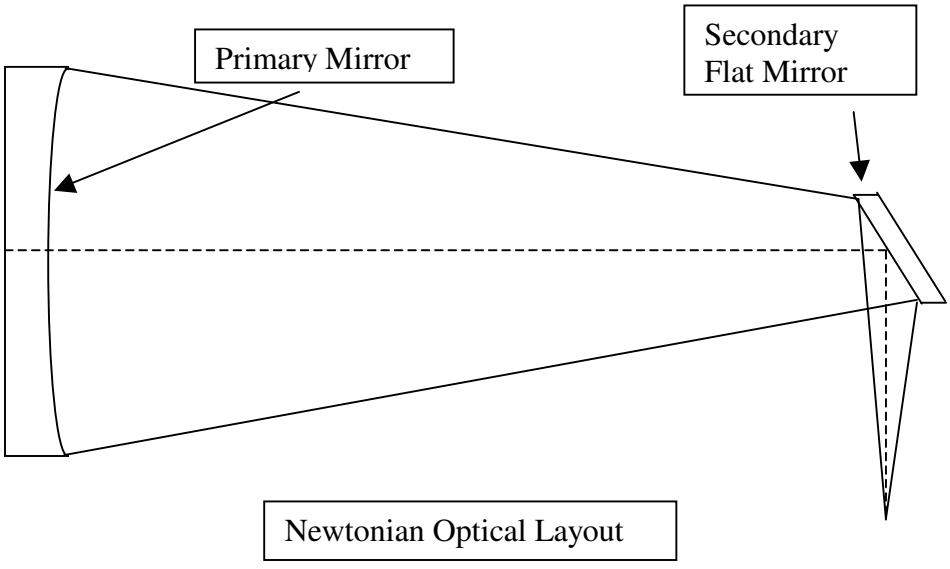
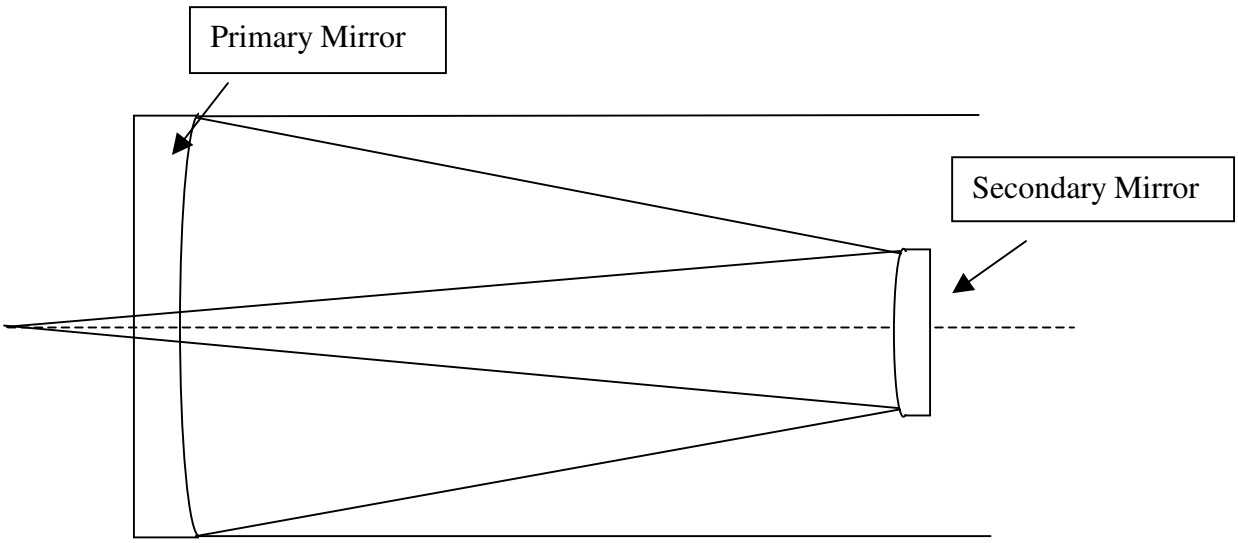
# Thoughts on Focal Ratios.

John Nichol MSc BSc

If you are thinking of building your own telescope there are a number of things you will need to consider, careful planning is essential if the project is to be a success. Let's begin by thinking about the focal length of the mirror, this may be expressed as a Focal Ratio which is arrived at by dividing the focal length of a mirror by its diameter, for example a 16 inch diameter mirror with a focal length of 80 inch has a focal ratio of 5, it is said to be F5. Put simply longer focal length telescopes (>F6) perform better on the planets, shorter focal length telescopes (<F5) have a wider field of view and are better suited to deep sky observing. With larger diameter mirrors shorter focal lengths offer the advantage of a shorter tube length, which can often appear attractive, such instruments are relatively easy to transport to dark observing sites. When it comes to high magnification observing a longer focal length is preferable, given that the magnification is found by dividing the telescope focal length by the eyepiece focal length it can be seen that a given focal length eyepiece will give a higher magnification with a longer focal length telescope. Eyepieces with longer focal lengths generally give better images than those with shorter focal lengths and a longer focal length telescope can give high magnification without having to resort to eyepieces with very short focal lengths. This is another reason why longer focal length telescopes are best suited to high power work. Somebody interested in planetary observing might opt for telescope designs that lend themselves well to high power observing by having a longer focal length. Examples of such designs include the traditional Cassegrain and the Dall-Kirham Cassegrain, they are typically between F15 and F20. Incidentally, another Cassegrain type the Ritchey-Cretien, is a design optimised for imaging and is not best suited for visual observing.




Newtonian Optical Layout




Cassegrain Optical Layout

All telescope mirrors suffer from an inherent aberration that becomes more pronounced with decreasing focal length, it is known as coma. As a result of this stars towards the edge of the field appear as fan shapes. No matter how well a telescope mirror is made this aberration will always be present. Increasing the focal length reduces the effect of coma. Fortunately some manufacturers produce coma-correcting lenses that are used in combination with eyepieces or imaging devices. Many consider these coma correctors to be essential with F-numbers of 4.5 or less; many have found them useful at F5. Please bear in mind that if you are using a fast optics system (F5 or less) you may need to invest in a coma corrector.

Another problem with fast optical systems (F5 or less) is that the optics must be accurately aligned with one another, a process known as collimation. There are tools available to help with this process and at F4 many consider these collimating tools essential in order to bring out the best performance of an optical system. This may represent an additional cost that will have to be considered.

If an optical system is to perform optimally it needs to be mounted in a well designed and made telescope. One key factor is the mirror cell; this must be able to support the mirror without introducing distortions that will affect the performance of the optical system. An excellent reference for mirror cell design and building and for that matter on all aspects of telescope construction is the book, The Dobsonian Telescope by David Kriege and Richard Berry. I would consider this essential reading for anyone planning to build a large telescope.

Despite the problems outlined above many have successfully built large astronomical telescopes and are using them profitably.