



THE THEORY OF SHEAVES

By RICHARD G. SWAN

The theory of sheaves is a fundamental advanced branch of algebraic topology; the subject is closely connected with a number of other branches of mathematics using the techniques of homological algebra. This is the first volume in a new series, *Chicago Lectures in Mathematics*.

160 pages, Paper \$2.00

A MODERN ALGEBRA FOR BIOLOGISTS

By HOWARD M. NAHIKIAN *with a Foreword by* N. RASHEVSKY

An advanced textbook which puts emphasis on the biological applications of contemporary algebraic theories.

212 pages \$10.00

CONTINUED FRACTIONS

By A. YA. KHINCHIN

This translation of a little book by a celebrated Russian mathematician is suited for young students with a beginning knowledge of mathematics, and might serve as a novel introduction to the field.

Cloth \$5.00
Paper \$1.95

THE CALCULUS: A GENETIC APPROACH

By OTTO TOEPLITZ

"Highly recommended for independent study, or as supplementary reading suggested to classes in introductory (or even advanced) calculus."—ROBERT BREUSH, *Amherst College*

Cloth \$6.50
Paper \$1.95

THE UNIVERSITY OF CHICAGO PRESS
**Chicago and
London**

Important new books from Holden-Day

COUNTEREXAMPLES IN ANALYSIS, by *Bernard R. Gelbaum, University of California, Irvine, and John M. H. Olmsted, Southern Illinois University*

Intended mainly for browsing, this unique book will also unify mathematical ideas by providing insights into analysis. An excellent supplement to any standard text in advanced calculus or real analysis, much of the material will also be suitable for students who have not yet completed a first course in the calculus. Graduates will find it invaluable in preparing for examinations for advanced degrees, and even mature experts will find much of the reading new and worthwhile. \$7.95

ELEMENTS OF GENERAL TOPOLOGY, by *Sze-Tsen Hu, University of California, Los Angeles*

An introductory first course on general topology for advanced undergraduates and graduates in mathematics. Basic concepts, fundamental properties and important constructions are emphasized in the first three chapters; the final three present some more specific topological topics which either have not yet appeared in book form, or have appeared only in advanced treatises—cellular polytopes, function spaces, and fundamental groups—which should be of interest to all mathematicians, and not simply to specialists in topology. \$8.75

ELEMENTARY ANALYSIS, by *Richard F. McCoart, Malcolm W. Oliphant, and Anne E. Scheerer, Georgetown University*

An introductory text providing a logical, rather than an intuitive "problems," approach to the basic concepts of the calculus. A number of topics, carefully selected, are covered thoroughly, with emphasis on accurate mathematical reasoning. Appropriate for courses dealing with the ideas of the calculus for liberal arts students or the new curriculum teacher training, it can also be used as a first text in the usual calculus sequence for mathematics and science majors. \$7.95

HOLDEN-DAY, INC. 728 Montgomery Street, San Francisco 11, California

MATHEMATICS OF COMPUTATION

MATHEMATICS OF COMPUTATION is published quarterly by the American Mathematical Society for the National Academy of Sciences, National Research Council, Washington, D.C.

The journal is devoted to advances in numerical analysis, the application of computational methods, mathematical tables, high speed calculators and other aids to computation. Regularly featured are a section for reviews and descriptions of tables and books, and a section for table errata.

The journal is published quarterly in one volume per year with issues numbered serially since Volume 1, Number 1.

Subscriptions per year

List Price \$16.00

Member Price \$8.00

Order from

AMERICAN MATHEMATICAL SOCIETY
190 Hope Street, Providence, Rhode Island 02906



**New Wiley and Interscience
books for mathematicians**

LECTURES ON MODERN MATHEMATICS—Volume 2

Edited by T. L. SAATY, Office of Naval Research. The second volume of an outstanding lecture series given at George Washington University. Each chapter provides an expert, up-to-date evaluation of the accomplishments and future direction of research in a specific area of mathematics. 1964. 183 pages. \$5.75.

MULTIDIMENSIONAL GAUSSIAN DISTRIBUTIONS

By KENNETH S. MILLER, New York University and Visiting Professor of Engineering Mathematics, Columbia University, 1962-64. The latest publication in the *SIAM Series in Applied Mathematics*, this book provides a clear, concise, and crisp presentation of the subject. 1964. 129 pages. \$9.50.

READINGS IN MATHEMATICAL PSYCHOLOGY—Volume II

Edited by R. DUNCAN LUCE, University of Pennsylvania; ROBERT R. BUSH, University of Pennsylvania, and EUGENE GALANTER, University of Washington. Contains 33 important research papers. 1964. Approx. 736 pages. Prob. \$8.95.

TENSOR ANALYSIS: Theory and Application to Geometry and Mechanics of Continua—Second Edition

By I. S. SOKOLNIKOFF, University of California, Los Angeles. A thoroughly up-dated edition that offers extended discussion of applications. 1964. 361 pages. \$9.75.

DIFFERENTIAL EQUATIONS OF MATHEMATICAL PHYSICS

By N. S. KOSHYLYAKOV, Moscow. Translated from the Russian. Examines a number of physical and technical problems involving second-order partial differential equations with attention to both theory and applications. A North-Holland (Interscience) Book. 1964. 701 pages. \$21.00.

LIMIT THEOREMS FOR CONVOLUTIONS

By HARALD BERGSTRÖM. Presents a new method that permits the generalization of classical limit theorems to multi-dimensional problems. 1963. 247 pages. \$15.00.

MONTE CARLO METHODS

By J. M. HAMMERSLEY, Oxford University Institute of Economics and Statistics; and D. C. HANDSCOMB, Oxford University Computing Laboratory. A comprehensive discussion of this important branch of applied mathematics. One of the Methuen Monographs on Applied Probability and Statistics. 1964. 178 pages. \$4.75.

JOHN WILEY & SONS, Inc.
605 Third Avenue New York, N.Y. 10016

**MATHEMATICAL PUBLICATIONS
OF THE
POLISH ACADEMY OF SCIENCES**



Published by the State Science Publishers

ACTA MATHEMATICA

One of the world's leading publications devoted to the theory of numbers; an organ of the Mathematical Institute of the Polish Academy of Sciences. Publication was started in 1935, and resumed after the war with Volume 4, Paper 1. The publication appears in volumes of 4 papers each, printed in English, French, German and Russian.

Recently published: Vol. 8, Paper 4. 121 pp. 1963. \$2.50
(Starting with Volume 10, price will be \$3.00.)

COLLOQUIUM MATHEMATICUM

Published since 1948; now an organ of the Mathematical Institute. Contains articles on various branches of mathematics and science, and a chronicle of mathematical activity in Poland. All papers are printed in English, French, German and Russian.

Recently published: Vol. II, Paper 1. 140 pp. 1963. \$3.50

FUNDAMENTA MATHEMATICA

Continuation of a pre-war publication, started in 1920. Contains original works by leading Polish and other mathematicians on mathematical fundamentals, theory of numbers, topology, real functions, abstract algebra, and mathematical logic. Printed in English, French, German and Russian. Pre-war volumes are now being reprinted by photo-offset; by 1965 all volumes will be reprinted.

Recently published: Vol. 23, Paper 2, 193 pp. 1963. \$2.50

In the United States, order from:

STECHERT-HAFNER, Inc.
31 East 10th Street, New York, N. Y. 10003

Sole Exporter:
ARS POLONA
7 Krakowskie Przedmiescie, Warsaw, Poland

Journals Published by the American Mathematical Society

Soviet Mathematics—Doklady

SOVIET MATHEMATICS—DOKLADY is a translation journal containing the entire pure mathematics section of the DOKLADY AKADEMIĖ NAUK SSSR, the Reports of the Academy of Sciences of the USSR. The DOKLADY for a year contains more than 500 articles, each about 4 pages long. Issued bimonthly in January, March, May, July, September, and November.

Subscriptions, \$35.00.

Single issues are \$7.00. Vols. 1, 2, 3, and 4 (1960–1963), price per volume \$40.00.

Mathematical Reviews

This journal is devoted to abstracts and reviews of the current mathematical literature of the world. Two volumes of MATHEMATICAL REVIEWS will be published in 1964, Volume 27 and Volume 28. Each volume will consist of 6 regular issues plus an index issue. In each regular issue the abstracts and reviews are grouped under subject headings. Publication began in 1940. Subscription price per volume of 7 issues is \$50.00; 2 volumes per year \$100.00.

Prior to 1961 it appeared in eleven single issues. Orders for complete volumes only are accepted. Volumes 1–24 are available at the following prices: Vols. 1–16 (1940–1955), \$42.00 each; all other volumes \$50.00.

Notices of the American Mathematical Society

This journal announces the programs of the meetings of the Society. It carries the abstracts of all contributed papers presented at the meetings of the Society and publishes news items of interest to mathematical scientists.

The subscription price is \$7.00 per annual volume of seven numbers. A single copy is \$2.00. Orders for back volumes (back issues of the last two years only are available) are \$14.00 per volume.

All communications should be addressed to the Editor, 190 Hope Street, Providence, Rhode Island 02906. News items and insertions for each issue must be in the hands of the editor on or before the deadline for the abstracts for the papers to be presented in the meetings announced in that issue. These deadlines are published regularly on the back of the title page.

Mathematics of Computation

A journal devoted to original papers in numerical analysis, the application of numerical methods and high-speed calculator devices, the computation of mathematical tables, the theory of high-speed calculating devices and other aids to computation. In addition it publishes reviews and notes in these and related fields. Published by the Society for the National Academy of Sciences–National Research Council.

Prospective publications should be addressed to the Editor, Dr. Harry Polachek, Technical Director, Applied Mathematics Laboratory, David Taylor Model Basin, Washington, D. C. 20007. The author may suggest the name of an editor for review of his paper.

The subscription price is \$8.00 per volume of 4 issues. Single copies are \$2.50. Back issues insofar as they are available: (1943–1962) \$3.00 per issue; \$12.00 per volume. Write for specific information concerning availability.

Chinese Mathematics—Acta

This is a cover-to-cover translation into English of Acta Mathematica Sinica published by Academia Sinica Peking, People's Republic of China. Acta Mathematica Sinica contains current research in all fields of pure mathematics. Subscription price per volume \$20.00.

Volume 1, 1962 of the translation (corresponding to Volume 10, 1960 of the original) contained three issues. Volume 2, 1963 (Volume 11, 1961) and Volume 3, 1963 (Volume 12, 1962 of the original) will have four issues. In each case the translation will have the same number of issues as the original.

Back volumes \$30.00; single issue price one third of the volume price.

Journals Published by the American Mathematical Society

Bulletin of the American Mathematical Society

This journal is the official organ of the Society. It reports official acts of the Society and the details of its meetings. It contains some of the officially invited addresses presented before the Society, reviews of advanced mathematical books, research problems and a department of research announcements.

The subscription price is \$7.00 per annual volume of six numbers.

Research Problems and Invited Addresses offered for publication should be sent to WALTER RUDIN, Department of Mathematics, University of Wisconsin, Madison, Wisconsin; Book Reviews to FELIX BROWDER, Department of Mathematics, University of Chicago, Chicago 37, Illinois. Research Announcements offered for publication should be sent to some member of the Council of the Society, and communicated by him to E. H. SPANIER, Department of Mathematics, University of California, Berkeley 4, California. All other communications to the editors should be sent to the Managing Editor, FELIX BROWDER.

The members of the Council for 1964 are: A. A. Albert, H. A. Antosiewicz, Lipman Bers, Felix Browder, R. C. Buck, Eugenio Calabi, S. S. Chern, P. E. Conner, C. W. Curtis, M. L. Curtis, D. A. Darling, J. L. Doob, G. F. D. Duff, Eldon Dyer, J. W. Green, P. R. Halmos, G. A. Hedlund, M. H. Heins, L. A. Henkin, Edwin Hewitt, A. S. Householder, G. A. Hunt, Nathan Jacobson, Fritz John, V. L. Klee, P. D. Lax, M. M. Loève, R. C. Lyndon, G. W. Mackey, Lawrence Markus, W. S. Massey, A. E. Meder, Jr., J. W. Milnor, G. D. Mostow, Louis Nirenberg, R. S. Pierce, Everett Pitcher, Alex Rosenberg, Walter Rudin, Seymour Sherman, I. M. Singer, E. H. Spanier, J. D. Swift, Michio Suzuki, A. E. Taylor, J. V. Wehausen, John Wermer, George Whaples, Daniel Zelinsky, Leo Zippin, Antoni Zygmund.

Proceedings of the American Mathematical Society

This journal is devoted entirely to research in pure and applied mathematics and is devoted principally to the publication of original papers of moderate length. A department called Shorter Notes was established for the purpose of publishing very short papers of an unusually elegant and polished character, for which there is normally no other outlet.

The subscription price is \$11.00 per annual volume of six numbers.

Papers in algebra and number theory should be sent to ALEX ROSENBERG, Department of Mathematics, Cornell University, Ithaca, New York or GEORGE WHAPLES, Department of Mathematics, Indiana University, Bloomington, Indiana; in probability, real variables, logic, and foundations to R. C. BUCK, Department of Mathematics, University of Wisconsin, Madison 6, Wisconsin; in abstract analysis to either R. C. BUCK or ALEX ROSENBERG; in geometry and topology to ELDON DYER, Department of Mathematics, Rice University, Houston 1, Texas; in other branches of analysis, applied mathematics, and all other fields to M. H. HEINS, Department of Mathematics, University of Illinois, Urbana, Illinois, or FRITZ JOHN, Courant Institute of Mathematical Sciences, 4 Washington Place, New York 3, New York. All other communications to the editors should be addressed to the Managing Editor, ELDON DYER.

Transactions of the American Mathematical Society

This journal is devoted entirely to research in pure and applied mathematics, and includes in general longer papers than the PROCEEDINGS.

Four volumes of three numbers each will be published in 1964. The subscription price is \$8.00 per volume.

Papers in analysis and applied mathematics should be sent to LOUIS NIRENBERG, Courant Institute of Mathematical Sciences, New York University, New York 3, New York; in topology to W. S. MASSEY, Department of Mathematics, Yale University, Box 2155, Yale Station, New Haven, Connecticut; in algebra, number theory, and logic to DANIEL ZELINSKY, Department of Mathematics, Northwestern University, Evanston, Illinois; in geometry and abstract analysis to I. M. SINGER, Department of Mathematics, Massachusetts Institute of Technology, Cambridge 39, Massachusetts; in statistics and probability to MICHEL LOÈVE, Department of Statistics, University of California, Berkeley 4, California. All other communications to the editors should be addressed to the Managing Editor, DANIEL ZELINSKY.

CONTENTS—*Continued from back cover*

E. H. Zarantonello. The closure of the numerical range contains the spectrum.	781
L. T. Gardner. A note on isomorphisms of C^* -algebras. . . .	788
R. K. Miller. On almost periodic differential equations. . . .	792
R. V. Chacon. Ordinary means imply recurrent means. . . .	796
J. Barros-Neto. The Dirichlet problem for homogeneous elliptic operators in a half space.	798
R. A. Hunt. An extension of the Marcinkiewicz interpolation theorem to Lorentz spaces.	803
C. C. Chang. Some new results in definability.	808
H. B. Curry. Combinatory recursive objects of all finite types.	814
P. G. Anderson. Cobordism classes of squares of orientable manifolds.	818
Glen Baxter and I. I. Hirschman, Jr. An explicit inversion formula for finite-section Wiener-Hopf operators.	820
Neil Robertson. The smallest graph of girth 5 and valency 4	824
W. E. Singletary. Correction to "A complex of problems proposed by Post"	826
Officers and Lecturers of the Society.	827
Endowment Fund and Special Funds.	829
By-Laws of the American Mathematical Society.	833
Erratum, Volume 70.	841
Index to Volume 70.	842

CONTENTS

November, 1964

Invited Address

- J. J. Kohn. A priori estimates in several complex variables . 739

Research Problems

- R. M. Redheffer. Operators on Hilbert space..... 746
S. W. Golomb. Random permutations..... 747
R. R. Korfhage. Correction to "On a sequence of prime numbers"..... 747
The Summer Meeting in Amherst..... 748

Research Announcements

- D. H. Gottlieb and N. J. Rothman. Contractibility of certain semigroups..... 756
M. G. Barratt and M. E. Mahowald. The metastable homotopy of $O(n)$ 758
Lipman Bers and Leon Ehrenpreis. Holomorphic convexity of Teichmüller spaces..... 761
K. H. Hofmann and P. S. Mostert. Totally ordered D -class decompositions..... 765
Robert Finn. On normal metrics, and a theorem of Cohn-Vossen..... 772
Takashi Itô and Ichiro Amemiya. A simple proof of the theorem of P. J. Cohen..... 774
Gérard Lallement and Mario Petrich. Some results concerning completely 0-simple semigroups..... 777
Arlen Brown and Carl Pearcy. Structure theorem for commutators of operators..... 779

Continued on inside back cover