CHAPTER

1 Introduction

Christian Mayer published the first proper double star catalogue in 1784. However, the study of visual double stars effectively started with William Herschel. He not only systematically searched for them, initially to try to determine stellar parallax, but ended up by proving that some pairs of stars that appeared close together really were attracted by a common gravitational pull. By 1830 we knew of more than 3000 double stars but this figure did not exceed 10,000 until 1892. The current number is 146,000 and we stand on the brink of a revolution in terms of discovery which will come when the Gaia satellite ends its current mission. It is expected that millions of new pairs will be catalogued; however, Gaia will not only find new systems, but will also give us more detail on existing systems, in particular distances, proper motions, and multiplicity.

This volume aims to fill out the story on some of the brighter and more interesting visual double stars which can be seen in small and moderate apertures. Here we may define small as 20 cm or less, medium as 20 to 40 cm and large as 40 to 60 cm. Many double stars have contrasting colours; some are very unequal, some are at or beyond the resolving limit. To make a selection of pairs which can all be seen in a small aperture risks discouraging observers with larger telescopes who wish to push them optically. Its also fair to say that views of many pairs improve with aperture. Some systems have three or more components. None are the same.

It is, of course, impossible to definitively choose the finest visual double stars in the sky. Such a distinction depends too heavily on personal taste. The catalogue of objects that is discussed here does not necessarily contain the brightest, the most spectacularly coloured, the closest or the most-difficult-to-see pairs that exist in the heavens. Rather it is a summary of all these properties: visual pairs are presented that have something which attracts the observer to observe them. What can be said is that the vast majority have been observed (or attempted) by the authors, and hopefully this fact will recommend them to the reader.

Visual double stars come in two main forms. *Optical* pairs consist of two stars which appear to be angularly close on the sky but which are in reality totally unrelated because one star is much further away than the other. *Binary* stars appear close together on the sky because they are, in fact, physically connected and are rotating around a common centre of gravity. For the common telescope user the periods in which they do this range from about 25 years to tens of thousands of years. Binary stars are important to stellar astronomers. Measurements of the relative positions of the two components give good information on stellar masses and can also indicate how far away such stars are.

There has been a historical imbalance in the professional approach to research into visual double stars. This is clear from the numbers of observations made of southern binaries as opposed to those visible from the northern hemisphere. As an example, γ Virginis has had 1720 measures whereas its southern equivalent, γ Cen, has only 181, yet the latter has half the orbital period of the former.

The whole sky is covered in this volume. Not to do so would be to leave out some of the best objects in this class. In fact the very finest double star in the sky, α Centauri, is only practically visible to anyone south of about +25° – say, the latitude of Hawaii. Not every object in the catalogue will be resolvable, even with a significant aperture, but, because of the changing nature of binary stars, that will not always be the case. That well-known test object, the companion to the star

γ And B, is now way beyond the resolution of most telescopes and will remain so for ten years or so; in the case of ζ Boo it might be 20 years before it can be seen again. As apertures and techniques used by amateurs are constantly getting larger, these bland statements of fact might be seen as challenges to the observer wishing to test his or her telescope optics. When it comes to deciding whether stars of a particular separation can be divided by a given aperture there are a number of formulae can be used to check this possibility ([685]). We have the Rayleigh limit and the Dawes limit; whilst other more complex predictors exist, in my experience the Dawes limit is as good (and as simple) as any. The atmosphere and state of the telescope are just as important in obtaining a resolution. Go and find out for yourself.

If you are new to double star observing, it will take a little time to get used to the look of the images but, eventually, even though you cannot see two separate images, the fact that a close pair is double will usually be apparent given enough time. Even on nights when the atmosphere is very unsteady there will be the odd moment of calm when the images sharpen. This is the basis of the lucky imaging technique, which some observers are using to good effect with CCD cameras. How far can you go visually? With careful collimation of telescope optics and some experience of examining images from close pairs of stars, it is possible to see duplicity in stars at the $0''.2$ level with a 32-cm telescope whilst the Dawes limit is formally accepted as $0''.36$.

Other bright binaries move sufficiently quickly that the angular motion can be seen in the course of a year. Eyepieces contain a fine illuminated mesh of grid lines, called graticule eyepieces, can be used to make more precise measurements of the relative angle and separation between two stars but are not, in general, suitable for binary stars, which tend to be too close. Other instruments, such as micrometers for the visual observer or a CCD camera for those who prefer their stars served electronically, can be employed. It is outside the scope of this book to describe these techniques, but see the volume edited by Argyle [85].