Preface

Molecules, galaxies, art galleries, sculpture, viruses, crystals, architecture, and more: *Shaping Space: exploring polyhedra in nature, art, and the geometrical imagination* is an exuberant survey of polyhedra in nature and art. It is at the same time hands-on, mind-turned-on introduction to one of the oldest and most fascinating branches of mathematics. In these pages you will meet some of the world's leading geometers, and learn what they do and why they do it. In short, *Shaping Space* is as many-faceted as polyhedra themselves.

Shaping Space is a treasury of ideas, history, and culture. For students and teachers, from elementary school to graduate school, it is a text with context. For the multitude of polyhedra hobbyists, an indispensable handbook. *Shaping Space* is a resource for professionals—architects and designers, painters and sculptors, biologists and chemists, crystallographers and physicists and earth scientists, engineers and model builders, mathematicians and computer scientists. If you are intrigued by the exquisite shapes of crystals and want to know how nature builds them, if you marvel at domes and wonder why most stay up but some fall down, if you wonder why Plato thought earth, air, fire and water were made of polyhedral particles, if you wonder what geometry is and are willing to try it yourself, this book is for you. In *Shaping Space* you will see that polyhedra are as new as they are old, and that they continue to shape our spaces in new and exciting ways, from computer games to medical imaging.

The computer revolution has catalyzed new research on polyhedra. A quarter century ago, discrete and computational geometry (the branch of mathematics to which polyhedra belong) was less a field in its own right than—in the eyes of many people, even many mathematicians—a grab-box of mathematical games. Today an international journal, *Discrete and Computational Geometry*, publishes six issues a year with the latest research on configurations and arrangements, spatial subdivision, packing, covering, and tiling, geometric complexity, polytopes, point location, geometric probability, geometric range searching, combinatorial and computational topology, probabilistic techniques in computational geometry, geometric graphs, geometry of numbers, and motion planning, and papers with a distinct geometric flavor in such areas as graph theory, mathematical programming, real algebraic geometry, matroids, solid modeling, computer graphics, combinatorial optimization, image processing, pattern recognition, crystallography, VLSI design, and robotics.

Figure 1. An icosahedron built and decorated by elementary school children. Photograph by Stan Sherer.

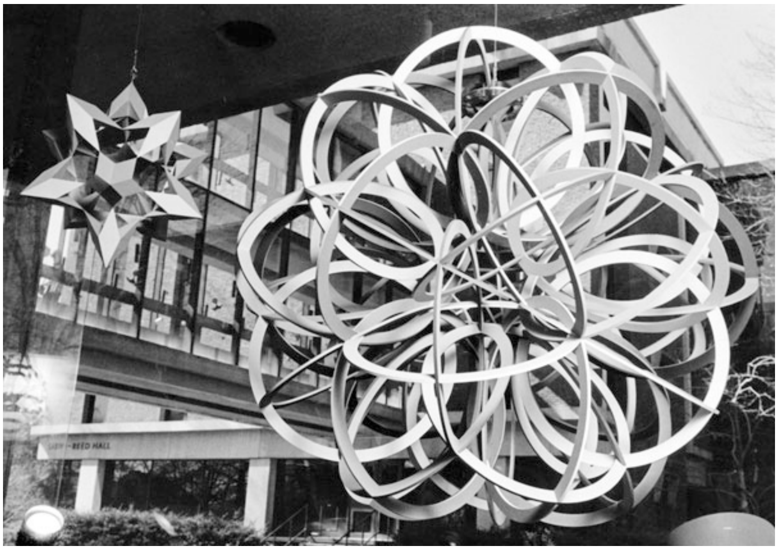

Figure 2. Sculptures by Morton Bradley. Photograph by Stan Sherer.

Yet, it is also true, as the saying goes, *plus ça change, plus c'est la même chose*. The more things change, the more they stay the same, especially in school mathematics curricula. Despite its central importance in the sciences, the arts, in mathematics and in engineering, solid geometry has all but vanished from the schools, plane geometry is being squeezed to a minimum, and model-building is relegated to kindergarten. Reasons for this unfortunate (and, unfortunately, long-term) trend include a lack of teacher training and pressures to teach testable skills. But educators will realize, sooner rather than later, that "technology in the classroom" is more than clicking the latest gadgets, it means understanding our technological world. Geometry will reappear as a blend of model-building, engineering and fundamental math and science.

Meanwhile, the internet is helping to bring geometry back to life and with it a community of geometers. You can explore polyhedra in nature, art, and the geometrical imagination on the world wide web by yourself, with *Shaping Space* as your guide, and share your findings and frustrations with the like-minded through chat groups. Keep pencils, paper, a ruler, scissors, and tape handy: Confucius got it right 2500 years ago:

> I hear and I forget,
> I read and I remember,
> I do and I understand.

Shaping Space will evolve as the subject grows. The notes and references at the end of this book are also on my website, http://www.marjoriesenechal.com. Authors will post updates there; you will also find links to instructional and recreational materials, and to websites of polyhedra-minded scientists, artists and hobbyists. Visit often!

Indeed, *Shaping Space* has grown already. Its ancestor, *Shaping Space: a polyhedral approach* was inspired by a three-day festival of workshops, exhibitions and lectures on polyhedra held at Smith College in 1984. *Shaping Space: Exploring Polyhedra in Nature, Art, and the Geometrical Imagination* includes the best of the past and new chapters by Robert Connelly, Erik Demaine (with Martin Demaine and Vi Hart), George Hart, Joseph O'Rourke, Ileana Streinu, and Günter Ziegler (with Moritz Schmidt).

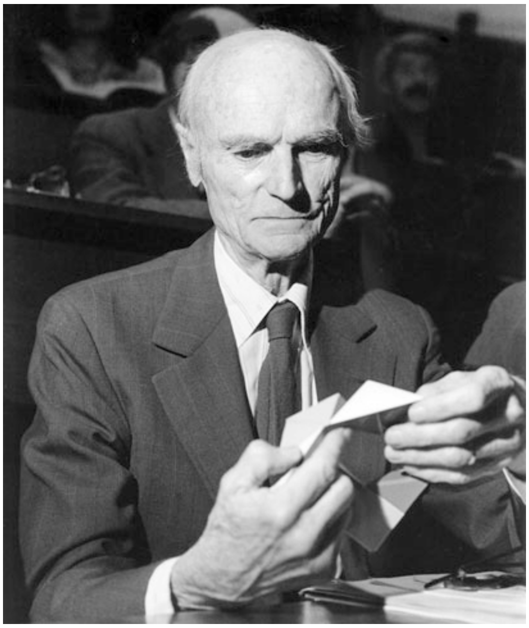

Figure 3. H. S. M. Coxeter (1907–2003). Photograph by Stan Sherer.

Figure 4. Arthur L. Loeb (1923–2002). Photograph by Stan Sherer.

Shaping Space: exploring polyhedra in nature, art, and the geometrical imagination is dedicated to the memory of two friends and colleagues, the legendary geometer H. S. M. Coxeter and the many-faceted design scientist Arthur L. Loeb. Without their enthusiasm, encouragement, support and participation, the Shaping Space Conference could not have been held and the first edition of this book might never have appeared. They continue to inspire us.

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http://www.springer.com/978-0-387-92713-8

Shaping Space
Exploring Polyhedra in Nature, Art, and the Geometrical Imagination
Senechal, M. (Ed.)
2013, X, 341 p., Hardcover
ISBN: 978-0-387-92713-8