

Preface (Divine Proportions)

Divine Proportions: Rational Trigonometry to Universal Geometry introduces a remarkable new approach to trigonometry and Euclidean geometry.

Teachers and students will benefit from this simpler and cleaner theory, which takes perhaps a quarter of the usual time to learn. Engineers, surveyors and scientists will have a wonderful new set of tools that increase accuracy and reduce computation time for geometric problems. Mathematicians will finally have a logically coherent framework for metrical geometry, which opens up exciting areas for investigation in algebraic geometry, number theory, combinatorics and special functions.

The key insight is that *geometry is a quadratic subject*. So *rational trigonometry* replaces the quasi-linear notions of distance and angle with the related, but more elementary, quadratic concepts of *quadrance* and *spread*, and replaces the transcendental functions $\cos \theta$ and $\sin \theta$ and their inverse functions with purely algebraic relations. The basic laws take on a novel and simplified form, with many calculations now possible by hand that formerly required tables or calculators.

Quadrance and spread allow the formulation of a Euclidean theory of geometry over any field. Many classical theorems of Euclidean planar geometry have analogues in this more general setting, called *universal geometry*, but there are also many new formulas and phenomenon, such as nine-point circles over the complex numbers, or five-fold symmetry on a 19×19 Go board. Number theory and algebra become intimately bound up with geometry.

This text covers the key definitions and results of this new theory in a systematic way, along with many applications from engineering, physics and surveying, including Platonic solids, projectile motion, Snell's law, the problems of Snellius-Pothenot and Hansen, and three dimensional volumes and surface areas.

The message of this book is controversial, but it will be hard to deny the power of its content. I hope that *Divine Proportions* will encourage more people to study, and enjoy, the utility and beauty of geometry.

N J Wildberger
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