Bibliographie

Proceedings of Symposia in Pure Mathematics, Vol. III. **Differential Geometry,** VII+200 pages, Providence, R. I., American Mathematical Society, 1961.

This volume, edited by CARL. B. ALLENDOERFER, contains the material of the Symposium on Differential Geometry held at the University of Arizona in Tucson, Arizona, February 18—19, 1960. Its contents represent a wide variety of topics in global differential geometry. The papers in the volume are as follows: RAUL BOTT: A report on the unitary group, M. F. ATIYAH and F. HIRZEBRUCH: Vector bundles and homogeneous spaces, JOHN MILNOR: A procedure for killing homotopy groups of differentiable manifolds, D. C. SPENCER: Some remarks on homological analysis and structures, ALBERT NIJENHUIS: Vector form methods and deformations of complex structures, A. G. WALKER: Almost-product structures, ELDON DYER and R. K. LASHOF: Homology of principal bundles, JAMES EELLS, JR.: Alexander—Pontrjagin duality in function spaces, RICHARD S. PALAIS: The cohomology of Lie rings, LUIS AUSLANDER: On the theory of solvmanifolds and generalization with applications to differential geometry, WILLIAM M. BOOTHBY: Homogeneous complex contact manifolds, EUGENIO CALABI: On compact Riemannian manifolds with constant curvature, I. L. NIRENBERG: Elementary remarks on surfaces with curvature of fixed sign, SHOSHICHI KOBAYASHI: Canonical forms on frame boundles of higher order contact, HANS SAMELSON: On immersions of manifolds.

Each of the papers in this volume reports on significant new developments in research.

J. Szenthe (Szeged)

R. Engelking, Outline of general topology, 388 pages, North-Holland Publishing Company, Amsterdam—PWN Polish Scientific Publishers, Warszawa, 1968.

This book is an excellent introduction to modern concepts and results of general topology intended for readers familiar with elementary analysis and set theory, e. g. for graduate students or specialists in any branch of mathematics.

The text consists of an Introduction and eight chapters. The Introduction enumerates basic notions and results of set theory needed in the following, in general without proofs. Chapter 1 introduces topological spaces, various methods of generation of a topology, important kinds of sets in a topological space, continuity, separation axioms, and convergence of nets and filters. Chapter 2 deals with operations on topological spaces such as construction of subspaces, sums, products, quotients, inverse limits and mapping spaces. Chapter 3 is devoted to compact spaces, compactifications of Tychonoff spaces, locally compact spaces, Lindelöf spaces, completeness in the sense of Čech, countably compact spaces, pseudo-compact spaces, and real-compact spaces. Chapter 4 summarizes basic properties of metrizable spaces including the metrization theorems of Nagata—Smirnov and Bing. Chapter 5 gives a survey on paracompact, countably paracompact, weakly paracompact (=metacompact), and strongly paracompact spaces. The subject of Chapter 6 is a short outline of elementary properties of connected spaces and the analysis of various kinds of disconnectedness. The latter subject serves as an introduction to Chapter 7, dealing with dimension theory; here the dimensions ind, Ind, dim are introduced for regular, normal, and Tychonoff spaces respectively, their fundamental properties are presented, and the equalities dim $X=\text{Ind } X$ for metrizable X, ind $X=\dim X=\text{Ind X}$ for separable metrizable X, ind $X=\dim X=\text{Ind } X=n$ for $X=R^n$ are proved (the latter is based on Brouwer's fix point theorem, the proof of which is added in an Appendix). Finally Chapter 8 contains basic concepts and results of the theory of uniform and proximity spaces.

In the formulation of definitions and the choice of terminology, simplicity is preferred to most possible generality. E. g. mapping denotes a continuous mapping, regular spaces have to be T_1, compact spaces are necessarily T_2, Lindelöf spaces are regular by definition, etc. The proofs are extremely clear, the connections are pointed out perfectly. All concepts are illustrated by well-chosen examples and counter-examples exposed in a sufficiently detailed manner (and not left to the reader like in many monographs). Each section is followed by exercises and each chapter by a rich collection of problems. Among them one finds quite a lot of important theorems belonging to the classical results of the theory. Extraordinarily valuable are the historical remarks and bibliographic notes standing at the end of each chapter. A Bibliography of 14 pages and a very practical Subject Index are useful supplements of this outstanding work.

Ákos Császár (Budapest)

A. Zygmund, Trigonometric series, vol. I and II, XIV+383 pages and VII+364 pages, reprint of the second edition, bound in one volume, Cambridge University Press, New York, 1968.

The first edition of this book was published in Warsaw in 1935. It presented a concise account of the main results known by then, and before long it became the "Bible" of the analysts interested in trigonometric series, Fourier series and related branches of pure mathematics. Indeed, the first edition was three times reprinted in New York between 1940 and 1955; nevertheless, one volume of 330 pages considerably limited the amount of the discussed material.

The theory of trigonometric series has progressed a good deal since 1935, and Professor Zygmund took full account of this great development. The second edition of his monograph, published in Cambridge in 1959, treats exhaustively this field so vastly enriched by recent investigations. It consists of two volumes, and totals over 750 pages, introducing many topics that had not been considered in the first edition. In particular, Volume I contains, essentially, the completely rewritten material of the original work. Volume II provides much material previously not treated in textbooks.

The second edition is, as the first one, devoted to the classical theory of trigonometric series. Recent extensions of the theory to abstract fields such as the theory of groups, algebra, theory of numbers, etc. has been deliberately left aside.

Despite of the intricacy and the vast dimensions of the material discussed, Professor Zygmund's complete mastery of his subject makes it eminently readable.

The book under review is a reprint of the second edition, bound in one volume, correcting a number of errors and including a more comprehensive index.

Finally, may the reviewer venture to express his particular desire to take some time the third edition of this work in his hands, complemented with an account of the research done in the field in the sixties, in particular with the results of L. Carleson and R. A. Hunt. Conceivably, these discoveries might considerably influence the development in years to come, although the present-day methods of the cited authors are very complicated and tortuous. The reviewer is hopeful that these questions in Professor Zygmund's presentation will prove to be more accessible to anyone interested in this field.

The above desire of the reviewer naturally does not concern the value of this almost perfect work at all. Every analyst should be familiar with this rich and beautiful book.

Ferenc Móricz (Szeged

D. G. Northcott, Lessons on rings, modules and multiplicities, XIV+414 pages, Cambridge, University Press, 1968.

This comprehensive book is a clear and modern introduction to the theory of rings and modules. It contains a large material in these fields including numerous results developed crly in the past ten to fifteen years.

The book consists of nine chapters. Chapter 1 has an introductory character. It contains among other things the concepts of homomorphism and isomorphism, submodule, factor module, composition series, maximal and minimal conditions, direct sum, ring of endomorphisms, simple and semi-simple ring, exact sequence and free module. Here are presented also the isomorphism theorems for left R-modules. Chapter 2 deals with the prime ideals and integral domains, minimal prime ideals, integral extensions, primary and homogeneous primary decompositions, and graded rings and modules. Chapter 3 contains investigations on rings and modules of fractions. The subject of Chapter 4 and 5 is the study of the Noetherian and Artin rings and of the semi-regular rings, especially the semiregular polynomial rings. In Chapter 6 the Hilbert ring of polynomials with coefficients in a field is studied. Chapter 7 is devoted to the development of the theory of algebraic multiplicities on Noetherian left R-modules. The limit formulae of Lech and Samuel and a few investigations on Hilbert functions are also presented here. The aim of Chapter 8 is to show how the properties of the Koszul complex throw light on certain aspects of the multiplicity theory and the theory of grade. Finally, Chapter 9 deals with the study of filtered rings and modules.

There are a lot of good exercises at the end of each chapter, helping the understanding of the material.

I. Peák (Szeged)

Hans Grauert—Wolfgang Fischer, Differential- und Integralrechnung. II (Heidelberger Taschenbücher, Bd. 36), XII+216 Seiten, Berlin—Heidelberg—New York, Springer-Verlag, 1968.

Hans Grauert—Ingo Lieb, Differential- und Integralrechnung. III (Heidelberger Taschenbücher, Bd. 43), X+177 Seiten, Berlin—New York, Springer-Verlag, 1968.

Band I ist im Jahre 1967 veröffentlicht und wurde schon vorherig (diese *Acta,* **19** (1968), 215) besprochen. Der vorliegende Band II betrachtet die Differentialrechnung für reelle Funktionen von mehreren Veränderlichen und die Theorie der gewöhnlichen Differentialgleichungen. Band III beschäftigt sich mit der Integralrechnung für reelle Funktionen von mehreren Veränderlichen einschließlich der Theorie der Kurven- und Flächenintegralen. Als Vorkenntnis ist nur der Stoff von Band I und Bekanntschaft mit der linearen Algebra vorausgesetzt. Die Behandlungsweise dieser Bände ist — wie im Band I — sehr klar und exakt; die moderne Terminologie der Analysis ist angewendet. Als ein weiterer großer Vorteil dieser Bände soll es erwähnt werden, daß sie trotz dem verhältnismäßig kleinen Umfang einen großen Stoff enthalten. Neben den gewöhnlichen, grundlegenden Fragen werden z. B. die rektifizierbaren Kurven, die kontra- und kovarianten Tangentialvektoren, sowie Pfaffsche Formen auf exakte Weise definiert und betrachtet; neben den grundlegenden elementaren Tatsachen werden die wichtigsten Stabilitätsaussagen und Sätze über den Definitionsbereich und die Differenzierbarkeit der allgemeinen Lösung, die Zusammenhang zwischen Differentialgleichungen und Pfaffschen Formen, die Theorie der linearen Systeme mit den benötigten Tatsachen bis zur Jordanschen Normalform einer Matrix, die für den Physiker wichtigen Differentialgleichungen mit Randwerten behandelt; die Betrachtung der Integrationstheorie enthält das Lebesguesche und das Lebesgue-Stieltjessche Integralbegriff und die Integration nach dem Diracschen Maß; die Absolutstetigkeit der Integralfunktion wird in Band III bewiesen; als Anwendung der Integrationstheorie werden die Maxwellschen Gleichungen betrachtet.

Die Behandlungsweise hat viele eigentümliche Züge. Besonders merkwürdig ist die Weise, auf die der n-dimensionale Integralbegriff eingeführt ist. Dadurch gelingt es die Ergebnisse leichter auf allgemeinere Fälle, z. B. auf Funktionen mit Werten in einem topologischen Vektorraum zu übertragen, und die Behandlung stellenweise zu vereinfachen. Diese Behandlungsweise ist aber weniger anschaulich. Im Text gibt es keine Beispiele und Übungsaufgaben. Diese Bände sind in erster Reihe für diejenigen Leser nützlich, die die Elemente dieses Problemkreises schon kennen; diese Leser bekommen aus diesen Büchern eine moderne und exakte Übersicht der Differential- und Integralrechnung.

K. Tandori (Szeged)

Géza Freud, Orthogonale Polynome, 294 Seiten, Budapest, Akadémiai Kiadó; Berlin, VEB Deutscher Verlag der Wissenschaften; Basel, Birkhäuser Verlag, 1969.

Das Buch gibt eine gute, zeitgemäße Übersicht der allgemeinen Theorie der Orthogonalpolynome. Nach der Erscheinung der klassischen Monographie von G. Szegő ist dies das erste Buch, das diesen Problemkreis genügend umfassend behandelt, und auch die neueren Ergebnisse in einer einheitlichen Behandlungsweise zusammenfaßt. Verf. beschäftigt sich nämlich mit den Resultaten, die lauter aus den beiden Tatsachen hergeleitet werden können, daß es sich um Polynome handelt, und daß die Folge der Polynome bezüglich einer vorgegebenen Belegung ein Orthogonalsystem bilden; viele Sätze über spezielle Orthogonalpolynomsysteme können so wesentlich einfacher und logisch durchsichtiger bewiesen werden.

In Kapitel I sind die grundlegenden Eigenschaften der Orthogonalpolynome behandelt: Rekursionsformel, Lage der Nullstellen, die Gauß-Jacobische Quadraturformel, die Markoff-Stieltjessche Ungleichung, elementare Abschätzungen, klassische orthogonale Polynome. Kapitel II beschäftigt sich mit den Elementen der Theorie des Hamburger-Stieltjesschen Momentenproblems: Lösbarkeit, Bedingungen für die Eindeutigkeit, Zusammenhang zwischen der Eindeutigkeit des Momentenproblems und der Approximation durch Polynome, die Vollständigkeit des Orthogonalpolynomensystems, Eindeutigkeitskriterium von M. Riesz. Kapitel III behandelt die Quadraturverfahren und Interpolation über die Nullstellen der Orthogonalpolynome, Kapitel IV aber die Konvergenz- und Summationstheorie der Orthogonalpolynomreihen. Endlich, in Kapitel V, ist die Theorie von G. Szegő betrachtet: die Orthogonalpolynome auf dem Einheitskreise, die Szegősche Extremumaufgabe, Hardyklassen, Asymptotik der Orthogonalpolynome.

Am Ende des Buches befinden sich ein Nachwort über offene Probleme, eine Bibliographie und ein Namen- und Sachverzeichnis. Am Ende der einzelnen Kapitel gibt es auch historische Bemerkungen und Aufgaben. Als Vorkenntnis werden — außer den üblichen Grundlagen der Analysis — nur die Elemente der reellen und komplexen Funktionentheorie vorausgesetzt.

K. Tandori (Szeged)

Kurt Schütte, Vollständige Systeme modaler und intuitionistischer Logik (Ergebnisse der Mathematik und ihrer Grenzgebiete, Band 42), VI+87 pages, Berlin—Heidelberg—New York, Springer-Verlag, 1968.

The monograph discusses extensions to predicate calculus of the propositional calculi M of von Wright and S 4 of Lewis. The semantics of these extensions is defined by the method of Kripke and a consistency and a completeness proof are given, the latter also providing a decision procedure for the propositional parts of the systems. A less constructive but simpler completeness proof based on Henkin's ideas is also given.

The Kripke semantics of the intuitionistic predicate calculus is given by its imbedding in the above-mentioned extension of S 4. A comparison between this method and Beth's is made. The book is concluded by a special account of modal systems of propositional calculus.

A. Máté (Szeged)

Paul Lorenzen, Einführung in die operative Logik und Mathematik (Die Grundlehren der Mathematischen Wissenschaften in Einzeldarstellungen, Band 78), second edition, 298 pages, Berlin—Heidelberg—New York, Springer-Verlag, 1969.

This second edition is, apart from the correction of some minor typographical errors and a slight change of the notational framework by adapting it to recent literature on the subject, an unchanged reprint of the first one published in 1955.

The book consistently and comprehensively elaborates a new way to the foundation of mathematics. The effectiveness of this method, as regards the provability of theorems, lies somewhere between intuitionism and classical mathematics. The approach to the problems of foundations is motivated by the philosophical principle that mathematics is a study of calculi of finite systems; thus the theorems of a mathematical discipline are considered as strings of a finite number of signs that are deducible with the aid of certain given starting strings and transformation rules. This may immediately recall the formalistic method by its treatment of mathematical disciplines as, in fact, a logical calculus on systems of axioms; nevertheless, there are very essential differences. Indeed, as regards the formalistic approach, it can be said that the use of the calculi on axiom systems is only descriptive of the discipline in question, whereas in the operative method the discipline itself is considered as the calculus. It should not be forgotten either that the former way gives logics an extra treatment, as this consists of the rules of the game on axiom systems, while the latter builds up logics within its operative framework. Thus Lorenzen's approach definitely has an advantage over formalism in that its edifice is not threatened by contradictions; though this is not obtained without price.

The work contains accounts of the operative treatment of logics, arithmetics, a substitute, called "layers of language", for either a higher-order language or set theory, analysis (essentially leaving intact the strength of the classical approach to analysis, especially as far as applications are concerned), and abstract mathematics; this last part deals with the merits of the axiomatic method within the operative framework. *A. Máté* (Szeged)

Andrew H. Wallace, Differential Topology, First Steps, XI + 130 pages, W. A. Benjamin, Inc., New York—Amsterdam, 1968.

The interest in differential topology is considerably increasing even among those who are not working in this field since it seems to become indispensable for several theories. A textbook on differential topology, however, should presuppose familiarity with algebraic topology to an extent which is not general. With these facts in mind the author has selected some topics in differential topology which admit a less technical approach, and composed of them this introduction.

The first chapter contains the prerequisites from point set topology. The second one, starting with differentiable maps in euclidean spaces, gives the definition of differentiable manifolds and of differentiable manifolds with boundary. Submanifolds are defined and a sketchy proof of the theorem on embedding a differentiable manifold in a euclidean space is given in the third chapter. Critical points of differentiable functions on differentiable manifolds are defined in the fourth chapter and a stronger embedding theorem is formulated, stating that a differentiable manifold with a differentiable function on it, having only non-degenerate critical points and finite in number, can be embedded in a euclidean space in such a way that the function will coincide with one of the coordinate functions. Neighborhoods of critical and non-critical levels of differentiable functions on differentiable manifolds with boundary are considered in the fifth chapter. These are treated as levels of coordinate functions of euclidean spaces on their differentiable submanifolds. The change of a non-critical level manifold when passing a non-degenerate critical level is considered as the result of an operation, called spherical modification, in the sixth chapter. The importance of this operation is illustrated by several theorems and examples. As an application of results on critical points, especially of theorems about spherical modifications the compact 2-dimensional manifolds are classified in the seventh chapter. The eighth one contains ideas such as killing of homotopy classes, complementary modifications and cancellation, to indicate in what direction can the subject be developed further.

As the above summary shows the author treats that part of differential topology which has evolved from MORSE's theory. Stress is laid more on the intuitive geometric ideas and less on tecnicalities; accordingly proofs are sometimes arranged in a sequence of exercises or only motivated. Examples and exercises are added to help and check understanding. The author managed to give, without prerequisites and in a relatively very short space, an overall account of the subject.

J. Szenthe (Szeged)

K. M. Kapp and H. Schneider, Completely O-simple semigroups. An abstract treatment of the lattice of congruences, X+110 pages, W. A. Benjamin, Inc., New York—Amsterdam, 1969.

The monograph contains many new results on completely O-simple semigroups and is a valuable contribution to the theory of this important class of semigroups.

Let S be a completely O-simple semigroup and let $\mathfrak{C}$ denote the lattice of all congruences on S. Let $(a)_l$, $(a)_r$ and (a) denote the principal left ideal, the principal right ideal and the principal two-sided ideal generated by a. Moreover, let $\mathcal{L}, \mathcal{R}, \mathcal{F}, \mathcal{H}$ and $\mathcal{D}$ be the Green's relations defined by $a \mathcal{L} b \Leftrightarrow (a)_l = (b)_l$, $a \mathcal{R} b \Leftrightarrow (a)_r = (b)_r$, $a \mathcal{F} b \Leftrightarrow (a) = (b)$ for all a, b ($\in S$), and $\mathcal{H} = \mathcal{L} \cap \mathcal{R}$ $\mathcal{D} = \mathcal{L} \circ \mathcal{R} (= \mathcal{R} \circ \mathcal{L})$. For a fixed $\mathcal{H}$-class H of S, which is a nonzero group, let $\mathfrak{N}$ be the lattice of all normal subgroups of H. Furthermore, let $\mathfrak{L}$ and $\mathfrak{R}$ denote the lattices of all equivalence relations on the set of all $\mathcal{L}$-classes and on the set of all $\mathcal{R}$-classes, respectively. By the Main Theorem of the first part of the book $\mathfrak{C}$ is isomorphic to a complete sublattice of the Cartesian product $\mathfrak{R} \times \mathfrak{N} \times \mathfrak{L}$. In § 9 necessary and sufficient conditions for the existence of a Brandt congruence on S are given and the sublattice of $\mathfrak{C}$ consisting of all Brandt congruences is studied. The later sections of the book are devoted to the study of chains in $\mathfrak{C}$ and it is proved that $\mathfrak{C}$ is an upper semimodular lattice and hence $\mathfrak{C}$ satisfies the Jordan-Dedekind chain condition. § 12 deals with the matrix representation of completely O-simple semigroups.

I. Peák (Szeged)

I. G. Macdonald, Algebraic Geometry: Introduction to Schemes (Mathematics Lecture Note Series), 113 pages, New York—Amsterdam, W. A. Benjamin, Inc., 1968.

Based on a series of lectures delivered at the University of Sussex in 1964—65, this book presents a brief introduction to the language of schemes. It is of primary interest to postgraduates in classical geometry, and is useful as well to pure mathematicians. An elementary knowledge of algebra and topology is assumed. Contents: Introduction. Noetherian spaces. The spectrum of a commutative ring. Presheaves and sheaves. Affine schemes. Preschemes. Operations of sheaves, quasi-coherent and coherent sheaves. Sheave cohomology. Cohomology and affine schemes. The Riemann-Roch theorem. Bibliography.

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