boundary conditions are replaced by their geometrical optics approximations as in the Kirchhoff theory and a solution of Maxwell's equations is sought which has the same value at infinity as the geometrical optics solution. One unique feature of the theory is the existence of a complex scalar function (remember the theory is vectorial) which when operated upon yields the diffracted electric and magnetic field vectors. In the important case of unpolarized light, the energy density can be written in terms of the absolute square of an integral over the complex scalar functions. The usefulness of this theory is slowly becoming evident to optical diffraction practitioners.

After a qualitative review of the diffraction patterns for different types of aberrations, the author proceeds to a discussion of resolution criteria for coherent and incoherent sources, rediscovering the Sparrow resolution criterion. Luneburg then formulates and partially solves a series of optimizing problems involving apodization. The Luneburg apodization problems and their variants now have an extensive literature. The last few pages are devoted to resolution of objects of periodic structure. He derives the transfer function and shows that an optical system acts as a low pass filter of spatial frequencies. Unfortunately the limited distribution of the old notes has prevented current workers in optics from appreciating the remarkable fact that Luneburg was in possession of the full theory of optical system analysis as early as 1943.

The volume closes with a series of appendices and supplementary notes, some by M. Herzberger. The notes are definitely worth studying as much of the material is not generally available. A foreword by Emil Wolf (not Emile Wolf as on the title page!) and a short bibliographical note round out the book.

In summary we can do no better than quote Wolf: "I consider it to be one of the most important publications on optical theory that has appeared within the last few decades".

Richard Barakat, Itek Corporation, Lexington, Mass.

Topologie II, by Wolfgang Franz. Vol. 2, Algebraische Topologie Samml. Göschen 1182/82a. W. de Gruyter, Berlin, 1965. 153 pages. Price D.M. 5.80.

This is a sequel to the Allgemeine Topologie of the same author, and, as in the case of the previous volume, the style is clear and concise, and the treatment remarkably comprehensive. In fact as before it seems quite surprising that so much information can be included in so small a space.

The book starts off with a general description of the scope of algebraic topology. There is then a preliminary chapter on the geometry of simplicial complexes, amplifying the material already treated in Volume 1 on this topic. Simplicial maps, simplicial approximation and contiguous maps are discussed. Chapter 2 gives the construction of the oriented simplicial homology and cohomology groups of a simplicial complex over the integers. Chapter 3 describes the algebra of chain complexes with applications to simplicial complexes. At this stage the relative homology and cohomology groups are introduced. In Chapter 4 the basic theorem for finitely generated abelian groups is proved and applied to the construction of a canonical basis for a complex. The Euler characteristic theorem is proved. In Chapter 5, cell complexes are introduced, and it is shown that the homology groups of a cell subdivision of a simplicial complex are isomorphic to the original simplicial groups. In particular it is shown that homology groups are invariant under the operation of barycentric subdivision. The topological invariance of the homology and cohomology groups is proved in Chapter 6. The method is to set up, using barycentric subdivision and simplicial approximation, isomorphisms between the homology and cohomology groups of different subdivisions of a complex, and so to construct abstract groups, independent of the triangulations. The discussion is carried out without the introduction of the singular theory. This chapter concludes with a treatment of fixed point theorems and local homology groups. In Chapter 7 the cup and cap products are constructed and their topological invariance is proved. Chapter 8 gives an introduction to the theory of homology manifolds. Poincaré duality is proved and dual bases are set up for the Betti groups. The classification of surfaces is described without proof.

There are two points of terminology which may cause a little confusion. "Teilkomplex" is as usual to be translated into the English "subcomplex". However the author also introduces the term "Subkomplex" the object of which turns out to be to get relative chain groups on which the boundary operator d will satisfy $d^2 = 0$. Also the author uses the term "Reduzierte Homologiegruppe", which is homology modulo torsion and not reduced homology in the usual sense.

Andrew H. Wallace, Institute for Advanced Study

An Introduction to Modern Calculus, by Wilhelm Maak. Translated from the German. Holt, Rinehart and Winston Inc. Publ., New York, 1963. x + 390 pages. $7.00.

The purpose of this book is described by the author in his preface: "This book is intended for use together with lectures. It is designed to help the student in his efforts to understand what is fundamental in differential and integral calculus." He goes on to say that whereas in Mathematics there are many "complete theories which start with axioms and, with a series of definitions and theorems, march to a well defined

https://doi.org/10.1017/S0008439500027521 Published online by Cambridge University Press