with reference to random motions of particles.

Semigroup methods have been highlighted throughout the notes. Care has been taken to make the presentation readily accessible to graduate students and beginners in research. Most of the results presented in the notes have not previously appeared in book form.

Distributed worldwide except in India, Bangladesh, Bhutan, Maldavis, Nepal, Pakistan, and Sri Lanka.

Contents: Introduction; Convergence in distribution: Products of random stochastic matrices; Nature of the limit distribution; Convergence in direction; Stochastic flows on a countable set: Products of infinite-dimensional random stochastic matrices; Products of random infinite-dimensional non-negative matrices: The equation $\eta_n = X_n \eta_{n-1}$; Probability measures on 2×2 stochastic matrices and a functional equation; The limit distribution for products of 2×2 random stochastic matrices: A specific example; Appendix: The multivariate central limit theorem: An elementary proof using a theorem of P. Chernoff; Notes and comments; Bibliography.

Tata Institute of Fundamental Research

March 2000, 121 pages, Softcover, ISBN 81-7319-297-9, 2000 *Mathematics Subject Classification*: 15A52, **All AMS members $20**, List $25, Order code TIFR/3N
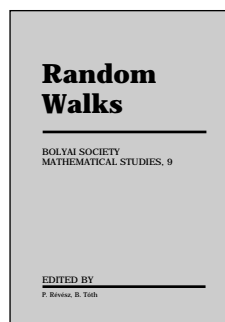
Random Walks

Pál Révész, *Hungarian Academy of Sciences, Budapest*, and **Bálint Tóth**, *Technical University of Budapest, Hungary*, Editors

A publication of János Bolyai Mathematical Society.

This volume surveys developments in the area of random walks. This most classical area of probability theory has generated a host of new and surprising techniques and exciting links to various other branches of mathematics and science. The papers collected here represent lectures given at the highly successful *International Workshop on Random Walks* held in Budapest under the auspices of the Paul Erdős Summer Research Center of Mathematics.

The first paper presents a panoramic survey of existing classical and more recent results on central limit theorems and

invariance principles for partial sums of strictly stationary random variables under various mixing conditions. This work (and its exhaustive list of references) is a self-contained and rich source of information and ideas for the researcher working in the field of general limit theorems of probability and statistics. Other papers cover asymptotic behavior of excursions of the two-dimensional walk and Brownian motion, financial mathematics, reinforced random walks, models of random walks in random environments (RWERE), recent results concerning the so-called *monotone solidification cellular automaton* models, results about the long-time asymptotics of some *additive functionals of Brownian motion*, critical exponents and fractal geometry of Brownian motion paths, the combinatorial background of one-dimensional random walk in the transient case, Berry-Esseen inequalities, asymptotic distribution of the particles in the d-dimensional Euclidean space, and late-time asymptotic behavior of *self-interacting random walks* (SIRW) and on the construction of a new type of stochastic process called *true self-repelling motion*.

Distributed worldwide, except in Eastern and Western Europe, by the AMS.

Contents: R. C. Bradley, Can a theorem of Csáki and Fischer provide a key to Ibragimov's conjecture?; **E. Csáki**, **A. Földes**, **P. Révész**, and **Z. Shi**, On the excursions of two-dimensional random walk and Wiener process; **M. Csörgő**, Random walking around financial mathematics; **B. Davis**, Reinforced and perturbed random walks; **N. Gantert** and **O. Zeitouni**, Large deviations for one-dimensional random walk in random environment—a survey; **J. Gravner** and **D. Griffeath**, Scaling laws for a class of critical cellular automaton growth rules; **Y. Hu** and **M. Yor**, Asymptotic studies of brownian functionals; **G. Lawler**, Geometric and fractal properties of brownian motion and random walk paths in two and three dimensions; **S. G. Mohanty**, Combinatorial aspects of some random walks; **G. Pap** and **M. Voit**, Rates of convergence for the central limit theorems for random walks related with the Hankel transform; **P. Révész**, Critical branching Wiener process; **B. Tóth**, Self-interacting random motions—A survey.

Bolyai Society Mathematical Studies, Volume 9

January 2000, 384 pages, Hardcover, ISBN 963-8022-91-4, 2000 *Mathematics Subject Classification*: 60J65; 60F05, 60F15, 60F17, 60G17, 60G18, 60J45, 60J55, 60J85, 60K35, 60K40, **Individual member $45**, List $75, Institutional member $60, Order code BSMS/9N

Previously Announced Publications

Featured Reviews in *Mathematical Reviews* 1997–1999
With Selected Reviews of Classic Books and Papers from 1940–1969

Donald G. Babbitt, *Publisher, American Mathematical Society, Providence, RI*, and **Jane Kister**, *Executive Editor, Mathematical Reviews, Ann Arbor, MI*, Editors

This second volume of *Featured Reviews* makes available special detailed reviews of some of the most important mathematical articles and books published from 1997 through 1999. Also included are excellent reviews of several classic books and articles published prior to 1970. Among those reviews, for

example, are the following: **Homological Algebra** by Henri Cartan and Samuel Eilenberg, reviewed by G. Hochschild; **Faisceaux algébriques cohérents** by Jean-Pierre Serre, reviewed by C. Chevalley; and **On the Theory of General Partial Differential Operators** by Lars Hörmander, reviewed by J. L. Lions. In particular, those seeking information on current developments outside their own area of expertise will find the volume very useful.

By identifying some of the best publications, papers, and books that have had or are expected to have a significant impact in applied and pure mathematics, this volume will serve as a comprehensive guide to important new research across all fields covered by MR.

May 2000, 754 pages, Softcover, ISBN 0-8218-2166-0, 2000 *Mathematics Subject Classification*: 00–XX, **Individual member $41**, List $69, Institutional member $55, Order code FREV/2RT067

Featured Reviews in *Mathematical Reviews* 1995–1996
Reviews of Outstanding Recent Books and Papers

Donald G. Babbitt, *Publisher, American Mathematical Society, Providence, RI*, and **Jane E. Kister**, *Executive Editor, Mathematical Reviews, Ann Arbor, MI*, Editors

November 1997, 380 pages, Softcover, ISBN 0-8218-0771-4, 2000 *Mathematics Subject Classification*: 00–XX, **All AMS members $31**, List $39, Order code FREV/1RT067

Set price
Set: May 2000, 1034 pages, Softcover, ISBN 0-8218-2631-X, 2000 *Mathematics Subject Classification*: 00–XX, All AMS members $58, List $86, Order code FREVSETRT067

New in Paperback
Price Reduced
Supplementary Reading

Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer

Charles W. Curtis, *University of Oregon, Eugene, OR*

This book is likely to be of interest to any mathematician who has had occasion in any of his/her own work to use group representation theory in any of its many contemporary guises. This is a beautiful and carefully written book, which succeeds at many levels. The mathematics discussed is powerful, and influences many areas of modern mathematics (and other sciences). The story of its evolution and its various diversifications has its own fascination, and serves to remind us how a single mathematical question can lead to the creation of vital new areas. The mathematical contribution of the main characters inspires admiration, while we also gain some insight into their lives at a human level. In short, the book fascinates both as mathematics and as history.
—*The London Mathematical Society Newsletter*

Co-published with the London Mathematical Society. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

History of Mathematics, Volume 15

July 2000, 292 pages, Softcover, ISBN 0-8218-2677-8, LC 99-14983, 2000 *Mathematics Subject Classification*: 01A55, 01A60, 20C15, 20C20; 01A70, 16G10, 20G05, **All AMS members $31**, List $39, Order code HMATH/15.SRT067

The Man Who Loved Only Numbers

The Story of Paul Erdős and the Search for Mathematical Truth

Paul Hoffman

A publication of Hyperion Press.

No mathematician is more legendary than Paul Erdős (1913–96) … The Man Who Loved Only Numbers is [Hoffman's] expanded homage to the man and his discipline … Hoffman does not analyze the man but lets Erdős and his colleagues speak for themselves, and Erdős the person, and his intellectual interests, emerge … We follow the trains of thought (and some of the personalities) that evolved from the attempts to comprehend the infinite sets lurking behind calculus. We visit Andrew Wiles' recent solution of the second-most famous theorem in mathematics, Fermat's last one. And we pursue the "Monty Hall" problem … This book opens doors on a world and characters that are often invisible. It is interesting that Hoffman, Erdős and others in the book remember the mathematical tidbit that first intrigued them and bound them to this world. Possibly a future scientist or mathematician, or future scientific writer, will remember something in this book that way.

—*New York Times Book Review*

Distributed worldwide by the American Mathematical Society.

Hyperbolic Partial Differential Equations and Wave Phenomena

Mitsuru Ikawa, *Kyoto University, Japan*

The familiar wave equation is the most fundamental hyperbolic partial differential equation. Other hyperbolic equations, both linear and nonlinear, exhibit many wave-like phenomena. The primary theme of this book is the mathematical investigation of such wave phenomena.

The exposition begins with derivations of some wave equations, including waves in an elastic body, such as those observed in connection with earthquakes. Certain existence results are proved early on, allowing the later analysis to concentrate on properties of solutions. The existence of solutions is established using methods from functional analysis. Many of the properties are developed using methods of asymptotic solutions. The last chapter contains an analysis of the decay of the local energy of solutions. This analysis shows, in particular, that in a connected exterior domain, disturbances gradually drift into the distance and the effect of a disturbance in a bounded domain becomes small after sufficient time passes.

The book is geared toward a wide audience interested in PDEs. Prerequisite to the text are some real analysis and elementary functional analysis. It would be suitable for use as a text in PDEs or mathematical physics at the advanced undergraduate and graduate level.

This item will also be of interest to those working in mathematical physics.

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 189

John von Neumann

The Scientific Genius Who Pioneered the Modern Computer, Game Theory, Nuclear Deterrence, and Much More

Norman Macrae

A full and intimate biography of 'the man who consciously and deliberately set mankind moving along the road that led us into the Age of Computers.'

—*Freeman Dyson, Princeton, NJ*

This book has now been reprinted by the AMS. It is good to have a biography of one of the most important mathematicians of the twentieth century, even if it is a biography that focuses much more on the man than on the mathematics.

—*MAA Online*

I always thought [von Neumann's] brain indicated that he belonged to a new species, an evolution beyond man. Macrae shows us in a lively way how this brain was nurtured and then left its great imprint on the world.

—*Hans A. Bethe, Cornell University*

The book makes for utterly captivating reading. Von Neumann was, of course, one of this century's geniuses, and it is surprising that we have had to wait so long … for a fully fleshed and sympathetic biography of the man. But now, happily, we have one.

Macrae nicely delineates the cultural, familial, and educational environment from which von Neumann sprang and sketches the mathematical and scientific environment in which he flourished. It's no small task to render a genius like von Neumann in ordinary language, yet Macrae manages the trick, providing more than a glimpse of what von Neumann accomplished intellectually without expecting the reader to have a Ph.D. in mathematics. Beyond that, he captures von Neumann's qualities of temperament, mind, and personality, including his effortless wit and humor. And [Macrae] frames and accounts for von Neumann's politics in ways that even critics of them, among whom I include myself, will find provocative and illuminating.

—*Daniel J. Kevles, California Institute of Technology*

A lively portrait of the hugely consequential nonmathematician-physicist-et al., whose genius has left an enduring impress on our thought, technology, society, and culture. A double salute to Steve White, who started this grand book designed for us avid, nonmathematical readers, and to Norman Macrae, who brought it to a triumphant conclusion.

—*Robert K. Merton, Columbia University*

Macrae paints a highly readable, humanizing portrait of a man whose legacy still influences and shapes modern science and knowledge.

—*Resonance Publications, Portal to Science, Engineering and Technology*

This volume is the reprinted edition of the first full-scale biography of the man widely regarded as the greatest scientist of the century after Einstein.

Born in Budapest in 1903, John von Neumann grew up in one of the most extraordinary of scientific communities. From his

arrival in America in the mid-1930s—with bases in Boston, Princeton, Washington, and Los Alamos—von Neumann pioneered and participated in the major scientific and political dramas of the next three decades, leaving his mark on more fields of scientific endeavor than any other scientist. Von Neumann's work in areas such as game theory, mathematics, physics, and meteorology formed the building blocks for the most important discoveries of the century: the modern computer, game theory, the atom bomb, radar, and artificial intelligence, to name just a few.

From the laboratory to the highest levels of government, this definitive biography gives us a behind-the-scenes look at the politics and personalities involved in these world-changing discoveries. Written more than 30 years after von Neumann's untimely death at age 54, it was prepared with the cooperation of his family and includes information gained from interviewing countless sources across Europe and America. Norman Macrae paints a highly readable, humanizing portrait of a man whose legacy still influences and shapes modern science and knowledge.

The AMS is licensed to produce and distribute this book in English throughout the world except in the British Commonwealth of Nations, Republics of Ireland and South Africa, Burma, Iraq, and Jordan.

June 2000, 406 pages, Softcover, ISBN 0-8218-2676-X, LC 99-37303, 2000 *Mathematics Subject Classification*: 01A70, **All AMS members $23**, List $29, Order code JVNM.SRT067

The Game's Afoot! Game Theory in Myth and Paradox

Alexander Mehlmann, *Vienna University of Technology, Austria*

Reviews of the German edition:

The author, well known for various imaginative, entertaining and instructive writings in the area of game theory, and for his game-theoretic excursions into classical literature, has now brought out this delightful little book on the basics of noncooperative games … [The book is] rewarding reading for a rather wide variety of reasonably well-educated persons. The reader will gain an appreciation for the mathematical modelling of conflict in economics, the social sciences and biology, and get a glimpse of game-theoretic analysis of conflict in some of the classical literature.
> —*Zentralblatt für Mathematik*

Through the amusing exposition of the material, overflowing with jokes and general culture, the new book by Alexander Mehlmann has become bedtime reading for me … It is a pleasure to see such things as the Dilemma of the Arms Race, Goethe's Mephisto, the Chain-Store Paradox, and the Madness of Odysseus brought under one game-theoretic roof.
> —*Eric Lessing (from a translation of "What I am reading" in Die Presse*

It all started with von Neumann and Morgenstern half a century ago. Their *Theory of Games and Economic Behavior* gave birth to a whole new area of mathematics concerned with the formal problems of rational decision as experienced by multiple agents. Now, game theory is all around us, making its way even into regular conversations. In the present book, Mehlmann presents mathematical foundations and concepts illustrated via social quandaries, mock political battles, evolutionary confrontations, economic struggles, and literary conflict. Most of the standard models—the prisoners' dilemma, the arms race, evolution, duels, the game of chicken, etc.—are here. Many non-standard exam-

ples are also here: the Legend of Faust, shootouts in the movies, the Madness of Odysseus, to name a few.

The author uses familiar formulas, fables, and paradoxes to guide readers through what he calls the "hall of mirrors of strategic decision-making". His light-hearted excursion into the world of strategic calculation shows that even deep insights into the nature of strategic thought can be elucidated by games, puzzles and diversions.

Originally written in German and published by Vieweg-Verlag, this AMS edition is a translation tailored for the English-speaking reader. It offers an intriguing look at myths and paradoxes through the lens of game theory, bringing the mathematics into sharper focus at the same time. This book is a must for those who wish to consider game theory from a different perspective: one that embraces science, literature, and real-life conflict.

The Game's Afoot! would make an excellent book for an undergraduate course in game theory. It can also be used for independent study or as supplementary course reading. The connections to literature, films and everyday life also make it highly suitable as a text for a challenging course for non-majors. Its refreshing style and amusing combination of game theoretic analysis and cultural issues even make it appealing as recreational reading.

Student Mathematical Library, Volume 5

April 2000, 159 pages, Softcover, ISBN 0-8218-2121-0, LC 00-020915, 2000 *Mathematics Subject Classification*: 91–01, 91A05, 91A40, 97A20, 97A90, **All AMS members $21**, List $26, Order code STML/5RT067

Dynamical Systems on Homogeneous Spaces

Alexander N. Starkov, *Moscow State University, Russia*

A homogeneous flow is a dynamical system generated by the action of a closed subgroup H of a Lie group G on a homogeneous space of G. The study of such systems is of great significance because they constitute an algebraic model for more general and more complicated systems. Also, there are abundant applications to other fields of mathematics, most notably to number theory.

The present book gives an extensive survey of the subject. In the first chapter the author discusses ergodicity and mixing of homogeneous flows. The second chapter is focused on unipotent flows, for which substantial progress has been made during the last 10–15 years. The culmination of this progress was M. Ratner's celebrated proof of far-reaching conjectures of Raghunathan and Dani. The third chapter is devoted to the dynamics of nonunipotent flows. The final chapter discusses applications of homogeneous flows to number theory, mainly to the theory of Diophantine approximations. In particular, the author describes in detail the famous proof of the Oppenheim-Davenport conjecture using ergodic properties of homogeneous flows.

This item will also be of interest to those working in number theory.

Translations of Mathematical Monographs, Volume 190

March 2000, 243 pages, Hardcover, ISBN 0-8218-1389-7, LC 00-022001, 2000 *Mathematics Subject Classification*: 37A17;11H55, 22E40, 37–02, 37A45, **Individual member $57**, List $95, Institutional member $76, Order code MMONO/190RT067