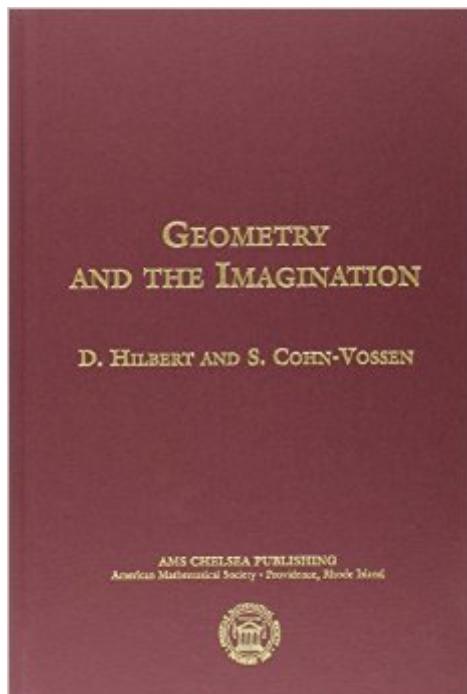


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# Geometry And The Imagination (AMS Chelsea Publishing)



## Synopsis

This remarkable book has endured as a true masterpiece of mathematical exposition. There are few mathematics books that are still so widely read and continue to have so much to offer--after more than half a century! The book is overflowing with mathematical ideas, which are always explained clearly and elegantly, and above all, with penetrating insight. It is a joy to read, both for beginners and experienced mathematicians. "Hilbert and Cohn-Vossen" is full of interesting facts, many of which you wish you had known before, or had wondered where they could be found. The book begins with examples of the simplest curves and surfaces, including thread constructions of certain quadrics and other surfaces. The chapter on regular systems of points leads to the crystallographic groups and the regular polyhedra in  $\mathbb{R}^3$ . In this chapter, they also discuss plane lattices. By considering unit lattices, and throwing in a small amount of number theory when necessary, they effortlessly derive Leibniz's series:  $\pi/4 = 1 - 1/3 + 1/5 - 1/7 + \dots$ . In the section on lattices in three and more dimensions, the authors consider sphere-packing problems, including the famous Kepler problem. One of the most remarkable chapters is "Projective Configurations". In a short introductory section, Hilbert and Cohn-Vossen give perhaps the most concise and lucid description of why a general geometer would care about projective geometry and why such an ostensibly plain setup is truly rich in structure and ideas. Here, we see regular polyhedra again, from a different perspective. One of the high points of the chapter is the discussion of Schlaflie's Double-Six, which leads to the description of the 27 lines on the general smooth cubic surface. As is true throughout the book, the magnificent drawings in this chapter immeasurably help the reader. A particularly intriguing section in the chapter on differential geometry is Eleven Properties of the Sphere. Which eleven properties of such a ubiquitous mathematical object caught their discerning eye and why? Many mathematicians are familiar with the plaster models of surfaces found in many mathematics departments. The book includes pictures of some of the models that are found in the Göttingen collection. Furthermore, the mysterious lines that mark these surfaces are finally explained! The chapter on kinematics includes a nice discussion of linkages and the geometry of configurations of points and rods that are connected and, perhaps, constrained in some way. This topic in geometry has become increasingly important in recent times, especially in applications to robotics. This is another example of a simple situation that leads to a rich geometry. It would be hard to overestimate the continuing influence Hilbert-Cohn-Vossen's book has had on mathematicians of this century. It surely belongs in the "pantheon" of great mathematics books.

## Book Information

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## Customer Reviews

The leading mathematician of the 20th century, David Hilbert liked to quote "an old French mathematician" saying "A mathematical theory should not be considered complete until you have made it so clear that you can explain it to the first man you meet on the street". By that standard, this book by Hilbert was the first to complete several branches of geometry: for example, plane projective geometry and projective duality, regular polyhedra in 4 dimensions, elliptic and hyperbolic non-Euclidean geometries, topology of surfaces, curves in space, Gaussian curvature of surfaces (esp. that fact that you cannot bend a sphere without stretching some part of it, but you can if there is just one hole however small), and how lattices in the plane relate to number theory. It is beautiful geometry, beautifully described. Besides the relatively recent topics he handles classics like conic sections, ruled surfaces, crystal groups, and 3 dimensional polyhedra. In line with Hilbert's thinking, the results and the descriptions are beautiful because they are so clear. More than that, this book is an accessible look at how Hilbert saw mathematics. In the preface he denounces "the superstition that mathematics is but a continuation ... of juggling with numbers". Ironically, some people today will tell you Hilbert thought math was precisely juggling with formal symbols. That is a misunderstanding of Hilbert's logical strategy of "formalism" which he created to avoid various criticisms of set theory. This book is the only written work where Hilbert actually applied that strategy by dividing proofs up into intuitive and infinitary/set-theoretic parts.

The purpose of this book is very well described by the author in the preface. There Hilbert says "...In this book, it is our purpose to give a presentation of geometry, as it stands today, in its visual,

intuitive aspects. With the aid of visual imagination we can illuminate the manifold facts and problems of geometry, and beyond this, it is possible in many cases to depict the geometric outline of the methods of investigation and proof, without necessarily entering into the details connected with the strict definitions of concepts and with the actual calculations."A little further, he says "...This book was written to bring about a greater enjoyment of mathematics, by making it easier for the reader to penetrate to the essence of mathematics without having to weight himself down under a laborious course of studies."As a reader of this book, I can say that the key words are "visual imagination" and "enjoyment of mathematics".The purpose described by Hilbert is completely (and excellently) achieved.The book is a masterpiece, written by one of the masters of Mathematics.In an elegant and clear style, Hilbert explains the most beautiful geometrical concepts.When reading it, you feel as if Hilbert was sit down besides you, just talking about geometry to you, (maybe with the aid of a sheet of paper and a pencil), and you can grasp the genius of the Göttingen Professor.He does not use practically any formula or mathematical expression, however his prose is full of mathematical insights, geometrical facts, stimulating images and delicious "expository" proofs.

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