

Contents

1. Introduction	
1.1. The scope of the book	1
1.2. The background of the work	2
1.3. Viewing the stereoscopic drawings	2
1.4. The use of matrices	3
2. Symmetry in one, two, and three dimensions	
2.1. Symmetry in one dimension	7
2.2. Symmetry in two dimensions	7
2.3. Symmetry in three dimensions	10
2.4. Systematization of the treatment of symmetry	16
2.5. Handedness	17
2.6. Some characteristics of symmetry matrices	18
3. Symmetry in four dimensions	
3.1. Introduction	19
3.2. The identity	19
3.3. Mirror hyperplanes	19
3.4. Rotation planes	20
3.5. Rotation-inversion axes	20
3.6. Point elements of symmetry	21
3.6.1. Double rotation involving two two-fold rotation planes	21
3.6.2. Double rotation involving two rotation planes, only one of which is two-fold	22
3.6.3. Double rotation involving planes of equal order	23
3.6.4. Double rotation involving rotation planes of unequal order greater than two	24
3.6.5. Multiple rotation	25
3.6.6. The five-fold and ten-fold operations	26
3.7. Summary	26

4. The stereographic projection and the hyperstereographic projection	
4.1. The stereographic projection	28
4.2. Representation of symmetry in the stereogram	31
4.2.1. Mirror planes	31
4.2.2. Rotation axes	33
4.2.3. Point symmetry elements	35
4.3. The hyperstereographic projection	37
4.4. Representation of symmetry in the hyperstereogram	41
4.4.1. The concept of the symmetry element	41
4.4.2. The identity	42
4.4.3. Mirror hyperplanes	42
4.4.4. Rotation planes	44
4.4.5. Rotation-inversion axes	46
4.4.6. Point symmetry elements	55
4.4.6.1. The $\bar{1}$ operation	55
4.4.6.2. The $\bar{3}$, $\bar{4}$, and $\bar{6}$ operations	55
4.4.6.3. The $\bar{2}$, $\bar{3}$, $\bar{4}$, and $\bar{6}$ operations	56
4.4.6.4. The $\bar{8}$ operation	65
4.4.6.5. The $\bar{2}$, $\bar{3}$, and $\bar{6}$ operations	67
4.4.6.6. The $\bar{5}$ and $\bar{10}$ operations	69
5. A notation for the four-dimensional crystal classes	
5.1. Introduction	72
5.2. Axes and hyperplanes	72
5.3. Rotation planes	72
5.4. Crypto-components of symmetry axes	74
5.5. Point symmetry elements	74
5.6. Null symbols	75
5.7. Economy of symbols versus clarity	76
5.8. Enantiomorphy	77
6. The atlas	
6.1. Introduction	78
6.2. Table of crystal families and crystal systems	80
6.3. Summary of the crystallographic axes adopted for the twenty-three crystal families	81
Family I—hexaclinic	82
Family II—triclinic	83
Family III—diclinic	84
Family IV—monoclinic	85
Family V—orthogonal	86

Family VI—tetragonal monoclinic	89
Family VII—hexagonal monoclinic	92
Family VIII—ditetragonal diclinic	98
Family IX—ditrigonal diclinic	98
Family X—tetragonal orthogonal	100
Family XI—hexagonal orthogonal	106
Family XII—ditetragonal monoclinic	115
Family XIII—ditrigonal monoclinic	116
Family XIV—ditetragonal orthogonal	118
Family XV—hexagonal tetragonal	123
Family XVI—dihexagonal orthogonal	131
Family XVII—cubic orthogonal	142
Family XVIII—octagonal	148
Family XIX—decagonal	149
Family XX—dodecagonal	151
Family XXI—di-isohexagonal orthogonal	153
Family XXII—icosagonal	163
Family XXIII—hypercubic	172
References	197
Index	199