investigations with very complex expressions, or on the description of certain such computer systems.

The article by D. Chudnovsky and G. Chudnovsky deals with how to use computers to investigate diophantine approximation via functional approximation methods; in particular, Padé approximations. The paper constitutes about one third of the entire volume. A short article by H. Cohn reports on computing certain Hilbert modular equations. G. Andrews investigates, using the Scratchpad system, summation-product identities arising in various contexts; among them, the famous Rogers-Ramanujan identities. R. Askey points to difficult multidimensional definite integrals of special functions for the need of using computers to handle the complicated algebra necessary in their proofs. D. Ford and J. McKay give a brief account of how one would determine the Galois group of a rational polynomial. The paper by L. Auslander and A. Silberberg and the paper by J. Cooley describe the application of the Scratchpad systems in the search for better convolution algorithms.

The systems described are the Cayley system for finite group theory in the article by M. Slattery, who exhibits several example sessions; the special-purpose system POLYPAK for computing very high-order series solutions of differential equations in celestial mechanics, described by its designer D. Schmidt; and a Fortran library by R. Riley (called the PNCRE system) for manipulating finitely generated subgroups of $SL_2(\mathbf{C})$.

J. Davenport's paper discusses several issues arising in data abstraction and representation when building a computer algebra system. The book ends with a transcript (taken by Davenport) of a panel discussion on "The Potential of Computer Algebra as a Research Tool" held during the conference. The panel members were R. Askey, M. E. Fisher, J. McCarthy, J. Moses, and J. Schwartz. As a participant of the conference and the panel discussion, I found it quite useful to have a written record of what was said then—four years ago—about this field.

Overall, the book has the flavor of a conference proceedings (with an index of key terms), and certainly provides glimpses into the possibilities of using computers for doing mathematics. I find it a good addition to my collection of works on computer algebra.

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20[18-04, 55-04, 55Q05, 68Q40].—MARTIN C. TANGORA (Editor), *Computers in Geometry and Topology*, Lecture Notes in Pure and Applied Mathematics, Vol. 114, Dekker, New York and Basel, 1989, viii+317 pp., $25\frac{1}{2}$ cm. Price $99.75.

These lecture notes contain fourteen papers arising from the Conference on Computers in Geometry and Topology, held on March 24-28, 1986, in Chicago.

The papers, though varying in tone and flavor, are all concerned with the problems one encounters when trying to do calculations in topology or homological algebra. Usually in mathematics, and especially in topology, the interesting canonical invariants that one wishes to determine are given in terms of certain obstruction groups like cohomology or homotopy groups. These groups are in turn defined to be the quotient of some very infinite object by another. The actual computation of these invariants poses therefore new and, as it turns out, interesting problems.

It is, for a start, shown in the first paper, by D. J. Anick, the only paper with a genuine computer science flavor, that the subject matter is difficult: he shows that computing the homotopy groups $\pi_n(X) \otimes \mathbf{Q}$ of finite simply connected CW-complexes X is at least as hard as any problem that can be solved nondeterministically in polynomial time. The difficulties one encounters, in theory and in practice, are vividly illustrated by three papers that are concerned with calculations pertaining to the higher homotopy groups of the spheres, and by several other papers concerned with explicit computations: regarding knots, immersions of $\mathbf{P}^n(\mathbf{R})$ in Euclidean spaces, bifurcation theory and the classifying space of the generalized dihedral group of order 16.

The volume contains furthermore some papers on general-purpose algorithms to compute cohomology groups, syzygies, etc. and discussions of computer algebra packages suitable for "topological calculations". Finally, there are two papers by Milnor and by Handler, Kauffman and Sandin on the Mandelbrojt set.

R. S.

21[11A15, 11Y55].—Samuel S. Wagstaff, Jr., *Table of all Carmichael numbers* $< 25 \cdot 10^9$, 38 computer output sheets deposited in the UMT file.

This table of the 2163 Carmichael numbers $< 25 \cdot 10^9$ was placed in the UMT file in connection with the paper [2]. It has not been reviewed until now for reasons too complicated to set down here. It is reviewed now because of Jaeschke's UMT table described in the following review.

Wagstaff's table has 14 columns. Col. 1 has the sequential number of the Carmichael number (CN) from 1 to 2163. Col. 2 is the CN from CN = 561 to CN = 24991309729. Cols. 3–12 give a characterization of the CN for each of the first ten prime bases: $p = 2$ through $p = 29$. If the CN is not a *strong pseudoprime* to the base p (and this is usually the case), the respective column states "weak". See, e.g., Definition 44 in [3, p. 227]. If p divides CN, the column is left blank. If

$$\mathrm{CN} = t \cdot 2^s + 1,$$

with t odd, and if

$$(*) \qquad p^t \equiv 1 \pmod{\mathrm{CN}},$$