ROGERS, C. A., *Packing and Covering* (Cambridge Tracts in Mathematics and Mathematical Physics, No. 54, Cambridge University Press, 1964), viii+109 pp., 30s.

Since the war great progress has been made in the theory of packing and covering of Euclidean space by congruent bodies. L. Fejes Tóth's book *Lagerungen in der Ebene, auf der Kugel und in Raum* (Springer, 1953) is concerned mainly with problems in two or three dimensions, while Professor Rogers has been interested mainly in problems in n-dimensional space, particularly when n is large. In these fields his work has surpassed that of other workers and has been of outstanding importance. For this reason this latest Cambridge Tract is particularly welcome. It gives a systematic account of a body of work which is otherwise only available in individual papers. The theory is developed in a more general setting than is possible in papers. The arguments are broken down into more easily digestible constituents and the structure of the proofs is in this way made clearer. The style is clear although the arguments are often complex and difficult and demand considerable geometric intuition.

After a general historical introduction and outline of the theories of packing and covering, the associated densities are defined both for general and lattice arrangements. There follow chapters on the existence of reasonably dense packings and reasonably economical coverings. The book concludes with an account of the most recent work of the author, together with Daniels, Coxeter and Few, on packings and coverings by spheres.

R. A. RANKIN

RUDIN, W., *Principles of Mathematical Analysis* (McGraw-Hill Publishing Company Ltd., 1964), ix+270 pp., 62s.

The principal difference between the present edition of this familiar text and the first one is that the chapter on functions of several variables has been recast and considerably extended. By using derivatives of transformations, defined as linear transformations, the author is able to state and prove the inverse and implicit function theorems for vector valued functions without the use of determinants. (The sufficiency of the more familiar conditions is established later.) The chapter begins with some basic vector space concepts, and ends with a rather general version of Stokes' theorem.

In preparation, the earlier chapters contain more material on Euclidean and metric spaces. This is an advantage as far as the mature student is concerned, and individually the new sections are written with the splendid style and clarity which characterised the first edition.

I feel, however, that the mixture of old and new is not always satisfactory. The changes in Chapters 3, 4 and 5, previously straightforward chapters on sequences and series, continuity, and differentiation, make it impossible to reommend the second edition to an average student embarking on his first course in formal analysis. Even a more advanced student may find it confusing to have, on consecutive pages (42-45) in the early part of the chapter on sequences, independent theorems proved in a general metric space, for complex sequences, in R^k, and again in a general metric space.

The number of examples has been increased to about 200 and some of the material which is unchanged in substance has been rewritten. The printing and layout are similar to those of the first edition, but a slightly larger type has been used and this gives a pleasing appearance to the pages.

P. HEYWOOD

SAUL'YEV, V. K., *Integration of Equations of Parabolic Type by the Method of Nets* (Pergamon Press, 1964), 346 pp., 80s.

This is an English translation of a book published in Russian in 1960. The translator has added, in a few instances, a clarification of the original text, and has also brought the list of references up to date.

The book is in two distinct parts, the first part being concerned with the construction of net replacements (otherwise known as finite difference replacements) of parabolic equations and the second part with the numerical solution of such replacements. The parabolic equations dealt with include the heat conduction equation in one, two, and three space dimensions, and with cylindrical and spherical symmetry, the equation of longitudinal vibrations of a bar, and certain non-linear equations in one space variable.

In the first part, the net equations constructed are mainly for the heat conduction equation in one space dimension. This is a suitable model equation, and in fact twenty-two different schemes are examined and their conditions for stability determined. These schemes are mostly first order in time, but some second order schemes are also considered. The general conclusion, not surprisingly, is that the implicit schemes are better from the stability point of view, but the explicit schemes are easier to use. The accuracy of the schemes varies between $O(h)$ and $O(h^8)$, depending on the complexity and stability range of the schemes, where h is the mesh length in the space direction.

The second part deals with the practical numerical solution of the implicit net equations set up in the first part. The equations in one space dimension lead to a three point recurrence relation at each time step and the solution presents no real problem. Difficulty occurs however in the two and three dimensional cases. There, implicit methods require the solution of N^2 and N^3 linear equations respectively at each time step where $(N+1)h = 1$, and N is large. The author describes in detail a variety of methods for solving the sets of " elliptic " equations. These include variational methods such as the method of steepest descent and the method of conjugate gradients, and pure iterative methods employing overrelaxation, Chebyshev polynomials, and alternating direction methods respectively.

The reviewer feels that although the material covered in the second part is very comprehensive and clearly explained, it does not contain some of the recent developments in iterative methods of solution of elliptic equations which can be found in R. S. Varga's *Matrix Iterative Analysis* (Prentice-Hall, 1962). This, of course, is probably due to the fact that the present volume was first published in Russian in 1960.

Nevertheless, there is no doubting the merit of the present work or the industry and experience of the author. To the reader who wishes to obtain a solution on an electronic computer of a problem involving a parabolic equation. this volume is invaluable.

DOMORYAD, A. P., *Mathematical Games and Pastimes* (Pergamon Press; Macmillan, New York, 1964), xi+298 pp.

This is a translation by Halina Moss of a book originally published in Russia as a good-quality paper-back; copies from the first printing of 200,000 sold here for 4s.

Western readers will find little which is not already available to them—from Rouse Ball, or Kraitchik, for instance. This is yet another treatment of standard topics, rather than any glimpse of something rich and strange. Relatively to comparable works, the level of sophistication is a little higher in number theory (Euclid algorithm, Josephus problem), and a little lower in respect of geometry (patterns, dissections, curves, polyhedra).

The writing is simple and clear, and the translation reads smoothly. Some infelicities of crude transliteration must count as a blemish: a few diagrams have lost clarity by being altered, and some displayed algorithms by not being altered.

Worth a place in the lists—for individuals, or school libraries: but definitely not in the top ten.

T. H. O'BEIRNE