this requires simplifying assumptions. Thus, the stage is set for as many different opinions as there are investigators.

Separation Methods in Biochemistry is highly recommended to anyone who wishes to become more informed about the possibilities and complexities of fractionation.

LYMAN C. CRAIG Rockefeller Institute, New York

Dantzig's Simplex Method

Linear Programming and Extensions. George B. Dantzig. Princeton University Press, Princeton, N.J., 1963. xviii + 625 pp. Illus. \$11.50.

Linear programming is applicable to many large-scale problems of optimization from economic, industrial, military or administrative situations. It provides specific techniques for the maximization or minimization of linear functions subject to linear constraints and is closely related to game theory, although with different emphasis. Some of its mathematical foundations were laid in Motzkin's 1936 dissertation (Basel, not Zurich) on linear inequalities, and its industrial importance was recognized by Kantorivitch in Russia in 1939, but the full-scale development of the subject should probably be dated from Dantzig's introduction of the simplex method in 1947. In recent years, the field has grown tremendously and has given rise to many books, some of a general nature and others restricted to a particular area of application (economic theory, transportation, electrical networks, portfolio selection, and the like). Dantzig's long-awaited book is of the general sort, striking a nice balance between theory and applications.

When one of the "fathers" and recognized leaders in a field writes a book on his specialty, he has reason to hope that it will become the book on the subject. He also has reason to fear that, in aiming at a definitive treatment, his book may become unreadable to all but the experts. In my opinion, Dantzig's book comes very close to realizing the hope, and it does pretty well in skirting the danger by designing a certain set of chapters to serve as an introductory text. By almost any measure-number of pages, completeness of bibliography and index, variety of applications, completeness of theoretical discussion, scope of the exercises, or list of acknowledgements in the preface (which is a virtual *Who's Who* of the subject)—Dantzig's book seems to compare favorably with its predecessors.

With the praise, a word of caution. Although the book will be of great value to research workers in the field and to *serious* students of the subject, it does not seem suitable for the reader who wants only a routine working knowledge of the simplex method. For such a reader, less detailed treatment is preferable, but it might well be supplemented by material from Dantzig's book.

Space does not permit a technical discussion of the many strengths and the very few weaknesses of the book, but the chapter headings will indicate its contents: "The linear programming concept" (11 pp.); "Origins and influences" (20 pp.); "Formulating a linear programming model" (31 pp.); "Linear equation and inequality systems" (25 pp.); "The simplex method" (18 pp.); "Proof of the simplex algorithm and the duality theorem" (27 pp.); "The geometry of linear programs" (26 pp.); "Pivoting, vector spaces, matrices, and inverses" (28 pp.); "The simplex method using multipliers" (17 pp.); "Finiteness of the simplex method under perturbation" (13 pp.); "Variants of the simplex algorithm" (13 pp.); "The price concept in linear programming" (23 pp.); "Games and linear programs" (21 pp.); "The classical transportation problem" (17 pp.); "Optimal assignment and other distribution problems" (19 pp.); "The transshipment problem" (17 pp.); "Networks and the transshipment problem" (16 pp.); "Variables with upper bounds" (17 pp.); "Maximal flows in networks" (19 pp.); "The primal-dual method for transportation problems" (9 pp.); "The weighted distribution problem" (20 pp.); "Programs with variable coefficients" (15 pp.); "A decomposition principle for linear programs" (23 pp.); "Convex programming" (28 pp.); "Uncertainty" (15 pp.); "Discrete variable extremum problems" (37 pp.); "Stigler's nutrition model: An example of formulation and solution" (17 pp.); and "The allocation of aircraft to routes under uncertain demand" (24 pp.). There are a 19-bage bibliography and an 11-page index.

VICTOR KLEE University of Washington, Seattle, and Boeing Scientific Research Laboratories

New Books

Mathematics, Physical Sciences, and Engineering

Acta Imeko, 1964. Proceedings of the Third International Measurement Conference. vols. 1–3. Ing. S. Kovács and J. Solt, Eds. Hungarian Scientific Society for Measurement and Automation, Budapest, 1964. vol. 1, 498 pp.; vol. 2, 475 pp.; vol. 3, 530 pp. Illus. \$30. Contain the full text of 105 papers in their original languages followed by abstracts in three languages---German, English, and Russian

Analysis. vol. 1. Einar Hille. Blaisdell (Ginn), New York, 1964. 640 pp. Illus. \$10.

Atlas of Electron Spin Resonance Spectra. vol. 2, Theoretically Calculated, Multicomponent, Symmetrical Spectra. Ya. S. Lebedev, V. V. Voevodskii, and N. N. Tikhomirova. Translation from the Russian. Consultants Bureau, New York, 1964. 201 pp. Illus. \$15.

Atomic Migration in Crystals. L. A. Girifalco. Blaisdell (Ginn), New York, 1964. 174 pp. Illus. \$3.75.

Azeotropic and Extractive Distillation. E. J. Hoffman. Interscience (Wiley), New York, 1964. 336 pp. Illus. \$14.

Bailey's Industrial Oil and Fat Products. Karl F. Mattil, Frank A. Norris, Alexander J. Stirton, and Daniel Swern. Daniel Swern, Ed. Interscience (Wiley), New York, ed. 3, 1964. 1117 pp. Illus. \$25.

The Binary Stars. Robert Grant Aitken. Dover, New York, 1964 (corrected reprint of 1935 edition). 319 pp. Illus. Paper, \$2.

Chemical Engineering. Paul P. De Rienzo. Macmillan, New York, 1964. 253 pp. Illus. \$7.

A Collection of Problems on Mathematical Physics. B. M. Budak, A. A. Samarskii, and A. N. Tikhonov. Translated from the Russian edition by A. R. M. Robson. D. M. Brink, Translation Ed. Pergamon, London; Macmillan, New York, 1964. 782 pp. Illus. \$11.50.

The Constitution of Glasses: A Dynamic Interpretation. vol. 2, pt. 1, Constitution and Properties of Some Representative Glasses, Woldemar A. Weyl and Evelyn Chostner Marboe. Interscience (Wiley), New York, 1964. 486 pp. Illus. \$15.

A Course of Higher Mathematics. vols. 1-5. vol. 1, Elementary Calculus (557 pp., \$12.50); vol. 2, Advanced Calculus (634 pp., \$12.50); vol. 3, pt. 1, Linear Algebra (334 pp., \$9); vol. 3, pt. 2, Complex Variables-Special Functions (710 pp., \$15); vol. 4, Integral Equations and Partial Differential Equations (825 pp., \$17.50); vol. Integration and Functional Analysis (649 pp., \$17.50). V. I. Smirnov. Translated from the Russian editions (Moscow, vols. 1 and 2, ed. 16, 1958; vol. 3, pts. 1 and 2, 1957; vol. 4, 1959; vol. 5, 1960) by D. E. Brown. I. N. Sneddon, Translation Ed. Pergamon, London; Addison-Wesley, Reading, Mass., 1964. Illus.

Electromagnetic Fields and Interactions. vols. 1 and 2. Richard Becker. Fritz Sauter, Ed. vol. 1, *Electromagnetic Theory and Relativity* (453 pp., translated from the

> (Continued on page 1618) SCIENCE, VOL. 146



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NEW BOOKS

(Continued from page 1572)

German edition by A. W. Knudsen); vol. 2, Quantum Theory of Atoms and Radiation (413 pp., translated from the German edition by Ivor de Teissier; revised by Günther Leibfried and Wilhelm Brenig). Blaisdell (Ginn), New York, 1964. Illus. \$9.50 per volume.

Electronic Processes in Ionic Crystals. N. F. Mott and R. W. Gurney. Dover, New York, 1964 (reprint of ed. 2, 1948). 287 pp. Illus. Paper, \$2.

Elementary Dislocation Theory. Johannes Weertman and Julia R. Weertman. Macmillan, New York, 1964. 223 pp. Illus. Paper, \$4.40.

Elementary Electrical Network Theory. D. G. Tucker. Pergamon, London; Macmillan, New York, 1964. 179 pp. Illus. Paper, \$2.95.

Elementary Particles. A. A. Sokolov. Translated from the Russian edition (Moscow, 1963) by William E. Jones. D. ter Haar, Translation Ed. Pergamon, London; Macmillan, New York, 1964. 81 pp. Illus. Paper, \$1.95.

Elements of Abstract Harmonic Analysis. George Bachman. 268 pp. Illus. Paper, \$3.45; cloth, \$6.50. Engineering Aspects of Magnetohydro-

Engineering Aspects of Magnetohydrodynamics. Proceedings of the third annual symposium (Rochester, N.Y.), March 1962. Norman W. Mather and George W. Sutton, Eds. Gordon and Breach, New York, 1964. 689 pp. Illus. \$34.50. The 39 papers presented at the symposium sponsored by the American Institute of Electrical Engineers, the Institute of Astronautical Sciences, the Institute of Radio Engineers, and the University of Rochester are listed under the following headings: Diagnostics and Communications (10 papers); Energy Conversion (11 papers); Flight Applications (12 papers); and Fusion (6 papers).

Engineering Design. A synthesis of stress analysis and materials engineering. Joseph H. Faupel. Wiley, New York, 1964. 992 pp. Illus. \$19.75.

Ferromagnetic-Relaxation Theory. Marshall Sparks. McGraw-Hill, New York, 1964. 239 pp. Illus. \$12.50.

Finite Permutation Groups. Helmut Wielandt. Translated from the German edition by R. Bercov. Academic Press, New York, 1964. 124 pp. Illus. Paper, \$2.45; cloth, \$5.50.

The Flight of Uncontrolled Rockets. F. R. Gantmakher and L. M. Levin. Translated from the Russian edition by O. M. Blunn. W. G. Hughes, Translation Ed. Pergamon, London; Macmillan, New York, 1964. 393 pp. Illus. \$15. At the request of the publisher E. T. J. Davies has contributed a paper entitled "British and American work on the motion of unguided rockets during the burning period" (pp. 288-328).

The Galactic Novae. Cecilia Payne-Gaposchkin. Dover, New York, 1964 (corrected reprint of 1957 edition). 346 pp. Illus. Paper, \$2.45.

Heterocyclic Compounds with Threeand Four-Membered Rings. pts. 1 and 2. Arnold Weissberger, Ed. Interscience (Wiley), New York, 1964. pt. 1, 658 pp.; pt. 2, 540 pp. Illus. \$65. Pt. 1: "Ethylene

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Initiation à la Théorie de la Relativité. Vladimir Kourganoff. Presses Universitaires de France, Paris, 1964. 182 pp. Illus. Paper.

Interprétation Géochimique des Éléments en Traces dans les Roches Cristallines. Denis M. Shaw. Masson, Paris, 1964. 244 pp. Illus. Paper, F. 56.

Introduction to Astrophysics: The Stars. Jean Dufay. Translated from the French edition (1961) by Owen Gingerich. Dover, New York, 1964. 176 pp. Illus. Paper, \$2.

Introduction to Computer Programming. Donald I. Cutler. Prentice-Hall, Englewood Cliffs, N.J., 1964. 224 pp. Illus. \$9.35.

Introduction to Fortran. A program for self-instruction. S. C. Plumb. McGraw-Hill, New York (© 1961), 1964. 215 pp. Illus. Paper, \$3.50.

Introduction to Mine Surveying. W. W. Staley. Stanford Univ. Press, Stanford, Calif., ed. 2, 1964. 317 pp. Illus. \$7.50.

Introduction to p-Adic Numbers and Valuation Theory. George Bachman. Academic Press, New York, 1964. 183 pp. Illus. Paper, \$3.45; cloth, \$6.50.

An Introduction to Radioactivity. Eric Neil Jenkins. Butterworth, Washington, D.C., 1964. 201 pp. Illus. \$5.95.

Introduction to Semiconductor Physics. R. B. Adler, A. C. Smith, and R. L. Longini. Wiley, New York, 1964. 263 pp. Illus. Paper, \$2.65; cloth, \$4.50.

Introduction to the Atomic Nucleus. J. G. Cuninghame. Elsevier, New York, 1964. 232 pp. Illus. \$9.

The Language of Triangles. A secondary school trigonometry. vol. 1. A. W. Crown. Pergamon, London; Macmillan, New York, 1964. 125 pp. Illus. Paper, \$2.45.

The Laws and Applications of Thermodynamics. A. D. Buckingham. Pergamon, London; Macmillan, New York, 1964. 218 pp. Illus. Paper, \$3.75.

Linear Representations of the Lorentz Group. M. A. Naimark. Translated from the Russian edition (Moscow, 1958) by Ann Swinfen and O. J. Marstand. H. K. Farahat, Translation Ed. Pergamon, London; Macmillan, New York, 1964. 464 pp. Illus. \$14.50.

Manuel Pratique de Chromatographie en Phase Gazeuse. J. Buzon, N. Guichard, G. Guiochon, J. Lebbe, A. Prévot, J. Tranchant, and J. Serpinet. Masson, Paris, 1964. 235 pp. Illus. Paper, F. 36.

Marine Geology of the Gulf of California. A symposium (Memoir No. 3). Tjeerd H. van Andel and George G. Shor, Jr., Eds. American Assoc. of Petroleum Geologists, Tulsa, Okla., 1964. 414 pp. Illus. Charts. \$12.50. Sixteen papers and three charts (in a separate pocket).

Massenspektrometrie. C. Brunnée and H. Voshage. Thiemig, Munich, Germany, 1964. 328 pp. Illus. DM. 54.

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and Meaning. vols. 1-3. A. D. Aleksandrov, A. N. Kolmogorov, and M. A. Lavrent'ev, Eds. Translated from the Russian edition (Moscow, 1956) by S. H. Gould and T. Bartha (vol. 1), S. H. Gould (vol. 2), and K. Hirsch (vol. 3). M.I.T. Press, Cambridge, Mass., 1964. vol. 1, 371 pp.; vol. 2, 388 pp.; vol. 3, 367 pp. Illus. \$30. The authors' goal was to acquaint a sufficiently wide circle of the Soviet intelligentsia with the various mathematical disciplines, their content and methods, the foundations on which they are based, and the paths along which they have developed. The contributors are: A. D. Aleksandrov; M. A. Lavrent'ev and S. M. Nikol'skii; B. N. Delone; I. G. Petrovskil; S. L. Sobolev and O. A. Lady-zenskaja; V. I. Krylov; M. V. Keldyš; K. K. Mardzanisvili and A. B. Postnikov; A. N. Kolmogorov; S. A. Lebedev and L. V. Kantorovič; S. B. Stečkin; D. K. Faddeev; P. S. Aleksandrov; I. M. Gel'fand; and A. I. Mal'cev.

Methods in Microanalysis. vol. 1, Simultaneous Rapid Combustion. Translated microchemical research papers of Mirra Osipovna Korshun. J. A. Kuck, Ed. Translated from the Russian by Phyllis L. Bolton and Kurt Gingold. Gordon and Breach, New York, 1964. 576 pp. Illus. \$27.50. Modular Arithmetic. Burton W. Jones.

Modular Arithmetic. Burton W. Jones. Blaisdell (Ginn), New York, 1964. 101 pp. Illus. Paper, \$1.65.

Molten Salt Data: Electrical Conductance, Density, and Viscosity (Technical Bulletin Series). George J. Janz, Anthony T. Ward, and Roger D. Reeves. Rensselaer Polytechnic Inst., Troy, N.Y., 1964. 183 pp. Paper, \$2.50.

Neutron Physics. K. H. Beckurts and K. Wirtz. Translated from the German edition (ed. 2, 1964) by L. Dresner. Springer, New York, 1964. 454 pp. Illus. \$17.

Noneuclidean Geometry. Herbert Meschkowski. Translated from the second German edition by A. Shenitzer. Academic Press, New York, 1964. 112 pp. Illus. Paper, \$2.45; cloth, \$5.50.

Organic Complexing Reagents: Structure, Behavior, and Application to Inorganic Analysis. D. D. Perrin. Interscience (Wiley), New York, 1964. 377 pp. Illus. \$12.

Organic Syntheses. An annual publication of satisfactory methods for the preparation of organic chemicals. vol. 44. William E. Parham. Wiley, New York, 1964. 141 pp. Illus. \$4.95.

The Origin and Evolution of Atmospheres and Oceans. Proceedings of a conference (New York), April 1963. Peter J. Brancazio and A. G. W. Cameron, Eds. Wiley, New York, 1964. 326 pp. Illus. \$12.50. Seventeen papers: "Geologic history of sea water" by William W. Rubey; "Convection in the earth's mantle" by Peter J. Brancazio; "Degassing of argon and helium from the earth" by Karl K. Turekian; "Comments on the outgassing of the earth" by G. J. Wassenburg; "On the chemical evolution of the terrestrial and cytherean atmospheres" by Heinrich D. Holland; "The history of growth of oxygen in the earth's atmosphere" by L. V. Berkner and L. C. Marshall; "The escape of helium from the earth's atmosphere" by G. J. F. MacDonald; "Primordial rare gases in meteorites" by Peter Signer; "Isotopic analyses of xenon" by R. O. Pepin; "Interpretation of xenon measurements" by A. G. W. Cameron; "Outgassing processes on the moon and Venus" by Thomas Gold; "Observations of water vapor on Mars and Venus" by A. Dollfus; "The atmosphere of Mercury" by G. Field; "The atmosphere of Venus" by Carl Sagan; "The atmosphere of Mars" by Richard M. Goody; "Are the interiors of Jupiter and Saturn hot?" by P. J. E. Peebles, and "The atmosphere of Jupiter" by R. Wildt.

Paint Flow and Pigment Dispersion. Temple C. Patton. Interscience (Wiley), New York, 1964. 493 pp. Illus. \$16.50. Paleomagnetism and Its Application to

Paleomagnetism and Its Application to Geological and Geophysical Problems. E. Irving. Wiley, New York, 1964. 417 pp. Illus. \$19.50.

Partial Differential Equations of Mathematical Physics. S. L. Sobolev. Translated from the third Russian edition by E. R. Dawson. T. A. A. Broadbent, Translation Ed. Pergamon, London; Addison-Wesley, Reading, Mass., 1964. 437 pp. Illus. \$14.

Physical Electronics and Circuit Models of Transistors. Paul E. Gray, David De-Witt, A. R. Boothroyd, and James F. Gibbons. Wiley, New York, 1964. 282 pp. Illus. Paper, \$2.65; cloth, \$4.50.

Planetary Theory. Ernest W. Brown and Clarence A. Shook. Dover, New York, 1964 (corrected reprint of 1933 edition). 314 pp. Illus. Paper, \$2.25.

VERGLEICHENDE CHOROLOGIE Der Zentraleuropäischen Flora

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