1967, at the IBM Research Laboratory in Rüschlikon, Switzerland. The spectrum of ideas treated ranges from the presentation of an ALGOL algorithm for finding a real zero of a function $f(x)$ (that changes sign), to the specification of a mathematical algorithm for finding (to any given accuracy) all of the zeros of a polynomial with complex coefficients, to a discussion of iterative methods for numerically solving certain polynomial matrix equations, to a treatment of a logical constructive proof of the fundamental theorem for polynomials with algebraic coefficients. The state of the theory and the art in this fundamental field of logic and numerical analysis are well presented in the clearly written papers listed below:

DEJON, B., and NICKEL, K.: A Never Failing, Fast Convergent Root-Finding Algorithm; DEKKER, T. J.: Finding a Zero by Means of Successive Linear Interpolation; FORSYTHE, G. E.: Remarks on the Paper by Dekker; FORSYTHE, G. E.: What is a Satisfactory Quadratic Equation Solver?; FOX, L.: Mathematical and Physical Polynomials; GOODSTEIN, R. L.: A Constructive Form of the Second Gauss Proof of the Fundamental Theorem of Algebra; HENRICI, P., and GARGANTINI, L.: Uniformly Convergent Algorithms for the Simultaneous Approximation of all Zeros of a Polynomial; HERMES, H.: On the Notion of Constructivity; HOUSEHOLDER, A. S., and STEWART, G. W., III: Bigradients, Hankel Determinants, and the Padé Table; JENKINS, M.A., and TRAUB, J. E.: An Algorithm for an Automatic General Polynomial Solver; KUPKA, I.: Die numerische Bestimmung mehrfacher und nahe benachbarter Polynomnullstellen nach einem verbesserten Bernoulli-Verfahren; LEHMER, D. H.: Search Procedures for Polynomial Equation Solving; OSTROWSKI, A. M.: A Method for Automatic Solution of Algebraic Equations; PAVEL-PARVU, M., and KORGANOFF, A.: Iteration Functions for Solving Polynomial Matrix Equations; RUTISHAUSER, H.: Zur Problematik der Nullstellenbestimmung bei Polynomen; SCHRODER, J.: Factorization of Polynomials by Generalized Newton Procedures; SPECKER, E.: The Fundamental Theorem of Algebra in Recursive Analysis.

E. I.

20[3].—HAROLD W. KUHN, Editor, *Proceedings of the Princeton Symposium on Mathematical Programming*, Princeton Univ. Press, Princeton, New Jersey, 1970, vi + 620 pp., 24 cm. Price $12.50 (paperbound).

The field of mathematical programming has existed for less than 25 years. In that time, it has experienced phenomenal growth. The Princeton Symposium on Mathematical Programming, held at Princeton University on August 14–18, 1967, is one of a series of symposia held every three years since 1949. My major comment on these published Proceedings is that their value has been greatly diminished by the more than three years that it has taken to publish them. In fact, these Proceedings did not appear until after the 1970 Symposium had been held at the Hague.

From the more than 90 papers and addresses presented at the conference, 33 papers, in their entirety, and 48 abstracts are included in this volume. Of particular note are two bibliographies, one of 128 references on large-scale systems in the paper by Dantzig and one of 232 references on integer programming at the end of the first two papers by Balinski. These two papers form a very well written comprehensive survey of integer programming. The authors and titles of the 33 complete papers included in these Proceedings are listed below:

PART I. LARGE SCALE SYSTEMS

- J. ABADIE and M. SAKAROVITCH: Two Methods of Decomposition for Linear Programming
- E. M. L. BEALE: Matrix Generators and Output Analyzers
- R. H. COBB and J. CORD: Decomposition Approaches for Solving Linked Programs
- G. B. DANTZIG: Large Scale Systems and the Computer Revolution

PART II. PROGRAMMING UNDER UNCERTAINTY

- M. AVRIEL and D. J. WILDE: Stochastic Geometric Programming
- M. J. L. KIRBY: The Current State of Chance-Constrained Programming
- A. PREKOPA: On Probabilistic Constrained Programming
- D. W. WALKUP and R. J. B. WETS: Stochastic Programs with Recourse: Special Forms
- A. C. WILLIAMS: Nonlinear Activity Analysis and Duality

PART III. INTEGER PROGRAMMING

- E. BALAS: Duality in Discrete Programming
- M. L. BALINSKI: Integer Programming: Methods, Uses, Computation
- M. L. BALINSKI: On Recent Developments in Integer Programming
- M. L. BALINSKI: On Maximum Matching, Minimum Covering and Their Connections
- P. HUARD: Programmes Mathématiques Nonlinéaires à Variables Bivalentes
- C. ZOUTENDIJK: Enumeration Algorithms for the Pure and Mixed Integer Programming Problem

PART IV. ALGORITHMS

- A. BEN-ISRAEL: On Newton's Method in Nonlinear Programming
- H. D. MILLS: Extending Newton's Method to Systems of Linear Inequalities
- J. D. ROODE: Interior Point Methods for the Solution of Mathematical Programming Problems

PART V. APPLICATIONS

- P. BOD: The Solution of a Fixed Charge Linear Programming Problem
- A. CHARNES and K. KORTANEK: On Classes of Convex Preemptive Nuclei for N-Person Games
- A. J. HOFFMAN and T. J. RIVLIN: When is a Team "Mathematically" Eliminated?
- D. MCFADDEN: On the Existence of Optimal Development Plans

PART VI. THEORY

- O. L. MANGASARIAN: Optimality and Duality in Nonlinear Programming
- E. L. PETERSON and J. G. ECKER: Geometric Programming: Duality in Quadratic Programming and l_p-Approximation. I
- R. T. ROCKAFELLAR: Conjugate Convex Functions in Nonlinear Programming

PART VII. NONLINEAR PROGRAMMING

- A. R. COLVILLE: A Comparative Study of Nonlinear Programming Codes

D. G.

21[3].—B. N. Pshenichnyi, *Necessary Conditions for an Extremum*, Marcel Dekker, Inc., New York, 1971, xviii + 230 pp., 24 cm. Price $11.50.

Dr. B. N. Pshenichnyi is one of the most prolific contributors to the literature on optimization. He has written highly regarded papers on optimality conditions, on optimization algorithms, on optimal control problems, on minimax problems and on games. The breadth of his research experience has contributed substantially to the well-balanced perspective and maturity of this beautifully executed monograph on optimality conditions. Dr. Pshenichnyi avoids cumbersome results. Because of this, his monograph does not include an exhaustive study of constraint qualifications, nor the most general discrete maximum principle, nor the Pontryagin maximum principle for the general case, nor the most general possible optimality conditions for constrained optimization problems. Instead, by masterfully introducing a few simplifying, but not particularly constraining, assumptions, Dr. Pshenichnyi manages to present in an elegant fashion most of the important optimality conditions without getting bogged down in the very messy analysis which is required to treat the most general case. The result is an excellent and most readable middle-level text. The quality of the translation, carried out by Dr. K. Makowski under the supervision of the translation editor, Dr. L. W. Neustadt, both of the University of Southern California, is impeccable, and they deserve a commendation.

As to the actual contents of the monograph, which consists of an introduction and five chapters, Dr. Pshenichnyi starts out in the introduction with a few basic concepts of functional analysis and with some properties of convex sets and of convex functionals. Chapter I continues with more advanced properties of convex functionals defined on Banach spaces, and, in particular, it presents their directional derivatives.

Chapter II derives optimality conditions for convex programming problems in Banach space, with and without differentiability assumptions. In particular, the Kuhn-Tucker conditions are obtained.

Chapter III is primarily concerned with formulas for the directional derivatives of functions of the form $\mu(x) = \max_{\alpha \in Z} \varphi(x, \alpha)$, with x and α elements of Banach spaces, which occur in minimax problems.