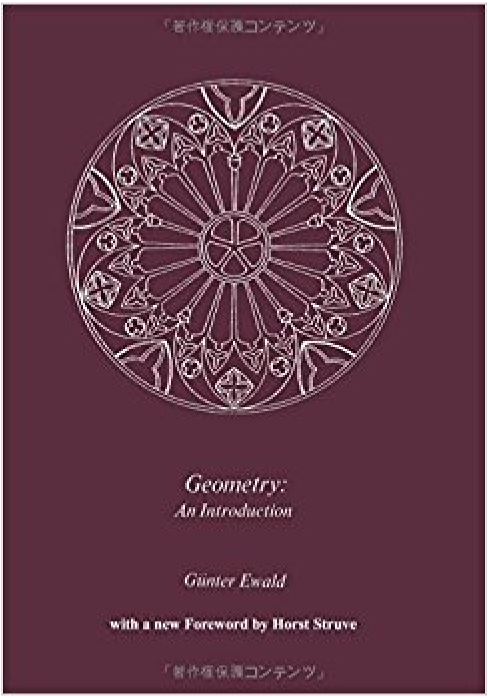
Geometry An Introduction



Synopsis

One of the insights that arose not long after Hilbert’s Foundations of Geometry was that it is possible to build geometry without notions of order or continuity. An essential tool in this direction was the calculus of reflections, an idea that owes much to Hjelmslev. Bachmann later deepened the study of reflection geometry in a systematic way and coined the concept of a metric plane,Ã Â a structure that captures the core of the orthogonality properties common to the Euclidean and the classical non-Euclidean planes.Ã Â All Hilbert planes, i. e. all models of the plane axioms of Hilbert’s axiom system, without the parallel axiom and the continuity axioms, turn out to be metric planes. Metric planes can be embedded in projective-metric planes, and thus can also be described analytically, i. e. in terms of coordinates. Reflection geometry emphasizes the interplay between geometry and group theory. This "Introduction" by Ewald occupies a singular place in the English language literature. Ewald’s book treats a central topic of geometry, the theory of metric planes in Bachmann’s sense. It makes this theory accessible to readers of English, in a systematic manner, through an axiomatic-deductive approach. Hyperbolic and elliptic geometries are also treated as substructures of a circle geometry, the Mobius geometry. This geometry is also introduced axiomatically by using an axiom system of van der Waerden.

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Customer Reviews

The author: Professor Ewald (Dr. rer. nat. University of Mainz) is Professor of Mathematics at the Ruhr Universitat. Professor Ewald is the author of a considerable number of research publications and a former Fulbright Scholar. He has taught as a visiting professor at Michigan State University and at the University of Southern California.

I own a used hard cover copy of this book, and I am very happy to see it reprinted. This seems to be the only exposition of the approach to geometry developed in Germany by Friedrich Bachmann and others. It is a fascinating alternative to expositions that follow Hibert’s axioms more closely, like the excellent book Geometry:Euclid and Beyond by Hartshorne. The approach here is in a sense more modern. It develops the idea of a "metric plane", which is a minimal geometry incorporating the idea of perpendicularity, and which can be extended to Euclidean, hyperbolic, and elliptic geometries. One of the undefined notions is that of a "reflection", which is a type of mapping that is defined axiomatically. Reflections are used to generate rotations and translations, and thus all plane motions. Finally, after axioms of order are introduced, congruence can be defined as superimposability by means of plane motions, without the need for extra axioms of congruence as for Hilbert.The book also generalizes the metric plane to affine, projective, and inversive planes. In each case the group of motions of a metric plane is shown to be a subgroup of the appropriate group, as in Klein’s Erlanger program. The book shows how any affine plane can be coordinatized by a skew field, and then extends this to three dimensions, which leads to the introduction of vector spaces. The culmination of the book is a proof that any metric plane can be embedded in a projective plane, which leads to a proof that the theories of a Euclidean, elliptic, or hyperbolic metric plane are each categoric.This is a rich book, and it is not an easy one. It does not assume any prerequisites beyond the ability to follow proofs. It introduces the necessary group theory and linear algebra as needed. But it quickly gets into fairly sophisticated topics, which would be appropriate for someone with a mathematical maturity at at least the upper undergraduate level.

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