Preface

Logic merely sanctions
the conquests of the intuition.
Jacques Hadamard

Topology is geometry without distance or angle. The geometrical objects of study, not rigid but rather made of rubber or elastic, are especially stretchy.

We want to present mathematics that is mind-stretching and magic, of a style that is conceptual and geometric rather than formulaic. In doing so we hope to whet the reader's appetite for this way of thinking, which is at the same time very old and very modern. It started with classical Greek geometry and is still a key part of current mathematical research, which is especially lively in geometry and topology. Indeed, just as in classical Greece, our understanding of the physical universe depends upon this geometrical thinking.

The heart of the book is in the first five chapters: homeomorphisms, surfaces, and polyhedra. Although these ideas are broadly pitched at the level of a second year undergraduate, the authors expect a tenacious mind with much less background to grasp them. The arguments of Chapter 6, still geometrical in style, add strength to the earlier chapters. This is not a book of pure geometry, as is Euclid, but rests upon the fine structure of the real number system. These underpinnings are mostly extracted from the early chapters and collected in Appendix A. Appendix B gives a fleeting glimpse into knot theory, introducing the *Jones polynomial.* Further breadth is given in Appendix C, in which we sketch the curious and instructive early history of topology.

The main ideas are illuminated by a wide variety of geometrical examples that we hope will fascinate and intrigue. Although elementary, the mathematics in this book is sharp and subtle, and will not be properly grasped without serious attempts at the exercises, the essential challenge of which may be undone by a premature glimpse of an illustrated solution. If you want to be a pianist you don't just read music and listen to it, you *play* it.

Several people have been extremely helpful to us in writing this book. We are very grateful to Colin Christopher, Neil Gordon, Charlotte Malcolmson, Dinh Phung, and Hannah Walker for all their work. Also, we are deeply indebted to John Moran for his patience with and dedication to the pictures.

For this revised edition we have made a number of corrections to the text and the figures, throughout the book, and we have written a short but completely new section at the end of chapter four. The Klein bottle can be thought of as a sphere with a "Klein handle". We illustrate how, given a sphere with any number of ordinary handles and at least one Klein handle, all the ordinary handles can be converted into Klein handles. This is a part of the important "Classification Theorem" for surfaces.

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