This collection, and in particular the detailed work on differential equations and the pioneering work in function theory and number theory, gives an excellent idea of Littlewood's qualities—on Hardy's estimate he was the man most likely to storm and smash a really deep and formidable problem. These handsomely produced volumes are a fitting memorial to an outstanding mathematician; they will fascinate and stimulate every analyst. We are greatly indebted to the editorial committee and the publishers.

PHILIP HEYWOOD

HUA, L. K. *Introduction to number theory* (translated by P. Shiu) (Springer-Verlag, Berlin-Heidelberg-New York, 1982), xviii + 572 pp. DM 96.

This is the English edition of a book on number theory written for Chinese students and first published in 1957. Its aim is to give a broad introduction to the subject, indicating the close relationship between number theory and mathematics as a whole. Its twenty chapters cover a very wide range of topics and contain much more material than could be dealt with in a single university course. The only existing English textbook with which it compares is the *Introduction to the Theory of Numbers* by Hardy and Wright. My impression is that, although it may not be quite so easy to read, Hua's book goes further into the subject than the earlier work.

As would be expected, the very considerable Chinese contribution to the subject is stressed. Thus the name of Soon Go will be unfamiliar to most western readers, but as his general solution of the Diophantine equation $x^2 + y^2 = z^2$ appeared much earlier than in the west it is right that he should be credited with his achievement.

In a short review it is not possible to give a full list of all the topics covered, but the following selection indicates the scope of the work. After basic introductory chapters the author discusses the distribution of prime numbers and gives two proofs of the Prime Number Theorem, namely the analytic proof of Wiener and the elementary one of Selberg and Erdös. Classical subjects, such as partition theory and the divisor and circle problems, are discussed, and other topics include trigonometric sums, continued fractions, indeterminate equations, binary quadratic forms, unimodular transformations, integer matrices, p-adic numbers, algebraic numbers, Waring's problem, Schnirelmann density and the Geometry of Numbers. Nearly everything required is proved in detail and there are indications of further improvements and more recent work. There are also extensive tables of primitive roots and data associated with quadratic fields.

The translator Peter Shiu has done an excellent job and, with very few exceptions, the text runs smoothly. This is a most excellent textbook and mine of information on the theory of numbers. The volume contains between its covers much work that cannot easily be found in one volume; every number-theorist will hope to be able to afford to place it on his shelves.

As the author asks in his preface to be informed of errors, I mention that, so far as I am aware, the values of the Hermite constants γ_9 and γ_{10}, given on p. 543, have not been conclusively established.

R. A. RANKIN

WHITELAW, T. A., *An Introduction to Linear Algrbra*, (Blackie, 1983), ix + 241pp., £7·95 (paper covers).

This book provides a substantial first course in linear algebra, with no previous knowledge of the subject assumed. The necessary terminology and facts about mappings are summarised in an appendix.

The first chapter deals with the geometry of three-dimensional vectors, as far as scalar product, but not discussing the geometrical ideas involved in linear dependence. Then comes an exposition of the elements of matrix algebra, with the basic operations defined but not motivated. A very detailed chapter on elementary row operations leads to the form of the general solution of a system of linear equations. The inevitable chapter on determinants avoids lengthy proofs by confining the details of some proofs to the 3×3 case, with an indication of how to attempt the general case.

Thereafter the book becomes slightly more abstract, with discussion of the properties of vector spaces over a field, up to direct sums, followed by a careful presentation of linear mappings with the barest mention of dual space, and then the matrices associated with linear mappings. The chapter dealing with eigenvalues and diagonalization of matrices considers geometric and algebraic multiplicities of eigenvalues, and gives criteria for diagonability, with a mention of the existence of a simple form of matrix for the non-diagonable case, but no statement of the form. The final chapter deals with euclidean spaces, orthonormal bases and orthogonal diagonalization, without mention of the extension to the complex field. A positive-definite matrix is defined, but there is no consideration of its place in the general inner product, and no discussion of quadratic forms.

Particularly in the early chapters the book proceeds gently, with ample explanation of what is being done. Even in the later chapters where the pace is faster a student should be well able to follow the arguments. The author includes helpful notes where needed, and points out very carefully which part of an "if and only if" result is being proved, a matter that many students seem to find difficult. To emphasise the parallelism between matrices and linear mappings many results which apply to both are separately stated. A summary of the main results in each chapter would be helpful, but perhaps it would be more profitable for a student to make his own summary. Each chapter ends with a set of exercises, answers being given where appropriate for numerical examples, with hints for other problems.

The printing of the book is disappointing in places, with irritating "breaking" of equations between lines, and some misalignment of matrices. But these are minor quibbles; the book is a useful text at this level, and can be confidently recommended.

H. G. ANDERSON

RICHTMYER, R. D., *Principles of advanced mathematical physics*, Volume II (Springer-Verlag, 1981), xii + 322 pp., DM 72.

Volume I under this title was published in 1978. It covers basic material on Hilbert spaces, Banach spaces, distributions and linear operators, with examples of ordinary and partial differential operators in physics. Other topics included are probability, initial value problems and fluid dynamics as an example of a non-linear problem. The three main areas of volume II are group and representation theory, Riemannian geometry and general relativity, and stability and dynamical systems.

The group theory is self contained, with examples of finite and continuous groups of physical interest. Group representations are discussed first in the context of the rotation group and spherical harmonics and subsequently the basic general theory of reduction and invariant integration is presented. Ray and in particular spin representations are motivated by discussing their role in quantum mechanics. Some elementary theory of manifolds is introduced prior to a discussion of Lie groups which ends with a sketch of the classification proof for simple complex Lie algebras.

The section on differential geometry begins with the definition of scalar, vector and tensor fields and introduces the important concepts in (pseudo-) Riemannian and affine geometry. A brief but clear presentation of the Einstein field equation is a starting point for a discussion of the Schwarzschild, Kerr and other solutions.

The presentation of stability and bifurcation is made in the context of fluid dynamics. Starting from a clear illustration of bifurcations in the flow between coaxial rotating cylinders, stability analysis by linearisation and simple examples of bifurcations are presented. A short chapter is devoted to some details of the rotating cylinder problem and the final chapter provides an introduction to the theory of the onset of turbulence, ending with a brief sketch of some period-doubling phenomena.

As its title indicates the book is at a higher level of mathematical sophistication than is conventional in a physics course but throughout the book the author bases his motivation and examples on physical problems. Much of the material could be used in specialised undergraduate courses. I would also recommend the book to postgraduate students and research workers in