matrix ideal) from a semifir is considered. There are some nice results here. For example it is shown that the group algebra of a free group is a fir (there are other proofs) and that the algebra of rational power series is also a fir.

The notes at the end of each chapter give a good account of the history of the subject. The exercises are plentiful, and range from fairly difficult to open problems (the reader is warned of which category he is dealing with).

This text is an invaluable tool for the researcher and the diligent reader will find it quite rewarding. The reader interested in more examples and applications (some spectacular) is directed to Cohn's companion volume [**1**], and especially to Schofield's lovely monograph [**2**]. Both of these give accounts of Bergman's indispensable coproduct theorems.

REFERENCES

1. P. M. Cohn, *Skew field constructions*, London Math. Soc. Lecture Notes no. 27, Cambridge Univ. Press, Cambridge, 1977.

2. A. H. Schofield, *Representations of the ring over skew fields*, London Math. Soc. Lecture Notes no. 92, Cambridge Univ. Press, Cambridge, 1985.

JACQUES LEWIN
SYRACUSE UNIVERSITY

BULLETIN (New Series) OF THE
AMERICAN MATHEMATICAL SOCIETY
Volume 21, Number 1, July 1989

0273-0979/89 $1.00 + $.25 per page

Sphere packings, lattices and groups by J. H. Conway and N. J. A. Sloane. Springer-Verlag, New York, Berlin, Heidelberg, London, Paris, Tokyo, 1988, xxviii + 663 pp., $87.00. ISBN 0-387-96617-X, and ISBN 3-540-96617-X

Most of us, mathematicians or not, playing with pennies or a compass at an early age, learnt that six circles fit exactly round an equal one; and most of us, whether we have the mathematical language or not, know that you can't do better: each outer circle subtends just one sixth of a revolution at the centre of the inner one. The **kissing number**, in two dimensions, is six.

In three dimensions the situation is much less clear. A theorem of Archimedes tells us that the solid angle subtended by one sphere at the centre of an equal touching sphere is $(2-\sqrt{3})\pi$. Divide this into 4π and get $8+4\sqrt{3}$, so the kissing number in three dimensions is less than 15. But it's clear, when you try to arrange billiard balls round another one, that you have to leave **holes**: you can always stare through the interstices at the central ball. It's not difficult, by taking this into account, to see that the kissing number is less than 14, but to prove that it is less than 13 is far from trivial. Indeed, as eminent mathematicians as David Gregory and Isaac Newton had an inconclusive discussion about it in 1694. The