BOOK REVIEWS

Karl-Heinz Hoffmann, Qi Tang, *Ginzburg-Landau Phase Transition Theory and Superconductivity.* Birkhäuser (International Series of Numerical Mathematics, vol. 134), 2001, 384 pp., Hardcover, ISBN 3-7643-6486-6

This book is dealing with the mathematical theory of the complex Ginzburg-Landau phase transition theory, which was elaborated in the years 1937-1950 to explain the superconductivity. From the mathematical point of view, the theory is rather complicated, since it is based on a nonlinear boundary value problem for a system of partial differential equations.

The authors start with an extended introduction, exposing in some details the physical foundations of the theory and only then they formulate the problem in precise mathematical terms. They discuss, in the sequel, asymptotics involving magnetic potential, steady state and evolutionary solutions, complex Ginzburg-Landau type phase transition theory, motion of vortices, thin plate/film Ginzburg-Landau models, pinning theory. The book concludes with the discussion of the numerical analysis of the equations.

Both authors are experts in the field. The book is addressed to people interested in various aspects of superconductivity (applied mathematicians, theoretical physicists and engineers), at least this is what the authors claim. Nevertheless, the style is entirely mathematical and, though very interesting and well written, including a lot of important results, the reviewer suspects that, due to the higher level of mathematical sofistication, the book will be really useful to people outside the mathematical circle.

Paul A. Blaga

Siegfried S. Hecker and Gian-Carlo Rota (Editors), *Essays on the Future: In Honor of Nick Metropolis.* Birkhäuser Verlag, Boston-Basel-Berlin 2000, xvi+276 pp, ISBN 3-7643-6573-0

This book contains twenty two essays dedicated to Nicholas C. Metropolis and to creative work in the Los Alamos National Laboratory. The main topics are the following: the future of Physics (nuclear power, relativity theory, numerical programs in physics), the future of Pure and Applied Mathematics (combinatorics, differential equations, approximate calculations, mathematical finance, mathematical biology), informational modeling, categorization in information science, the future of Philosophy, the future of western civilization.

The list of contributors contains leading authorities such as: H. Agnew, R.L. Ashenhurst, K. Baclawski, G.A. aker, N.L. Balazs, J.A. Freed, R.W. Hamming, M. Hawrylycz, F. Water, D.J. Kleitman, M.H. GKrieger, N.H. Krikorian, P.D. Lax, J.D. Louck, T.T. Puck, M.R. Raju, R.D. Richtmyer,J. Schwartz, R. Sokolowski, E. Teller, M.S. Waterman.

I recommend the book to anyone who is interested in the history and philosophy of science

Ioan A. Rus

Philippe Tondeur Editor, *Collected Papers of K.-T. Chen.* Contemporary Mathematicians, Birkhäuser Verlag, Boston-Basel-Berlin 2001, xxvii+737 pp, ISBN 3-7643-4005-3 and 0-8176-4005-3

Kuo-Tsai Chen was born on July 15, 1923 in Chekiang, China. He earned a Bachelor of Science degree in mathematics from Southwest Associated University in Kungming in 1946. After graduating he became a Assistant at the Mathematics Institute of the Academia Sinica in Shangai. On the recommendation of its director Shing-Shen Chern, he went to follow a doctoral program with Samuel Eilenberg at Indiana University. After being awarded his Ph.D. degree he worked at various prestigious universities in United States, Hong Kong and Brazil. His last position, until his death in 1987, after a long illness , was at the University of Illinois at Urbana.

The project of publishing Chen's collected work in a volume was initiated by the late Professor Gian-Carlo Rota who was attracted by his coherent body of research. The project was accomplished by Phippe Tondeur, with the help of Julia Chen (K.T. Chen's widow) and Betsy Gillies.

The volume contains 58 papers by K.T. Chen, reproduced photographically from the originals, and preceded by a paper "The Life and Work of Kuo-Tsai Chen" by Richard Haim and Philippe Tondeur. Kuo-Tsai Chen is best known for his results on iterated integrals and power series connections in conjunction with his research on the cohomology of loop spaces. His work falls into three periods: his early work on group theory and links in three sphere; his subsequent work on formal differential equations; and his work on iterated integrals and homotopy theory.

The aim of the volume is to bring together the papers of K.T. Chen and to place them into their proper context, demonstrating the power and scope of his influence.

Paul A. Blaga

Kevin P. Knudson, *Homology of Linear Groups*. Progress in Mathematics vol. 193, Birkhäuser Verlag, Basel-Boston-Berlin, 2001, xi+192 pp., Hardcover, ISBN 3-7643-6415-7.

The importance of the study of the homology of linear groups became apparent with Quillen's introduction of the higher algberaic K-groups of rings, which are defined as the homotopy groups of the space $BGL(R)^+$, a modification of the classifying space of the infinite general linear group $GL(R)$.

This volume presents the achievements of the last 25 years of work on the subject, starting with Quillen's calculation of the (co)homology of $GL_n(\mathbf{F}_q)$. The material is divided into six chapters Chapter 1 is mainly a survey of the early results, including the above mentioned calculation of $H^\bullet(GL_n(\mathbf{F}_q))$, Borel's calculation of the stable cohomology of arithmetic groups, and a presentation of certain conjectures due to Quilllen and Lichtenbaum on the structure of $H^\bullet(GL_n(\Lambda), \mathbf{F}_p)$, where Λ is a $\mathbf{Z}[1/p]$-algebra. A basic idea is to stydy the extent to which the group $H_i(GL_n)$ stabilizes as n increases. This is discussed in Chapter 2, where stability theorems due to W. van der Kallen, Y. Nesterenko and A. Suslin are presented. Chapter 3 is devoted to low-dimensional cohomology groups and their connections to the Bloch group and hyperbolic 3-manifolds. In Chapter 4, computations of the homology of rank one groups via their actions on trees are presented, and generalizations of these results to groups of higher rank are also discussed. Chapter 5 is a comprehensive account of the Friedlander-Milnor conjecture on the homology of abelian groups made discrete, all known cases being discussed. Each chapter ends with exercises of varying level of difficulty. The book also includes three useful appendices on the homology of discrete groups, basic notions on classifying spaces and k-theory, and on fundamentals of étale cohomology.

The reading of the book assumes familiarity with algebraic topology and group cohomology, and also basic knowledge on algebraic groups and schemes, but it should be accessible to graduate students.

As many results are gathered here for the first time in a single volume, this book is highly recommended to students and researchers interested in group theory, algebraic topology, k-theory and algebraic geometry.

Andrei Marcus

Jaume Aguadé, Carles Broto, Carles Casacuberta Editors, *Cohomological Methods in Homotopy Theory.* Progress in Mathematics vol. 196, Birkhäuser Verlag, Boston-Basel-Berlin 2001, vii+415 pp, ISBN 3-7643-6588-9.

The volume contains a collection of article summarizing the state of knowledge in modern homotopy theory. The articles were assembled during 1998 and 1999, on the occasion of an emphasis semester organized by the Centre de Recerca Matemàtica (CRM), and its highlight the 1998 Barcelona Conference on Algebraic Topology (BCAT).

In addition, an advanced course on Classifying Spaces and Cohomology of Groups was organized by the CRM. The lecture notes from this course follow to be published by Birkhäuser Verlag as the first volume of a newly created CRM Advanced Course series.

The 25 articles incorporated in the present volume deal with topics as: abstract stable and unstable homotopy, model categories, homotopical localizations and cellular approximations, p-compact groups, modules over Steenrod algebras, classifying spaces for proper actions of discrete groups, K-theory and other generalized cohomology theories, cohomology of finite and profinite groups, Hochschild homology, configuration spaces, H-spaces, Liusternik-Schnirelmann category, stable and unstable splittings. Other talks treats multidisciplinary subjects related to quantum field theory, differential geometry, and various aspects of group theory.

A characteristic of the 1998 BCAT Conference was the participation of a large number of young researchers – more than 40% of contributed talks were given by people under 35.

The volume is addressed first to mathematicians interested in homotopy theory and geometric aspects of group theory. This informative and educational book is a welcome reference for many results and recent methods in homotopy and homology theories and their applications.

Paul Aurel Blaga

Carel Faber, Gerard van der Geer and Frans Oort Editors, *Moduli of Abelian Varieties.* Progress in Mathematics; Vol. 195, Birkhäuser Verlag, Basel-Boston-Berlin, 2001, ix+439 pp., ISBN 3-7643-6517-X.

Abelian varieties and their moduli spaces represent one of the most important subjects in algebraic geometry and number theory. Their study begun in the 19th century with the work of Kronecker, Klein, Weber on moduli of elliptic curves. Many remarkable results have been obtained in this area since 1970, most notable being the proof by Wiles of Fermat's last theorem. Important advances have been made in the investigation of moduli of higher dimensional abelian varieties.

The present volume is devoted to these topics, and consists of high quality articles related to the lectures given at the Conference on Moduli of Abelian Varieties held on Texel Island during the last week of April 1999. The list of contributors and their papers is as follows. *V. Alexeev*, On extra components in the functorial compactification of A_g; *A. Beilinson and A. Polishchuk*, Torelli theorem via Fourier-Mukai transform; B. Edixhoven, On the André-Oort conjecture for Hilbert modular surfaces; *G. Faltings*, Toroidal resolutions for some matrix singularities; *G. van der Geer and T. Katsura*, Formal Brauer groups and moduli of abelian surfaces; *E. Howe*, Isogeny classes of abelian varieties with no principal polarizations; *K. Hulek*, Igusa's modular form and the classification of Siegel modular threefolds; *Yu.I. Manin*, Mirror symmetry and quantization of abelian varieties; *B. Moonen*, Group schemes with additional structures and Weil group cosets; *I. Nakamura and T. Terasoma*, Moduli spaces of elliptic curves with Heisenberg level structure; *A. Ogus*, Singularities of the height strata in the moduli of K3 surfaces; *F. Oort*, A stratification of a moduli space of abelian varieties; *F. Oort*, Newton polygon strata in the moduli space of abelian varieties; *T. Wedhorn*, The dimension of Oort strata of Shimura varieties of PEL-type; *Yu.G. Zarhin*, Hyperelliptic Jacobians and modular representations; *Th. Zink*; Windows for displays of p-divisible groups.

The book is highly recommended to researchers in algebraic geometry, number theory and mathematical physics, who will find here an excellent overview of the state of the art in the field.

Andrei Marcus

L. Conlon, *Differentiable Manifolds* (2nd edition). Birkhäuser (Birkhäuser Advanced Texts, Basler Lehrbücher), 2001, 418 pp., Hardcover, ISBN 0-8176-4134-3

Since the publication of the first edition (1993), the textbook of manifolds of Conlon gained recognition as one of the best ones in the field. Although we published a review at that time, let us say a few words about the contents for those who are not already acquainted with the book.

The author starts with a description of topological manifolds, switches to a reformulation of classical multivariate calculus and then combines the two subjects to construct the elementary theory of smooth manifolds and mappings. This philosophy, of starting with simple, known objects and adapt them to build objects in the smooth category is one of the guiding principle of the book. There follows all the machinery necessary for the study of manifolds: vector fields and 1-forms, flows, tensor fields, integration and de Rham cohomology, but there are also introduced some particular classes of manifolds, endowed with extra structure, such as Lie groups and Riemannian manifolds, as well as more involved objects, as vector and principal bundles.

Some higher level material (e.g. degree theory modulo 2, Morse functions, Poincaré duality a.o.) are scattered through the text, but they are distinctively marked and can be skipped safely at a first reading.

For the second edition some extra material has been included and other has been modified, therefore the author dropped the subtitle "a first introduction" (which, I think, it wasn't appropriate, as such, in the first place). For the sake of the connaîsseurs of the first edition, let me mention just a couple of additions in the second edition: a treatment of the Whitney embedding theorem, the construction of the universal covering space, a proof of the de Rham theorem for singular and Čech cohomology.

The book remains a highly recommended textbook in smooth manifold theory. I think, anyway, that it should be used especially for graduate students (as probably was intended)

Paul Aurel Blaga

Kwok-Yan Lam ,Igor Shparlinski, Huaxiong Wang and Chaoping Xing Editors, *Moduli of Abelian Varieties*. Progress in Computer Science and Applied Logic; Vol. 20, Birkhäuser Verlag, Basel-Boston-Berlin, 2001, viii+378 pp., ISBN 3-7643-6510-2.

The rapid development of cryptography and computational number theory was the motivation behind the organization of the Workshop CCNT '99 which was held in Singapore during November 22–26, 1999.

This volume contains refereed papers and surveys on different aspects of the subject, such as: new cryptographic systems and protocols; new attacs on the existing cryptosystems; new cryptographic paradigms such as visual and audio cryptography; pseudorandom number generator and stream cipher; primality proving and integer factorization; fast algorithms; crytographic aspects of the theory of elliptic and higher genus curves; polynomials over finite fields; analytical number theory.

Let me list the authors and their contributions. *C. Alonso, J. Guttierez and R. Rubio*, On the dimension and the number of parameters of a unirational variety; *A. Conflitti*, On elements of high order in finite fields, *C. Ding, D.R. Kohel and S. Ling*, Counting the number of points on affine diagonal curves; *J. Friedlander, C. Pomerance and I.E. Shparlinski*, Small values of the Carmichael function and cryptographic applications; *J. von zur Gathen and F. Pappalardi*, Density estimates related to Gauss periods; *W. Han*, Distribution of the coefficients of primitive polynomials over finite fields, *J. Hoffstein and D. Lieman*, The distribution of the quadratic symbol in function fields and a faster mathematical stream cipher; *D. Kohel*, Rational groups of elliptic curves suitable for cryptography; *K.Y. Lam and F. Sica*, Effective determination of the proportion of split primes in number primes; *P. Mihalescu*, Algorithms for generating, testing and proving primes: a survey; *R. Peralta*, Elliptic curve factorization using a "partially oblivious" function; *A.J. van der Poorten*, The Hermite-Serret algorithm and $12^2 + 33^2$; *C.P. Xing*, Applications of algebraic curves to constructions of sequences; *N. Alexandris, M. Burmeister, V. Chrissikopoulos and Y. Desmedt*, Designated 2-verifier proofs and their application to electronic commerce; *E. Dawson, L. Simpson and J. Golić*, Divide and conquer attacks on certain irregularly clocked stream ciphers; *A. De Bonis and A. De Santis*, New results on the randomness of visual cryptography schemes; *D. Gollmann*, Authentication – Myths and misconceptions; *M.I. Gonzales Vasco and M. Naslund*; A survey of bit-security and hard core functions; *M.I. Gonzales Vasco and I.E. Shparlinski*, On the security of Diffie-Hellman bits; *J. Hoffstein and J.H. Silverman*, Polynomial rings and efficient public key authentication II; *P. Mihalescu*, Security of biased sources for cryptographic keys; *M. Naslund and A. Russell*, Achieving optimal fairness from biased coinflips; *P.Q. Nguyen*, The dark side of the hidden number problem: lattice attacks on DSA; *P.Q. Nguyen, I.E. Shparlinski and J. Stern*, Distribution of modular sums and the security of the server aided exponentiation; *R. Safavi-Naini and W. Susilo*, A general construction for fail-stop signatures using authentication codes; *R. Safavi-Naini and H. Wang*, Robust additive secret sharing schemes over $\mathbf{Z_m}$; *R.D. Silverman*, RSA Public key validation.

The book definitely gives a state of the art presentation of the most significant areas of research in this field. Some of the new results are presented here for the first time. It is a valuable addition to the literature, and I warmly recommend it to mathematicians, computer scientists, cryptographers and engineers.

Andrei Marcus

A. O. Petters, H. Levine, J. Wambsganss, *Singularity Theory and Gravitational Lensing.* Progress in Mathematical Physics Volume 21, Birkhäuser, Boston-Basel-Berlin, 2001, XXIV+603 pp, ISBN 3-7643-3668-4.

The book under review, unique monograph in the literature, is the first to develop a mathematical theory of gravitational lensing, the deflection of light by gravitational field. The theory applies to any finite number of deflector and highlights the distinctions between single and multiple plane lensing.

As *David Spergel* remarks in the Foreword of this book gravitational lensing was an important part of astronomy during the 1990's, and will likely be even more essential in this new millennium. With gravitational lensing observations, astronomers are addressing many of the most important scientific questions in astronomy and physics:

What is the universe made of?

How big is the universe?

How old is the universe?

What makes up most of the mass of the galaxy?

Are we alone?

What does the surface of a distant star look like?

What are the properties of the super-massive black holes in the centers of galaxies?

Introductory material in Parts I and II present historical highlights and the astrophysical aspects of the subject. Among the lensing topics discussed are multiple quasars, giant luminous arcs, Einstein rings, the detection of dark matter and planets with lensing, time delays and the age of the universe (Hubble's constant), microlensing of stars and quasars.

The main part of the book – Part III – employs the ideas and results of singularity theory to put gravitational lensing on a rigorous mathematical foundation and solve certain key lensing problems. Results are published here for the first time.

Mathematical topics discussed: Morse theory, Whitney singularity theory, Thom catastrophe theory, Mather stability theory, Arnold singularity theory, and the Euler characteristic via projectivized rotation numbers. These tools are applied to the study of stable lens systems, local and global geometry of caustics, caustic metamorphoses, multiple lensed images, lensed image magnification, magnification cross sections, and lensing by singular and nonsingular deflectors.

Examples, illustrations, bibliography and index make this a suitable text for an undergraduate/graduate course, seminar, or independent thesis project on gravitational lensing. The book is also an excellent reference text for professional mathematicians, mathematical physicists, astrophysicists, and physicists.

Ferenc Szenkovits

Reinhard Siegmund-Schultze, *Rockefeller and the Internationalization of Mathematics Between the Two World Wars. Documents and Studies for the Social History of Mathematics in the 20th Century*, Birkhäuser (Science Networks • Historical Studies, Volume 25), 2001, Hardcover, 341 pp., ISBN 3-7643-6468-8

The subject of this book is somehow exotic for the history of science. Usually, the scientists do not like to talk about money, funding and others of the same category, which seem not directly related to their work. Unfortunately, the truth is that money *is* important, and it is only fair to acknowledge the support that some individuals or foundations gave for the development of science.

The book is based on the research done by the author at the Rockefeller Archive Center and describes the support gave by the Rockefeller Foundation for the exchange and mobility of mathematicians all over the world between the two world wars.

The situation in mathematics (and, generally, in science) at the beginning of the 20th century was very different from the situation we know today. The young American mathematics was developing very fast. Still, it needed a lot of input from the "old" European science, materialized both in monographs and more experienced teachers and leaders. On the other hand, the American mathematics was more supported both by the state and private foundations. Even inside Europe, there were big differences between countries and regions. Each important mathematical center developed its own language and there was a lack of communication.

The Rockefeller Foundation supported, first of all, the mobility of mathematicians, for several purposes: some young mathematicians could, thus, continue their work under the supervision of well known experts, some established mathematicians were encouraged to travel and give lectures or exchange ideas with their colleagues.

An important event, also supported by the Rockefeller Foundation, was the creation of the Henri Poincaré Institute in Paris, an international institution meant to ease the contact between scientists (mainly mathematicians and physicists) from all over the world. Surprisingly, for the contemporary mathematician, they encountered serious language problems. The official language of the institute was French and, for instance, only few Americans were able to give lectures in this language.

Another aspect of the activity of the Rockefeller Foundation is the support it gave to the European mathematicians that were forced to immigrate to United States in the 30th.

Definitely, this an important book that should be read not only by the historians of science, but also (and especially) by the young mathematicians which are so eager today to obtain scholarship and travel. They will probably consider with more respect the opportunities they are offered.

Let me mention that the book includes many photographs of institutions, mathematicians and members of the Rockefeller family. The reference apparatus is, really, impressive.

Paul A. Blaga

Jacques Faraut, Soji Kaneyuki, Adam Korányi, Qi-keng Lu, Guy Roos, *Analysis and Geometry on Complex Homogenous Domains.* xvii + 540 pp., Progress in Mathematics vol. 185, Birkhäuser Verlag, Boston-Basel-Berlin 2000, ISBN 0-8176-4138-6

The present book has grown out of lectures delivered at the CIMPA (Centre International de Mathématiques Pures et Appliquées, Nice, France) Autumn School "Analysis and Geometry on Complex Homogeneous Domanis and Related Topics" held in Beijing, September 15-30, 1997. It consists of five relatively independent parts, each written by an expert in the subject. The aim of the book is to give an introduction to some of the most interesting directions of research in the analysis and geometry of homogeneous complex domains and, more generally, of homogeneous complex manifolds. Most of the recent results in this area are journal articles and require for reading (or, more exactly, for understanding) a considerable amount of preliminary knowledge. The exposition is rapid-paced and efficient , enabling the reader to grasp the essential and showing them that the required preliminary knowledge is not overhelming. Still the book is at advanced graduate level, requiring familiarity with the language and some basic facts of differential geometry, several complex variables, and with the basics of Lie groups. The theory of semisimple Lie algebras, needed for Part II and for some sections of Parts I and III, is briefly presented in Chapter II of Part III, together with a guide to the literature.

Homogeneous complex domains and, more generally, homogeneous complex manifolds, are domains in $\mathbb{C}^n$ (resp. manifolds) on which the group G of holomorphic automorphism acts transitively. The subject has its roots in the investigations done by É. Cartan starting with 1935, of bounded symmetric domains. É. Cartan proved that G is a semisimple Lie group, gave a classification of symmetric domains, and explicitly described all but two. The existence of these two exceptional domains, for which G's are exceptional Lie groups, was proved only in 1956 by Harish-Chandra, who actually gave a construction of all bounded symmetric domains without the use of their classification. This construction based on the theory of semisimple Lie algebras is presented in Part III, *Function spaces on bounded symmetric domains,* written by A. Korányi. A completely different approach to bounded domains, based on the theory of Jordan triple systems, was initiated in the nineteen sixties by M. Koecher. The algebraic theory of the Jordan triple systems is presented by Guy Roos in Part V. The other parts of the book are: I, *Function spaces on complex semi-groups,* by J. Faraut, II, *Graded Lie algebras and pseudo-hermitian symmetric spaces,* by Soji Kaneyuki, and IV, *The heat kernels of non compact symmetric spaces*, by Ki-keg Lu.

The volume will be useful as a graduate text for students on Lie groups with connections to complex analysis, as well as a self-study for the newcomers to the field. It gives them acquainted, in a considerable shorter time than other existing texts, with the major themes of the subject.

S. Cobzaş