Contents

1	The Golden Number	1
	Pieces of paper, The golden ratio, Fibonacci's rabbits, Continued fractions, Pentagons, Phyllotaxis, Further reading, Exercises.	
2	Shapes and Solids	27
	Flatland, Polygons, Tiling, Vision and projection, Five classical polyhedra, Duality, Kepler and Poinsot, The Archimedean figures, Non-convex polyhedra, Pentagonal tilings, Further reading, Exercises.	
3	The Fourth Dimension	63
	What is the fourth dimension? Honeycombs, The 4-simplex, The hypercube and the 16-cell, Other regular convex figures, Non-convex regular figures, Honeycombs, five dimensions and more, Nets, Further reading, Exercises.	
4	Projective Geometry	89
	Pappus' theorem, Desargues' theorem, Duality, Duality in three dimensions, Infinity and parallels, Quadrilaterals and quadrangles, Conics, Coordinates, Finite geometries, Configurations, Further reading, Exercises.	
5	Topology	113
	Hairy dogs, Colour problems, Colouring maps on the torus, The Möbius band, The Klein bottle, The projective plane, Round up, Further reading, Exercises.	
6	Bubbles	137
	Surface tension, Two bubbles, Three bubbles, Four bubbles, Foam, Films on frames, Films on cylinders, That well known theorem, Further reading, Exercises.	

7	Harmony of the Spheres Steiner's porism, Inversion, Coaxial circles, Proof of Steiner's porism, Soddy's hexlet, Further reading, Exercises.	157
8	Chaos and Fractals Shaken foundations, Fractals, Fractional dimensions, Cantor sets, Population growth, Double, double, boil and trouble, Chaos and peace, And so to dust, Newton's method, Julia and Mandelbrot sets, Natural chaos, Further reading, Exercises.	179
9	Relativity The special theory, Time changes, The Lorentz-Fitzgerald contraction, Distortion of bodies, Lorentz transformation, Time and relativity, Mass and energy, Coordinates, Curvature, Einstein's equations, The Schwarzchild solution, Consequences of general relativity, Black holes, Properties of black holes, Further reading, Exercise.	205
10	Finale Squares on a quadrilateral, The Argand plane, The quadrilateral revisited, Other complex problems, Trisection, Bends, Pedal triangles, Coordinates of points and lines, Further reading.	231
A	The Bull and the Man The problem, The proof.	247
В	Stereo Images Compound figures, Desargues' theorem.	251
C	More on Four Archimedean figures in four dimensions, Prisms and hyperprisms.	261
D	Schlegel Images Schlegel diagrams, The hypercube, The 16-cell, The 24-cell, The 120-cell, 600-cell and tetroctahedric.	271

E	Crystals	287
	Packing of spheres, Crystals, Diamonds and graphite, Silica structures, Gems, Further reading.	
F	Stability Stability of fixed points, The fixed points, The two cycle, Three cycles.	305
G	Fanoland	319
	Seven girls and seven boys, Plus six girls and six boys, Explanation.	
Bibliography		321
Index		323

Contents xiii