42 [2.00, 3].—ALSTON S. HOUSEHOLDER. *Principles of Numerical Analysis,* Dover, New York, 1974, x + 274 pp., 21 cm. Price $4.00 (paperbound).

This a most welcome and slightly corrected reissue of the 1953 edition, originally published by McGraw-Hill. The thorough mathematical developments and the scholarly bibliographic discussions continue to make this work an indispensable classic.

The eight chapter headings are: 1. The art of computation, 2. Matrices and linear equations, 3. Nonlinear equations and systems, 4. The proper values and vectors of a matrix, 5. Interpolation, 6. More general methods of approximation, 7. Numerical integration and differentiation, 8. The Monte Carlo method.

E. I.

43 [9.00].—ALLAN M. KIRCH, *Elementary Number Theory: A Computer Approach,* Intext Educational Publishers, New York, 1974, xi + 339 pp., 25 cm. Price $11.75.

Elementary Number Theory: A Computer Approach, by Allan M. Kirch is an attempt to build a text around some reasonable mix of the two subjects. The avowed objective is to present certain aspects of elementary number theory together with related computer applications. This is carried out in terms of twenty-eight chapters, which are called "problems"; plus three appendices, the last of which is a "quick course in Basic Fortran IV".

The idea of attempting a work of this kind is certainly a valid one. Moreover, the nature of its objectives requires a rather detailed frame of reference which includes:

(i) for what group of students is the text intended,
(ii) what is meant by "elementary number theory",
(iii) what is meant by a "computer approach",
(iv) at what level and with what implied pedagogical technique is the material presented.

Having brought this book into existence, the author evidences a clear point of view concerning each of the above.

With regard to (i) the author presents the book as "a text for a beginning number theory course for students with good backgrounds in high school algebra" or as "a computer supplement to a more advanced treatment". The equivocation inherent in this becomes clear as one reads the book. The first eighteen problems touch on the basic properties of divisibility, greatest common divisor and least common multiple, the definition of prime numbers, unique factorization, number bases, and linear congruences. In this portion of the book the relevant theorems are either proved or included among the exercises (solutions at the end of the book). Here two criticisms might be made. First, the material is so thinly spread out that the subject hardly seems like a "theory". Secondly, the proofs tend to be very terse and awkward. In many instances the source of a critical theorem lies far away in the text. For example, the Unique Factorization Theorem is stated and proved in Problem 14, whereas it depends on material of Problems 4 and 5. In fact, the main step in the proof of the Unique Factorization Theorem is given as an exercise, which appears *after* the theorem. From Problem 19 to the end of the book proofs per se tend to be of less importance; and the reader is often referred to other texts. The existence of primitive roots modulo a prime power, and the quadratic reciprocity law, are typical casualties of this policy.

There is little doubt as to the author's conception of "computer approach". It involves a series of examples of gradually increasing complexity which illustrates various aspects of Fortran IV programming. This is carried out carefully, extensively, and enthusiastically. There is a clear impression that this is the main focus of the book; and that the number theory is a convenient excuse. Questions of optimal program design are equated to questions of programming technique rather than of methodology. This last is consistent with the very elementary level of the mathematics, and cannot be faulted.

The aforementioned level of the number theoretical material is quite basic, and certainly within the scope of an average undergraduate class. However, because of the tight mathematical presentation, the number theory itself would require considerable teacher supplementation. On the other hand, various attractive examples are provided which motivate at several levels. These include chapters on determining prime factors, calender analysis, and palindromic numbers; all of these being pointed principally towards related programming problems.

An overall summary view of the content of this book would reveal a modest amount of number theory together with a much larger amount of Fortran programming, both rather compactly presented. Whereas the amount of number theory technique which emerges is quite limited, the programming aspects fare better due to the detailed specimen programs.

Reactions to a noble experiment such as this one are of necessity subjective. This reviewer finds that the proposed marriage of number theory and Fortran IV leaves the former in a somewhat henpecked state. However, connubial matters of this sort are not that cut and dried. The author does succeed in exciting one's interest in the possibility of such a union and a search for an optimal basis of compatibility. Giving a course from this text might very well serve as a good starting point for such a quest.

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44 [4.00].— ROBERT E. O'MALLEY, JR., *Introduction to Singular Perturbations*, Academic Press, New York, 1974, viii + 206 pp., 25 cm. Price $16.50.

The term "singular perturbations" in this book refers to the study of ordinary differential equations which are modified by adding a small term of higher order of differentiation. The equation $\epsilon y'' + y' + y = 0$, which is a singular perturbation of the first order equation $y' + y = 0$, is a trivial illustration of this concept.

Until the late 1930's this type of problem was almost completely ignored by mathematicians, although the phenomena met in the boundary layer theory of Fluid Dynamics were known to be mathematically described by such differential equations. Since then, the theory of singular perturbations has grown into a substantial field of study, which has attracted numerous mathematicians in many countries. It has been recognized that questions of this sort often have surprising and fascinating mathematical answers and that singular perturbation aspects explain more physical phenomena than anybody would have foreseen forty years ago. The author of this book is one of the leading contributors to the progress in singular perturbation theory in the last ten years.

The book is written by a mathematician in the spirit of mathematics; but it is also, perhaps primarily, intended for users of mathematics in physics, engineering, biology and economics. The mathematical prerequisites are therefore held elementary, essentially at the undergraduate level, and many recondite matters of existence and of asymptotic smallness are omitted, with references to the appropriate literature. In the choice of subjects and of methods, the author has been influenced by his personal preferences and experience. Wherever possible, a unifying principle of uniform approximations that are obtained as the sum of two series is used, the first of which is itself a solution of the differential equation, while the second one involves a "stretched variable"