between an overview of basic geometry, albeit from this particular viewpoint, with copious references and some proofs and an exposition of the method in many explicit examples and through the inclusion of a large number of exercises involving symmetry groups and complete sets of invariants. Although it claims to require only a background in multilinear calculus, tensor and exterior algebra, and some group theory, the reader will, I think, find the many allusions to a huge variety of topics quite daunting, though no doubt rewarding as well. The style is lively and stimulating and, while making considerable demands on both the commitment and mathematical background of the reader, in 480 detail-packed pages it manages to serve up in digestible form a great deal of material of interest far beyond the equivalence problem.

Whether this monograph is for you will be determined by your need to know the material and the extent to which your basic knowledge coincides with what the author considers basic. You may also be swayed by the prodigious nature of some of the calculations which emerge in the solutions of equivalence problems. But there is no room for doubt about the author's authority in the subject. As a definitive work at its price every mathematics research library should have a copy.

J. F. TOLAND

MITRINOVIĆ, D. S., SÁNDOR, J. and CRSTICI, B. *Handbook of Number Theory* (Mathematics and its Applications Vol. 351, Kluwer Academic Publishers, Dordrecht, 1995), xxvi + 622 pp., 0 7923 3823 5, £179.

What is a handbook? The dictionary describes it as "a small guidebook, or book of instructions." This handbook is, at 622 pages, not small, nor is it a book of instructions. Perhaps it should not be called a handbook at all! The only other "Handbook" on my shelf is the *Handbook of Mathematics* by Bronshtein and Semendyayev (English edition: Verlag Harri Deutsch, 1985), which cost me a bargain £10 in 1989. It is not small either! At 972 pages it gives a masterly compact summary of much useful mathematics – no number theory though.

But what of the *Handbook of Number Theory*? What is its scope and how is it organised? It consists of a long list of results in analytic and prime number theory largely. The majority of results are either inequalities or estimates, for example for the size of sets or sums. The results are organised into themes with the major historical results preceding the latest ones. It is manifestly a massive work of painstaking scholarship, referring where possible to original sources, and well-organised. Writing this review just after the death of Paul Erdös, I realise that one way of describing the scope of the book is to say that it is almost entirely about (some of) the topics in number theory which interested him, for references to his work appear in every chapter except one.

The book has sixteen chapters, the first seven of which are devoted to the classical arithmetical functions $\phi(n)$, $d(n)$, $\sigma(n)$, $\mu(n)$ and so on. The other chapters concern primes in arithmetical progressions, additive and diophantine problems concerning primes, exponential sums (the only chapter without a reference to Erdös – a mistake, surely?!), character sums, binomial coefficients and consecutive integers, partitions, congruences, additive and multiplicative functions. Surprisingly there is also an interesting chapter entitled "Estimates for finite groups and semi-simple rings". A typical result of this chapter is the asymptotic order of the number of solutions of the equation $x^k = e$ in the symmetric group on $n$ symbols.

The broad description given above is perhaps enough to see that the choice of topics covered is, as the authors acknowledge, a personal one and no attempt has been made to cover all areas of number theory. So forms and diophantine equations appear mostly in the context of problems involving primes! There is no algebraic number theory. So, while it is not comprehensive enough in many areas of number theory to be called a "handbook", it is hard to think of a title which adequately describes its contents.

My main criticism of the book relates to the practicalities of finding and using the results in it. The authors state in the preface that the book is intended for use by non-specialists (such as the reviewer!) in the areas of the book. Did any non-specialist read the manuscript? If they had, surely they would have pointed out that "Euler's $\phi$-function" is not defined. In the list of basic notation at the front $\phi(n)$ is described as "Euler's totient function". So what is it? We are not told. While Chapter 6 is devoted to the Möbius $\mu$-function, the function is not defined anywhere in the book. While these are well-known functions, the reader is entitled to a reminder of their definitions. But what of "Jordan's divisor function $J_k$" and its "unitary analogue $J_K^*$"? No non-specialist could be expected to know what these are. Again we are not told. There are many other examples of undefined terms and notation in the book and this flaw seriously detracts from the usefulness of the book. It could however be easily remedied by making the list of basic notation at the front of the book into a thoroughly comprehensive list of definitions. And why does the book have no index? A detailed contents and author index (in the manner of Hardy and Wright) is no substitute – an inexcusable omission in a reference book. Finally, readers paying the top-of-the-range price of £179 will expect a book of top-of-the-range production quality. The typesetting in the book, while adequate, is far from top quality, being sometimes very cramped (as on page 71) and sometimes very spread out (as on page 551). The English, while adequate, would have benefitted from a native-speaker's red pencil.

C.J. SMYTH

MACDONALD, I.G. *Symmetric functions and Hall polynomials* (2nd edition) (Clarendon Press, Oxford, 1995), x + 475 pp, 0 19 853489 2, £55.

The first edition of Macdonald's book *Symmetric Functions and Hall Polynomials* appeared in 1979. It was slim (180 pages), magnificently written, and became the definitive book on the subject for a wide range of workers. Sixteen years later a second edition has appeared. It is no longer slim. Two new chapters have been added together with a rich selection of extra material and these changes demand a new review.

As with the first edition over half of the book is devoted to the first chapter, which gives an account of symmetric functions. Symmetric functions impinge on many disciplines and this will be the chapter that most readers consult. What material has been added to produce a chapter whose length rivals that of the original book? Although new text appears, the great majority of added material consists in further examples at the end of each section. As a rule of thumb the number of examples in each section has doubled and this has produced a veritable treasure trove. Doubly stochastic matrices (§1 Ex. 13), Muirhead's inequalities (§2 Ex. 18) and Kac's treatment of quadratic reciprocity (§3 Ex. 17) make an appearance alongside many more gems. A welcome consequence of this abundance of examples is that the references in this edition (sadly lacking in the first) have been expanded many-fold; this will greatly benefit those workers wishing to pursue the veins of enquiry opened by these examples. Macdonald has also made improvements to the text which were suggested in earlier reviews. Section §6, which deals with the transition matrices between the various symmetric functions, now gives a direct description of those involving the power-sum symmetric functions; Appendix A contains an elementary and self-contained account (§8) of the polynomial representations of $GL_m(k)$ for $k$ algebraically closed and of characteristic 0. The treatment of the inner (or internal) product of symmetric functions has been expanded. There is also an entirely new Appendix B dealing with the characters of wreath products $G \sim S_n$; this is treated in the same fashion as the new material in §7 and provides welcome preparation for Chapter IV.

As for the later chapters, Chapter II, "Hall Polynomials", sees changes in §4, which now provides an explicit formula for $g_s(t)$ in terms of basic hypergeometrics. This chapter also contains an appendix by A. Zelevinsky (the Russian translator of the first edition) giving a further proof of Hall's theorem. Chapter III, "Hall–Littlewood Symmetric Functions", sees some slight rewriting of §2 and §5; the last example of the earlier §7 (which deals with the case $t = -1$ of these functions) is now promoted to a section of its own (§8) on Schur's $Q$-functions.