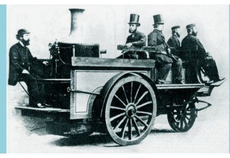
Instruments and Imaging Section
Technical Tips No. 8
25 November 2012



Director: Bob Marriott ram@hamal.demon.co.uk 01604 765190 http://britastro.org/iandi

The mystery object in the previous issue of *Technical Tips* is an 'orbit sweeper' designed by the Astronomer Royal, George Biddell Airy. The following are a few extracts from his paper (*Monthly Notices of the Royal Astronomical Society*, 21 (1861), 158–9): 'The elements of the comet's orbit, considered as a curved line through space of three dimensions, are known with considerable accuracy, but the time of the comet's return to perihelion is not known with accuracy, and therefore the actual place of the comet upon that curved line is not known with accuracy; all that is accurately known being, that the comet will be somewhere on that line... The mounting which for all ordinary purposes is the most convenient, namely, that of the equatoreal, cannot be easily applied here. For sweeping in right ascension only, or (with the aid of clockwork movement, which every equatoreal ought to have) for sweeping in polar distance only, it is excellent; but for sweeping in an inclined direction, it is no better than an unmounted telescope... I have arranged a form of mounting adapted to sweeping in all directions... The cross-axis will be similar to that of a German equatoreal; but instead of carrying the telescope it will carry a small trunk in which a second cross-axis turns. This second cross-axis carries the telescope. The polar axis should have a divided hour-circle, and clock-work movement. The first cross-axis must have a graduated circle, and a clamp or steps by which it may be firmly fixed in a given position. The second cross-axis carrying the telescope must have a graduated circle, and must have two stops limiting its sweeping motion to any arbitrary extent. The second cross-axis must have a counterpoise for the telescope. The first cross-axis must have a counterpoise sufficient to balance both the telescope and the telescope's counterpoise.' To my knowledge, no such instrument has ever been produced, and I would be interested to hear from anyone who knows of one.

No-one identified this instrument correctly, but another opportunity to fail is at top right. The device was designed and produced by a well-known English instrument maker *c.*1860.

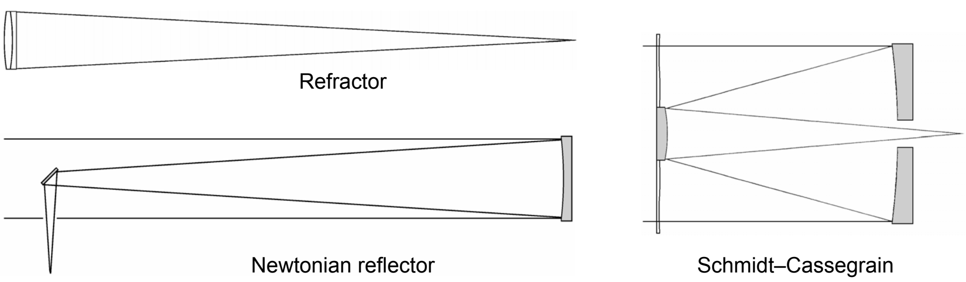
It's cheaper than sending him to the pictures...

The notes presented below will be commonplace to the experienced observer – particularly those of a more extended physiological vintage – but they represent aspects of instrumental usage that might not be familiar to the tyro, but which are essential in gaining full appreciation of instrumental performance and capabilities. It is important that relevant notes should be included in records of observations.

Notes on the use of the telescope

Bob Marriott

Basic types



Basic mounts (with numerous variant designs)

Altazimuth	Moves in altitude and azimuth
	Vertical and horizontal axes
	Field rotation
	Awkward when pointing the telescope at or near the zenith
Equatorial	Tilted at an angle equivalent to the latitude
	Polar axis points to the celestial pole
	Declination axis parallel with the celestial equator

Eyepieces (oculars)

The perfect eyepiece exists only in the astronomer’s imagination

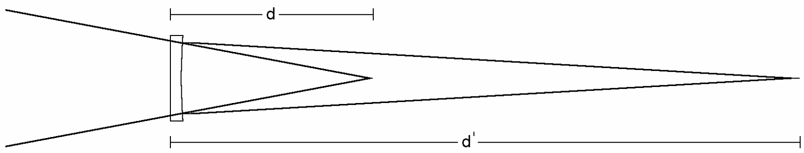
Ideally

Imperceptible aberrations – if not intrinsically, at least with the appropriate objective
Wide field, with good definition over at least the greater part of it
Flat field
Dark field, free from internal reflections and ghost images, and with greater contrast
Bright images, by the reduction of light lost by internal reflections and/or absorption
Sufficient clearance between the eye lens and the exit pupil

Barlow lens

Distance of Barlow lens from original focus	d
Distance of Barlow lens from new focus	d'
Amplification	A
Magnification without Barlow lens	m
Magnification with Barlow lens	m'

$A = d'/d$
$m' = mA$



Magnification

Magnification	m
Telescope focal length	f
Eyepiece focal length	f'

$m = f/f'$

Disadvantages of high magnification

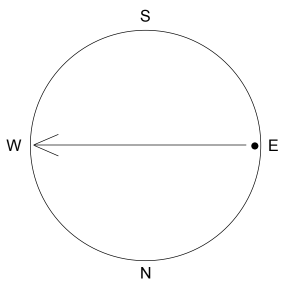
Smaller field
Frequent adjustment required
Decreased brightness of extended images
Exaggeration of atmospheric defects
Exaggeration of defects in the mount and/or drive

Advantage of high magnification

Increased contrast, revealing diffuse or faint objects

Field

Determined by transit time *t* with the telescope stationary



Object on the celestial equator

1 hour = 15°	4 min = 1°
1 min = 15'	4 sec = 1'

Object at declination δ : $15t \cos \delta$

Resolution

Dependent on aperture
Independent of focal ratio

Dawes' limit

4″.56/d (inches) — 115″.8/d (mm)

3-inch	4″.56/3 = 1″.52		76-mm	115″.8/76 = 1″.52
8-inch	4″.56/8 = 0″.57		203-mm	115″.8/203 = 0″.57
12-inch	4″.56/12 = 0″.38		305-mm	115″.8/305 = 0″.38

W. R. Dawes (1867): 'I thus determined as a constant, that a one-inch aperture would just separate a double star composed of two stars of the sixth magnitude, if their central distance was 4″.56 – the atmospheric circumstances being favourable.'

Orientation

1 Astronomical ocular
2 Terrestrial ocular
3 Diagonal vertical
4 Diagonal horizontal
5 Opaque projection screen
6 Translucent projection screen

1	2	3	4	5	6	
	•					
•		•		•		Erect
•			•	•		
•					•	
•			•			
•		•			•	
	•			•		Inverted (rotated through 180º)
	•	•				
	•		•		•	
•		•				
•			•		•	
•				•		Reversed (mirror image)
	•	•			•	
	•		•			
•						
	•	•		•		Inverted and reversed
	•		•	•		
	•				•	

Seeing

High	Caused by air currents at heights at around 20,000–40,000 feet
Low	Originating at heights up to a few hundred feet
Ground	Caused by radiation from the ground where the telescope stands
Observatory currents	Caused by currents throughout a roofed or domed observatory
Tube currents	Affect reflectors particularly although refractors are not immune
Mirror currents	Become troublesome with larger reflectors ≥18 inches aperture

Antoniadi scale

1 Steady for all or most of the time
2 Frequent periods of steady seeing
3 Mostly unsteady but generally good
4 Frequent periods of poor seeing
5 Poor throughout

Defocused image

Not required...

Alcohol ... tobacco ... nor anything else that reduces visual acuity