from spaces u, y respectively. Making the identifications $(u_j)\leftrightarrow\sum u_j\lambda^j$, $(y_j)\leftrightarrow\sum y_j\lambda^j$ we obtain a mapping $U[[\lambda]]\rightarrow Y[[\lambda]]$ of the spaces of formal power series over U, Y, and under fairly mild assumptions this mapping is a module homomorphism with respect to the action of the ring of polynomials $C[\lambda]$. Many questions about systems can thus be stated in module-theoretic terms: some convert to familiar questions with classical solutions, while others (notably ones about factorising homomorphisms) appear to be new. The basic theory was worked out in down-to-earth concrete fashion by engineers and has now been elevated into some elegant abstract algebra.

The internal states of some systems are better described by functions than finite vectors, and so there is a need for an infinite-dimensional version of the theory. Here things are very much more complicated. Aside from the introduction of topological considerations, there is the difficulty that $C[\lambda]$ has to be replaced by a ring of analytic functions which is not a principal ideal domain. Fortunately, the necessary generalisations of canonical form theory were being developed at exactly the right time by operator theorists, though in a language so different from the engineers' that the two lines of development did not make contact till around 1975. This must be the first book by an author expert in both operator theory and linear systems, and both camps should welcome it heartily.

The book contains three chapters. The first is a succinct presentation of the algebraic theory. The second takes up over half the book and is devoted to operators on Hilbert space, starting with the definition and covering an immense range of material right up to recent work on canonical models. The third chapter effects a synthesis of the first two, elaborating the theory of linear systems whose states can be represented by elements of a Hilbert space.

The author aims to reach both mathematicians and systems scientists, though he admits that the latter would have to devote "maybe even considerable" time and effort to its study. The "maybe" could safely have been omitted, for Chapter two is substantial fare indeed for all but an operator theorist: it contains more than some full length texts on operator theory, in extremely concise form and without exercises. Surely any engineer who wrestles with, for example, Carleson's Corona Theorem and the Nagy–Foiaş theory of canonical models just to be able to deal with transcendental transfer functions is a pure mathematician *manqué*. However, the book is finely written, well produced and reasonably priced; the first chapter should be accessible to, and rewarding for every mathematician with the slightest hankering for applications, while the rest of the book can be strongly recommended to operator theorists for its novel and enriching viewpoint.

N. J. YOUNG

MATSUMURA, H., *Commutative Algebra*, Second Edition (Benjamin/Cummings, 1980), 313 pp., $19.50.

The first edition of this book was published in 1970, and it provided a stimulating introduction to classical and homological commutative algebra, as well as to Grothendieck's reworking of parts of the classical theory. The lectures on which the book was based were paralleled by a course on algebraic geometry. Fortunately, since 1970, a number of outstanding books have been published in this area, and can now serve as companion works.

As regards the second edition of the book, the chapter on depth has been rewritten, and this, together with a few alterations and additions, is the only change to the original material; a large appendix, covering a diverse range of topics, has also been added. The index has been enlarged.

The new exposition on depth includes a discussion of quasi-regular as well as regular sequences, while a few elegant homological results have been added to shorten and clarify some of the original proofs. It is slightly unfortunate, however, that the new version leaves as implicit matters which formerly were made explicit. For example, the inequality depth $M \leq \dim M$, the effect on depth of factoring out a regular sequence, and the connection between graded rings and polynomial rings arising from certain ideals in a Cohen–Macaulay ring, all have to be ferreted out to a greater or lesser extent.

In the main, the appendix covers developments in areas involving the first module of differentials, though a proof of the Eakin–Nagata theorem, following Formanek, is given. Thus there is a discussion of p-bases and differential bases, coefficient rings, Jacobian criteria re openness of loci, Marot's theorem on the preservation of the Nagata property under power-series extension, Falting's proof of Grothendieck's theorem on the equivalence of formal smoothness and geometric regularity, and Kunz' theorems on Noetherian rings of characteristic p. Finally, there is a brief introduction to André cohomology. All these topics display the beautiful interrelationship between the properties of excellent rings (or, more generally, G-rings or Nagata rings), smoothness, differentials, and field extensions.

The appendix also contains some possible source of confusion. The result on p. 248 needs to be stated for the semilocal case, and the footnote on p. 252 should refer to Th. 77 as well. It is only implicitly given that a semilocal G-ring is a Nagata ring, since it is a J2 ring, yet this fact is used on p. 260. The reference on p. 258 should be to (24.B), while the second example on p. 260 needs to be supported by a reference to (37.8) of Nagata's "*Local Rings*". (A reference to p. 64 of Nagata's book would have been of interest in the result on Zariski rings on p. 176.) Recalling the method of proof of Th. 65 might have been of help in the section on formal étaleness. On p. 291 it would perhaps be better to refer to the *proof* of Th. 73 (3). The implications of Marot's theorem could have been made explicit. In the discussion of the second of Kunz' theorems, the expression "$=K \underset{K^p}{\otimes} B^*$" needs a little interpretation, while part of the subsequent lemma is taken for granted in the proof of the theorem.

As regards misprints, on p. 248 the reference should be to Lemma 1(ii); on p. 273 "formally étale" is meant, not "formally smooth"; on p. 300 we should have $A \simeq A^q$; while on p. 303, $q = Q \cap B^*$, on p. 305, κ not δ (twice), and on p. 270, K' not K^p are meant. There are one or two other minor misprints and lacunae as well.

However, set against page after page of beautiful mathematics, these are very minor cavils. Professor Matsumura has once again given us a marvellous and engrossing book—it's a must.

L. O'CARROLL

DAVIES, E. B., *One-Parameter Semigroups* (Academic Press, London, 1980), viii + 230 pp., £19.80.

The title refers to semigroups $\{T_t\}$ $(0 \leqq t < \infty)$ of bounded linear operators on a Banach space, and the book is primarily concerned with the relationship between the semigroup and its generator Z $(Zf = \lim_{t \to 0(+)} t^{-1}(T_t f - f)$, the limit existing for all f in some dense subspace of the Banach space). The author's stated aim is to provide an up-to-date treatment concentrating on the abstract theory rather than applications. This may seem a bold strategy in view of the current tide, but it is justified in terms of both the existing state of the literature and the need to keep the book to a manageable size. It should be mentioned in this respect that the preface contains a careful list, with references, of several related topics and applications which are not covered in the sequel. Also, various concrete examples throughout the text, often involving semigroups generated by differential operators, serve both to illustrate the general theory and to give some indication of the range of applications.

In Chapter 1 the basic properties of generators are established and it is quickly shown that the Cauchy problem for the differential equation $f_t' = Zf_t$ is uniquely soluble if Z is the generator of a one-parameter semigroup and f_0 lies in the domain of Z. Chapter 2 deals with spectral theory for Z and T_t, and then covers a range of results of Hille–Yosida type giving conditions for an operator Z to be the generator of a (possibly contraction) semigroup. The core of the book is completed by the perturbation theory in Chapter 3 (if Z is a generator when is $Z + A$ also a generator, and what is the relationship between the generated semigroups?).

Both Chapters 4 and 6 deal with operators on Hilbert space. Chapter 4 concentrates on self-adjoint operators; it covers Stone's theorem on one-parameter unitary groups (though curiously the result is nowhere referred to under this name), self-adjoint contraction semigroups, and quadratic forms. This chapter might benefit if the functional calculus for an unbounded self-adjoint operator were dealt with a little more fully instead of being relegated to the problems. The main feature of Chapter 6 is the theorem concerning the dilation of a one-parameter contraction semigroup to a unitary group on a larger Hilbert space. Chapter 5 is concerned with asymptotic