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Book Reviews

Communicated by P. Hajnal

Sheldon Axler, Peter Rosenthal and Donald Saranson (eds.), **A Glimpse at Hilbert Space Operators, Paul R. Halmos in Memoriam** (Operator Theory: Advances and Applications, Vol. 207), viii+362 pages, Birkhäuser, Basel, 2010.

"Paul Richard Halmos, who lived a life of unbounded devotion to mathematics and to the mathematical community, died at the age of 90 on October 2, 1996. This volume is a memorial to Paul by operator theorists he inspired." — It is written by the editors in the Preface.

The first section contains reminiscences of Paul Halmos: "Paul Halmos – Expositor par excellence" by V.S. Sunder, "Paul Halmos: In his own words" by J. Ewing, "Obituary: Paul Halmos, 1916–2006" by H. Radjavi and P. Rosenthal, supplemented by G. Piranian's review on Halmos' "How to write mathematics". This section includes also the complete list of publications of Halmos, followed by an extensive gallery of photos of Paul or taken by Paul.

The main section of the volume consists of a collection of expository articles by prominent operator theorists on areas which were enriched and inspired by Halmos' research and questions. These surveys are the following: "What can Hilbert spaces tell us about bounded functions in the bidisc?" by J. Agler and J.E. McCarthy, "Dilation theory yesterday and today" by W. Arveson, "Toeplitz operators" by S. Axler, "Dual algebras and invariant subspaces" by H. Bercovici, "The state of subnormal operators" by J.B. Conway and N.S. Feldman, "Polynomially hyponormal operators" by R. Curto and M. Putinar, "Essentially normal operators" by K.R. Davidson, "The operator Fejér–Riesz Theorem" by M.A. Dritschel and J. Rovnyak, "A Halmos doctrine and shifts on Hilbert space" by P.S. Muhly, "The behaviour of functions of operators under perturbations" by V.V. Peller, "The Halmos similarity problem" by G. Pisier, "Paul Halmos and invariant subspaces" by H. Radjavi and P. Rosenthal, "Commutant lifting" by D. Sarason, and "Double cones are intervals" by V.S. Sunder.

Beyond giving tribute to the outstanding achievement of an excellent mathematician, this volume provides a marvelous panorama of developments in operator theory over the last fifty years.

László Kérchy (Szeged)

Tanja Eisner, **Stability of Operators and Operator Semigroups**, vii+204 pages, Birkhäuser, Basel, 2010.

This nice volume gives a good introduction to the asymptotic behaviour of linear dynamical systems. The stability of discrete and continuous semigroups are treated in parallel. More precisely, the convergence to zero of $\{T^n\}_{n=1}^{\infty}$ and $\{T(t)\}_{t\geq 0}$ in various specified ways is the main point of interest. Chapter I gives the necessary functional analytic background, including sections on compact semigroups, mean ergodicity, specific concepts from semigroup theory, and positivity in $\mathcal{L}(\mathcal{H})$. Chapter II deals with the stability of the powers of a linear operator; the topics discussed are power boundedness, strong stability, weak stability, almost weak stability, category theorems, and stability via Lyapunov's equation. Chapter III is devoted to the stability of C_0-semigroups with the topics of the previous chapter, supplemented by a section on uniform exponential stability. Chapter IV provides an overview of the connections to ergodic and measure theory, consisting of sections on stability and the Rajchman property, stability and mixing, and rigidity phenomena. Finally, Chapter V builds bridges between the discrete and continuous cases, discussing embedding operators into C_0-semigroups and cogenerators. The book ends with an extensive bibliography consisting of 266 items.

This volume leads to the frontiers of recent research in a rapidly developing area of mathematics. It can be warmly recommended to researchers and graduate students interested in this field.

László Kérchy (Szeged)

Shmuel Kantorovitz, **Topics in Operator Semigroups** (Progress in Mathematics, Volume 281), xiii+266 pages, Birkhäuser, Basel, 2010.

This book is a greatly expanded version of the author's previous monograph "Semigroups of Operators and Spectral Theory" (Pitman Research Notes 330, 1995). The author writes in the Preface: "We expose some aspects of the theory of semigroups of linear operators, mostly (but not only) from the point of view of its meeting with that part of spectral theory which is concerned with the integral representation of families of operators. This approach and selection of topics differentiate this book from others in the general area, and reflect the author's own research directions." The material is divided into three parts. The first part deals with the general theory, providing an introductory chapter on the basic theory involved, and pursued by discussion of topics on the semi-simplicity space for groups, analycity, the semigroup as a function of its generator, large parameter, boundary values, and pre-semigroups. The second part is devoted to integral representations, with sections on the semi-simplicity space, the Laplace–Stieltjes space, and families of unbounded symmetric operators. Finally, the third part gives a taste of applications in the areas of analytic families of evolution systems, and similarity. The volume ends with a collection of exercises, followed by historical notes and a bibliography.

This monograph is suitable for second-year graduate students, but it can be recommended also to any researcher interested in operator semigroups.

László Kérchy (Szeged)

Marcel Berger, **Geometry Revealed, A Jacob's Ladder to Modern Higher Geometry**, xvi+831 pages, Springer-Verlag, Berlin, 2010.

This is an excellent book on some branches of geometry written by Marcel Berger who is the author of several successful books. The present one, in a certain sense, can be regarded as an extension of the earlier monograph of the author (Geometry I-II.).

From the introduction: "Numerous problems of geometry that are quite visual and can be presented in a very simple manner have one or more of the following properties in common:

- they remain unsolved, or have been solved only recently following great efforts;
- for being well understood – and eventually completely or partly solved – they require the creation of concepts and tools that vary in their degree of abstraction, which is in any case greater than what is required for stating the problem;
- the mathematical tools used in solving them were conceived for quite other purposes."

The book contains twelve chapters, each of them is a collection of such problems about geometric objects with more and more complexity (see the table of contents below). According to the intention of the author, each chapter is a ladder. On the ground level the basic elementary geometric properties and problems of the corresponding object are discussed. After then, step by step, more and more advanced notions and topics are presented. In each step the necessity of a new concept is clearly motivated and their role in the solution of the corresponding problems are explained. As we climb up on the ladder our perspective is expanding. Finally we get a good survey on the present state of the subject with the most important unsolved problems of the area.

Table of contents: I. Points and lines in the plane, II. Circles and spheres, III. The sphere by itself: can we distribute points on it evenly? IV. Conics and quadrics, V. Plane curves, VI. Smooth surfaces, VII. Convexity and convex sets, VIII. Polygons, polyhedra, polytopes, IX. Lattices, packings and tilings in the plane, X. Lattices and packings in higher dimensions, XI. Geometry and dynamics I: billiards, XII. Geometry and dynamics II: geodesic flow on a surface.

The book is very readable, instead of the usual "definition, theorem, proof" structure the author uses informal description of the subject, no formulae and no unnecessary technical details. It is a great pleasure reading this book, it is a novel rather than a scientific monograph. There are lots of figures which help understanding the hard notions and ideas and at the end of each chapter huge number of references can be found.

This book can be used in different ways. The chapters are independent from each other, any of them can serve as a course. Researchers in geometry can use it as a source for further research. Maybe the most important point is that the book is accessible to a wide audience of people who are interested in geometry. The readers are led into the heart of the subject and one can feel that geometry is a wonderful and alive part of mathematics today.

János Kincses (Szeged)

W. Forst and D. Hoffmann, **Optimization — Theory and Practice**, xviii+420 pages, Springer-Verlag, Berlin, 2010.

Optimization is a hard part of mathematics. It requires firm knowledge of analysis in $\mathbb{R}^n$, algebra (mainly linear algebra) and geometrical imagination are also helpful (of course in high dimension). To understand important examples you should be familiar with statistics, finance, engineering and combinatorics. At the same time optimization is an important part of curriculum of economics, electrical engineering, statistics, applied and pure mathematics. It is not surprising that optimization has its roots in classical mathematics and since the introduction of linear programming techniques (the first half of the XXth century) optimization is a fast growing topic. So it is deep mathematics that should be available for a wide range of audience. If you teach or apply optimization you need a good source, that provide complete but easily available knowledge. This book intended to give you the right text. First let me quote the preface of the book, that explains the goal of the authors:

"This self-contained book on optimization is designed to serve a variety of purposes. It will prove useful both as a textbook for undergraduate and first-year graduate-level courses as well as a reference book for mathematicians, engineers and applied scientists interested in a careful exposition of this fascinating and useful branch of mathematics. Students, mathematicians and practitioners alike can profit from an approach which treats central topics of optimization in a concise, comprehensive and modern way."

The authors are aware of the fact that optimization is an important tool for outsiders too. "Optimization is not only important in its own right but nowadays forms an integral part of a great number of applied sciences such as operations research, management science, economics and finance, and all branches of math-oriented engineering. Constrained optimization models are used in numerous areas of application and are probably the most widely used mathematical models in operations research and management science." To help the application driven readers they provide many examples with detailed discussion of the numerical background.

The chapter headings are: Preface, 1. Introduction, 2. Optimality Conditions, 3. Unconstrained Optimization Problems, 4. Linearly Constrained Optimization Problems, 5. Nonlinearly Constrained Optimization Problems, 6. Interior-Point Methods for Linear Optimization, 7. Semidefinite Optimization, 8. Global Optimization; Appendices: A Second Look at the Constraint Qualifications, B The Fritz John Condition, C Optimization Software Tools for Teaching and Learning, Matlab Optimization Toolbox, SeDuMi: An Introduction by Examples, Maple Optimization Tools; Index of Symbols; Subject Index; Bibliography.

The authors explain the structure of the chapters in the preface: "Each chapter starts with a summary, is divided into several sections and ends with numerous exercises which reinforce the material discussed in the chapter. Exercises are carefully chosen both in content and in difficulty to aid understanding and to promote mastery of the subject."

The book is a marvelous introduction to a wonderful part of mathematics. It is appealing, easy to understand and at the same time serious mathematics is covered. Semidefinite programing is discussed in detail besides classical topics like Karush–Kuhn–Tucker conditions. It is certainly a good choice for required text in an introductory course on optimization.

Péter Hajnal (Szeged)