debugging programs, if the user is allowed to interfere, by means of setting parameters, into the interaction between flow of control and block structure. E.g., every END might have a count associated with it, which gets reset to zero every time control passes, and gets incremented by one each time control bounces. The user might specify a limit L (either for all or for a particular END) such that if this count exceeds L, some systems action gets invoked.

In NUCLEOL, the variable T may also assume a value W ('wrong'), which gets set whenever erroneous conditions arise. Hence blocks may be protected from being entered in the W state, one can count how many BEGIN's or END's were encountered while T had the value W, and the user can specify that some system action occurs whenever this count exceeds some limit.

We considered other rules for setting and using the test variable T in addition to the ones described above. E.g., if T were a pushdown stack, the current value at T could be pushed down every time a block is entered (and a new value N put on top), and the stack could be popped when control leaves a block. We could not see any advantage of this scheme over the one we chose. In both cases, the outcome of a test is available only at the same level of block nesting at which the test occurred, the only difference being that in one case the current value of T is permanently lost upon entering a block, while in the pushdown case it is only temporarily lost.

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Book Review

Constructive Aspects of the Fundamental Theorem of Algebra. Edited by B. Dejon and P. Henrici, 1969; 337 pages. (*London, New York, Sydney, Toronto: John Wiley and Sons Ltd.*, £3·50)

A symposium entitled 'Constructive Aspects of the Fundamental Theorem of Algebra' was held in Zurich in 1967 with the basic purpose of assembling together experts in constructive and numerical analysis to discuss the problem of determining the zeros of a polynomial. The present book contains all the invited papers and most of the short communications given at this symposium.

There are seventeen articles in the book, these varying considerably in length and depth. Thus the shortest article is a two page contribution by Professor Forsythe detailing the merits of a general routine for finding real zeros of a given function (not necessarily a polynomial) due to Dekker. (A detailed description of the routine, together with an ALGOL 60 procedure is given by Dekker in the preceding paper.) The longest article is a theoretical discussion by Pavel-Parvu and Korganoff comprising fifty-six pages on certain iterative methods for solving polynomial *matrix* equations. Again by way of contrast, Professor Forsythe in a further contribution points to the near absence of computer routines which deal in a completely satisfactory manner even with the humble quadratic equation!

Most of the methods described are essentially algorithms for determining a single zero or a quadratic factor of a polynomial, which is then removed by deflation or suppression. In particular, papers by Dejon and Nickel, Jenkins and Traub and Ostrowski fall into this category. A paper by Henrici and Gargantini however describes, with numerical examples, an algorithm based on the use of exclusion tests to produce simultaneous approximations to all the zeros of a polynomial, whilst a further paper by Lehmer discusses general search procedures for solving polynomial equations. On the more theoretical side, Householder and Stewart show the connection between bigradients, Hankel determinants and the Padé table and comment on the relevance of their development to localisation problems for the zeros of a polynomial, whilst Professor Schröder presents a unified treatment of 'treppeniteration', the QD algorithm, Bernoulli's method, Newton and Bairstow's method regarded as generalised Newton procedures for polynomial factorisation. Some general remarks are made by Professor Rutishauser on the effect of different representations on the calculation of polynomials and Professor Fox comments in a short paper on the practical need to determine meaningful figuresfor zeros of 'physical' polynomials (i.e. those in which the coefficients are subject to errors of known upper bound.)

The book will be of interest primarily to specialist workers in numerical analysis. Apart from a PL/1 program given by Dejon and Nickel as an implementation of their algorithms and an ALGOL 60 procedure given by Dekker for his zero-findıng routine, no detailed computer routines are included. A disappointing feature of the book is that no attempt is anywhere made to give error estimates for the accuracy of computed zeros. Dejon and Nickel have published a version of their method which includes the evaluation of error bounds using interval arithmetic, but this has been excluded from the book due to the general lack of such an arithmetic in common computer languages.

E. L. ALBASINY (Teddington)