as, for example, closed subgroups, special mention should be made of the discussion of local groups and group germs. He clearly shows that the classical approach—even when restricted to a neighborhood of the identity—was really inadequate.

ALBERT NIJENHUIS

Introduction to algebraic geometry. By Serge Lang. New York, Interscience, 1958. 11+260 pp., $7.25.

This book, an introduction to the Weil-Zariski algebraic geometry, is an amplification of lecture notes for one of a series of courses, given by various people, going back to Zariski about a dozen years ago. Restricted to qualitative algebraic geometry (i.e. no intersection multiplicities, not even Chow coordinates), it is an admirable introduction to Weil's *Foundations* and, more generally, the whole of the modern literature as it existed before the advent of sheaves.

The text starts with the usual material on valuations, places, and integral dependence. From this are swiftly derived all the elementary facts on varieties (first affine, later projective or abstract, all either relative to a fixed ground field or to a universal domain) such as irreducibility, generic points, the Hilbert Nullstellensatz, dimension, dimension of intersections, products, projections, and correspondences. The effects of ground field extensions are given, and a subsidiary discussion of linear disjointness and separability leads to the notions of field of definition of a variety and rationality of a cycle over a field. It goes without saying that a large number of extremely important facts crop up almost incidentally (examples: separable points are dense in the Zariski topology, an abstract variety is a regular image of one in a projective space). Next come normal varieties, normalization of a variety (in a larger field), Zariski's original proof of his Main Theorem, divisors and linear systems (including the associated rational map and finite dimensionality on a complete variety), the last theorem of *Foundations* and the least field of rationality of a cycle. A brief chapter on derivations and differential forms (after Koizumi) is followed by one on (absolutely) simple points that includes a bit on local rings and the irreducibility of the generic hyperplane section. Two final chapters direct attention to a topic of current interest: connected algebraic groups are defined and some first results on these are proved (e.g. completeness implies commutativity, and in this case a map of a product variety decomposes), the Riemann-Roch theorem for curves is proved (following Weil and repartitions, for an algebraically closed ground field, but

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including the connection with the sum of the residues), and the construction of the jacobian variety is sketched. The very last item is a cute proof that a real curve of genus g has at most $g+1$ topological components.

One sees that a lot of ground is covered, enough for a solid basic knowledge of the subject. The question arises whether this is the book, so long demanded by any number of mathematicians intrigued by certain of the applications of algebraic geometry but frightened by the formidable mechanism, that in a few well-chosen words makes things intelligible to the layman. This book certainly goes a long way toward such an improbable ideal. Perhaps twice as much material is included as would be advisable for such a purpose, but one can skip judiciously.

An essential bit of adverse criticism is occasioned by the author's generally breezy style, so appropriate to lecture notes and so conducive to compactness, which now and then (fortunately rarely!) makes some slurred argument, misprint, or misstatement all the more difficult to untangle. And the sketchy index is of too little help.

M. ROSENLICHT

Numerical analysis and partial differential equations. By G. E. Forsythe and P. C. Rosenbloom. (Surveys in Applied Mathematics, vol. V.) New York, Wiley, 1958. 10+204 pp., $7.50.

The two parts of this book are independent of each other and shall be described separately.

The article by Forsythe is a brief and very readable essay on the main problems of numerical analysis and on the kind of computing machines that are available to solve them. It will be of service to the practicing numerical analyst and at the same time it is a good introduction into the subject for a mathematically sophisticated novice. The problems described here are: (A) approximate quadrature, and best approximation to functions of one and several variables, least square fits; (B) solving simultaneous algebraic equations by Gauss elimination and, for sparse matrices, by iteration; the calculations of eigenvalues of matrices; (C) difference method for solving Laplace's equation and the associated eigenvalue problem.

There is a brief discussion of past, present and future methods for solving these problems, with an excellent guide to the literature, especially to articles in Russian.

Rosenbloom's survey of recent researches in the theory of linear partial differential equations is much longer and more ambitious.

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