"The use of computers in the theory of numbers": P. Swinnerton-Dyer presents a brief treatment of a topic in number theory in which the theory appears to be incomplete (i.e., there are yet undiscovered relations between the existing concepts) and in which a computer can be used to accumulate facts in the hope that a pattern will emerge. The particular problem is to find rational solutions of inhomogeneous cubic equations with rational coefficients and to study the set of its rational solutions.

"A machine calculation of a spectral sequence": M. E. Mahowald and M. D. MacLaren study Stiefel manifolds with a view to uncovering some internal structure by means of machine computation. After a brief description of the topology of the problem they discuss some of the details of the computations, which were performed on a CDC 3600.

"Numerical hydrodynamics of the atmosphere": C. E. Leith describes a numerical model for the long-term prediction of weather. The partial differential operators of the continuous model are approximated by finite-difference equations, which reduce the integration of the evolution equations to a numerical process. However, no computer calculations are presented.

"The calculation of zeros of polynomials and analytic functions": J. F. Traub studies a class of new methods for the calculation of zeros. Continuing his earlier work, he gives a simplified treatment of the case of a polynomial with distinct zeros and one zero of largest modulus. In other sections he treats the case of a zero of smallest modulus, the calculation of multiple zeros and equimodular dominant zeros of polynomials, and zeros of analytic functions. This research paper is of particular interest to numerical analysts.

"Mathematical theory of automata": Michael O. Rabin surveys the major developments and trends in the theory of finite automata. The treatment is very complete since it covers the theories of nonprobabilistic finite-automata, probabilistic finite-automata, and finite tree-automata, whose foundations were largely established by the author. He appends a list of interesting problems for further research.

"Linearly unrecognizable patterns": Marvin Minsky and Seymour Papert study the classification of certain geometrical properties according to the type of computation necessary to determine whether a given figure has them. This lengthy research paper treats local vs. global geometric properties, series vs. parallel computation, and the theory of perceptrons.

In summary, this volume has bits of knowledge from many different branches of mathematics, with the computer or computation being the common thread. All authors are recognized in their field and their lists of references are generally excellent. Only a few minor typographical errors were noted, which the reader can easily detect and correct.

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44[4, 5, 6].—Francis B. Hildebrand, *Finite-Difference Equations and Simulations*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1968, ix + 338 pp., 23 cm. Price $12.75.

This is an introductory text, in three chapters, dealing with the following topics: (i) Calculus of finite differences and difference equations, (ii) Numerical solution of ordinary differential equations, (iii) Numerical solution of partial differential equations. The term "simulations" in the title is to be understood in the restricted sense of simulating differential equations by finite-difference equations. An attempt has been made to incorporate recent advances in this field, particularly concerning the theory of error propagation and stability. Each chapter is followed by a short list of references and an extensive set of problems.

The text provides, at a modest level, a well-motivated introduction to the approximate solution of differential equations, and should serve well to prepare the student for a study of more specialized treatises on the subject.

W. G.

45[7, 9].—W. A. Beyer, N. Metropolis & J. R. Neergaard, *Square Roots of Integers 2 to 15 in Various Bases 2 to 10: 88062 Binary Digits or Equivalent*, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, December 1968. Plastic-bound computer printout, 277 pages, deposited in the UMT file.

The first ten tables here list $\sqrt{n}$ for $n = 2, 3, 5, 6, 7, 10, 11, 13, 14$, and 15 to 29354 octal digits.

The next five tables list $\sqrt{2}$ to the bases 3, 5, 6, 7, and 10 to the equivalent accuracies: 55296, 36864, 32768, 30720, and 24576 digits, respectively. The last ten tables give the corresponding data for $\sqrt{3}$ and $\sqrt{5}$. Thus, starting on page 237, we find

$$(\sqrt{5})_5 = 2.1042234\cdots$$

The purpose of the authors to test the normality of these irrationals to different bases; their results and conclusions will appear elsewhere. For recent reviews on related matters, see [1], [2], [3] and the references cited there.

The three decimal numbers were compared with the slightly less accurate values in [2] in the vicinity of 22900D. No discrepancy was found. No details were given concerning programs or computer times, nor any explanation for the coincidence (?) that the number of digits to the base 6 turns out to be exactly 2^{15}.

D. S.

1. *Math. Comp.*, v. 21, 1967, pp. 258–259, UMT **17.**
2. *Math. Comp.*, v. 22, 1968, p. 234, UMT **22.**
3. *Math. Comp.*, v. 22, 1968, pp. 899–900, UMT **86.**

46[7, 9].—Daniel Shanks & John W. Wrench, Jr., *Calculation of e to 100,000 Decimals*, 1961. Computer printout deposited in the UMT file.

This calculation of e was performed seven years ago at the time that π was computed to the same accuracy [1]. In contrast to the latter computation, the programming for e had no special interest, inasmuch as it was based upon the obvious procedure of summing the reciprocals of successive factorials, and consequently it was dismissed in a footnote to [1].

Since a number of requests for copies of this approximation to e have been received, we accordingly deposit here two copies: the first, a full-size, 20-page, computer printout; the second, a photographic reduction thereof.