

# Preface

In *A Mathematical Olympiad Primer*, Geoff Smith described the technique of inversion as a ‘dark art’. It is difficult to define precisely what is meant by this phrase, although a suitable definition is ‘an advanced technique, which can offer considerable advantage in solving certain problems’. These ideas are not usually taught in schools, mainstream olympiad textbooks or even IMO training camps. One case example is projective geometry, which does not feature in great detail in either *Plane Euclidean Geometry* or *Crossing the Bridge*, two of the most comprehensive and respected British olympiad geometry books. In this volume, I have attempted to amass an arsenal of the more obscure and interesting techniques for problem solving, together with a plethora of problems (from various sources, including many of the extant mathematical olympiads) for you to practice these techniques in conjunction with your own problem-solving abilities. Indeed, the majority of theorems are left as exercises to the reader, with solutions included at the end of each chapter. Each problem should take between 1 and 90 minutes, depending on the difficulty.

The book is not exclusively aimed at contestants in mathematical olympiads; it is hoped that anyone sufficiently interested would find this an enjoyable and informative read.

All areas of mathematics are interconnected, so some chapters build on ideas explored in earlier chapters. However, in order to make this book intelligible, it was necessary to order them in such a way that no knowledge is required of ideas explored in *later* chapters! Hence, there is what is known as a *partial order* imposed on the book. Subject to this constraint, the material is arranged in such a way that related concepts are as close as possible together; this is complemented by a hierarchical division into chapters and sections.

One concern is that a book of this depth would be too abstract. Wherever possible, both two-dimensional and three-dimensional full-colour diagrams are included to aid one’s intuition.

I have assumed that the reader will have at least the cumulative knowledge contained in both *A Mathematical Olympiad Primer* and a typical A-level mathematics syllabus. I also recommend reading either *Plane Euclidean Geometry* or *Crossing the Bridge*, although this is not a prerequisite to understanding the content of this book.

Be fruitful, and multiply.

*Adam P. Goucher, 2012*