
Contents

Preface *page vii*

| | | |
|----------|----------------------------------|--------|
| | PART ONE OVERVIEW | 1 |
| 1 | Close Packing | 3 |
| | 1.1 History | 3 |
| | 1.2 Face-Centered Cubic | 6 |
| | 1.3 Hexagonal-Close Packing | 10 |
| | 1.4 Gauss | 13 |
| | 1.5 Thue | 14 |
| | 1.6 Dense Packings in a Nutshell | 17 |
| | PART TWO FOUNDATIONS | 23 |
| 2 | Trigonometry | 25 |
| | 2.1 Background Knowledge | 25 |
| | 2.2 Trig Identities | 27 |
| | 2.3 Vector Geometry | 33 |
| | 2.4 Angle | 39 |
| | 2.5 Coordinates | 51 |
| | 2.6 Cycle | 55 |
| | 2.7 Chapter Summary | 60 |
| 3 | Volume | 61 |
| | 3.1 Background in Measure | 61 |
| | 3.2 Primitive Volume | 63 |
| | 3.3 Finiteness and Volume | 70 |

| | | |
|-------------------|---|-----|
| 4 | Hypermap | 72 |
| 4.1 | Background on Permutations | 73 |
| 4.2 | Definitions | 74 |
| 4.3 | Walkup | 78 |
| 4.4 | Planarity | 83 |
| 4.5 | Path | 86 |
| 4.6 | Subquotient | 91 |
| 4.7 | Generation | 95 |
| 5 | Fan | 112 |
| 5.1 | Definitions | 112 |
| 5.2 | Topology | 117 |
| 5.3 | Planarity | 121 |
| 5.4 | Polyhedron | 132 |
| | PART THREE THE KEPLER CONJECTURE | 143 |
| 6 | Packing | 145 |
| 6.1 | The Primitive State of Our Subject Revealed | 145 |
| 6.2 | Rogers Simplex | 150 |
| 6.3 | Cells | 167 |
| 6.4 | Clusters | 180 |
| 6.5 | Counting Spheres | 185 |
| 7 | Local Fan | 194 |
| 7.1 | Localization | 194 |
| 7.2 | Modification | 203 |
| 7.3 | Polarity | 209 |
| 7.4 | Main Estimate | 212 |
| 8 | Tame Hypermap | 235 |
| 8.1 | Definition | 236 |
| 8.2 | Contravening Hypermap | 238 |
| 8.3 | Contravention is Tame | 243 |
| 8.4 | Admissibility | 248 |
| 8.5 | Linear Programs | 250 |
| 8.6 | Strong Dodecahedral Theorem | 252 |
| Appendix A | Credits | 257 |
| | <i>References</i> | 261 |
| | <i>General index</i> | 264 |
| | <i>Notation index</i> | 269 |