



SYMMETRIES
— OF —
ISLAMIC
GEOMETRICAL
PATTERNS

Syed Jan Abas
Amer Shaker Salman

World Scientific

CONTENTS

Preface: About the Book	v
Acknowledgments	xi
Dedication by S. J. Abas	xiii
Dedication by A. S. Salman	xv
Foreword by Michael Atiyah	xvii
Foreword by Ahmed Moustafa	xix
1. Islamic Patterns and Their Geometrical Structures	1
1.1. Islamic Patterns: An Introduction	2
1.1.1. Types of Patterns	2
1.1.2. Recognizable Characteristics	4
1.1.3. A Definition	6
1.1.4. Turning to Geometry	8
1.1.5. Related Literature	12
1.2. Geometrical Strategies and Structures	14
1.2.1. Khatem Sulemani: The Most Basic Shape	14
1.2.2. Variations on Khatem Sulemani	16
1.2.3. Harmonious Proportions: The Secret of Beauty	18
1.2.4. A Complex Pattern	19
1.2.5. Grids and Circles	21
1.2.6. The Zalij Approach to Islamic Patterns	24
1.3. Concluding Remarks	27
2. In Praise of Pattern, Symmetry, Unity & Islamic Art	29
2.1. In Praise of Pattern	30
2.1.1. In Praise of Symmetry	32
2.2. In Praise of Unity	35
2.3. In Praise of Islamic Art	36
2.3.1. Islamic Patterns and Atomic and Molecular Structures	37
2.3.2. A Celebration of Unity	39
2.4. Concluding Remarks	43

3. The Gateway from Islamic Patterns to Invariance and Groups	45
3.1. An Example of Symmetries of an Islamic Pattern	46
3.2. The Key Property of Symmetric Objects	54
3.2.1. Finite Symmetric Objects with Centres of Rotations and Lines of Mirror Reflections	54
3.2.2. Infinite Symmetric Objects with Translations and Lines of Glide Reflections	56
3.2.3. Definition of Symmetry for Geometrical Objects	57
3.2.4. Symmetry Group of a Geometric Object	58
3.2.5. The Four Special Properties of a Symmetry Group	59
3.3. The Symmetry Group of an Islamic Pattern	61
3.3.1. The Translation Symmetries	62
3.3.2. The Rotation Symmetries	63
3.3.3. The Mirror Reflection Symmetries	64
3.3.4. The Glide Reflection Symmetries	65
3.3.5. Symmetries Depicted in a Unit Cell	65
3.4. Symmetry and Groups in General	66
3.5. The Two Grand Questions and One that is Grandest	69
3.6. Concluding Remarks	71
4. Classification, Identification and Construction of the Seventeen Types of Two-Dimensional Periodic Patterns	73
4.1. Classification of Patterns	74
4.1.1. The Five Net Types	75
4.1.2. The Seventeen Pattern Types	76
4.1.3. The International Crystallographic Notation	77
4.2. Examples of the Seventeen Types of Patterns from Islamic Art	79
4.3. Identifying the Seventeen Pattern Types	108
4.4. Tile-Based Algorithms for the Seventeen Pattern Types	114
4.4.1. The Notation	114
4.4.2. The Procedure	115
4.4.3. An Example	115
4.5. Concluding Remarks	116
5. Islamic Patterns and Their Symmetries	135
5.0.1. Related Works	136
5.0.2. Preferred Symmetry Types in the Islamic Culture	138
5.1. Concluding Remarks	139
References	389
Index	395