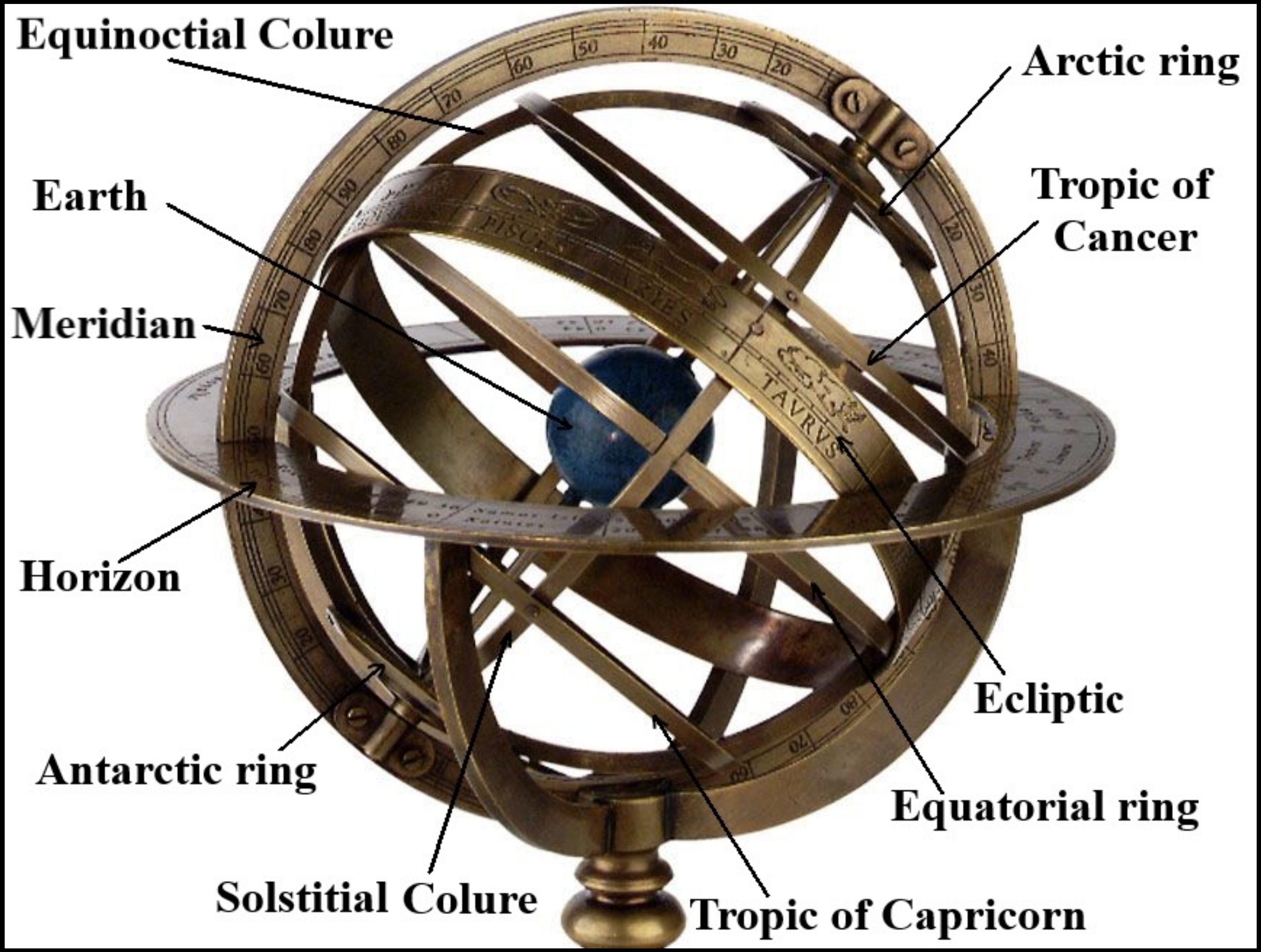
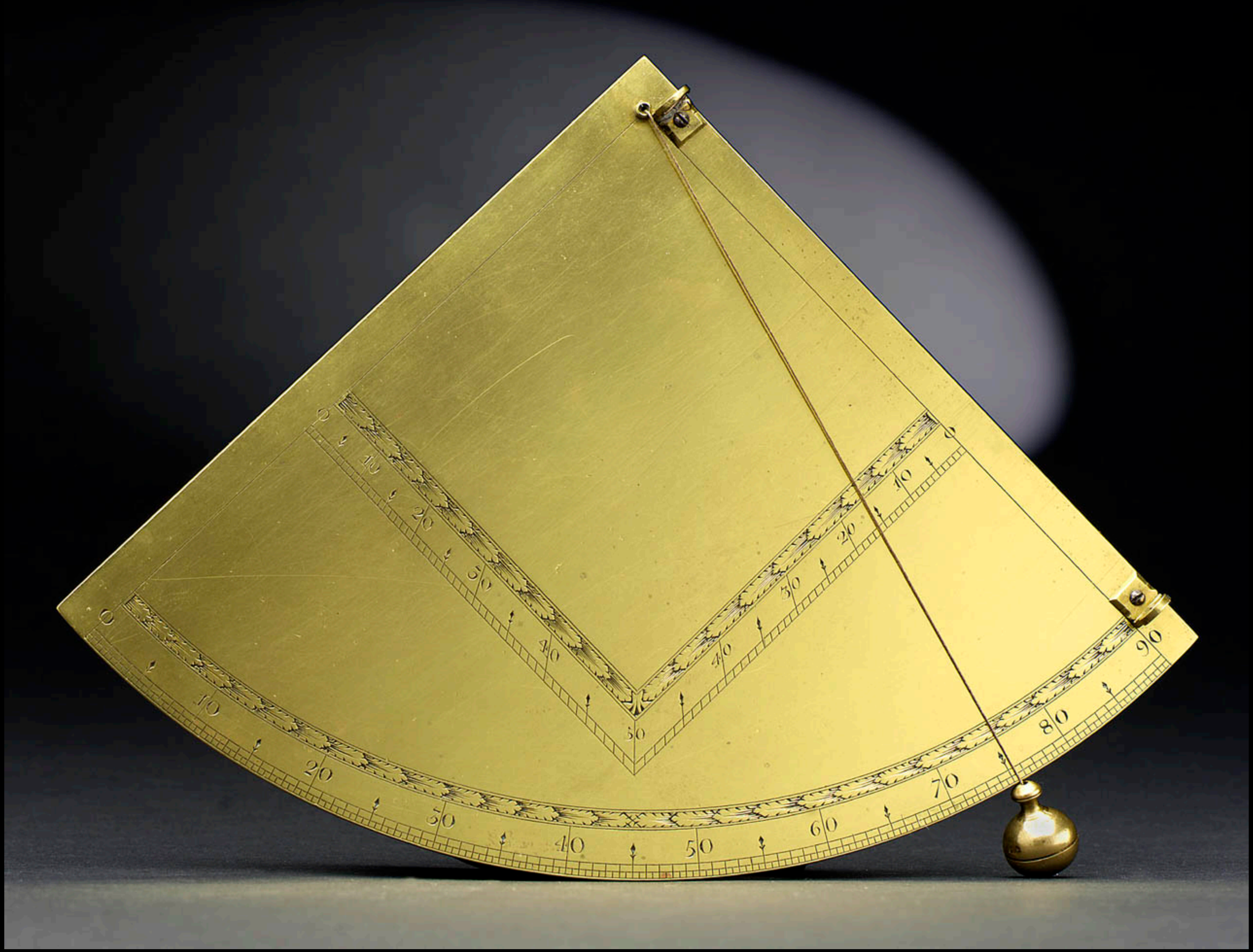
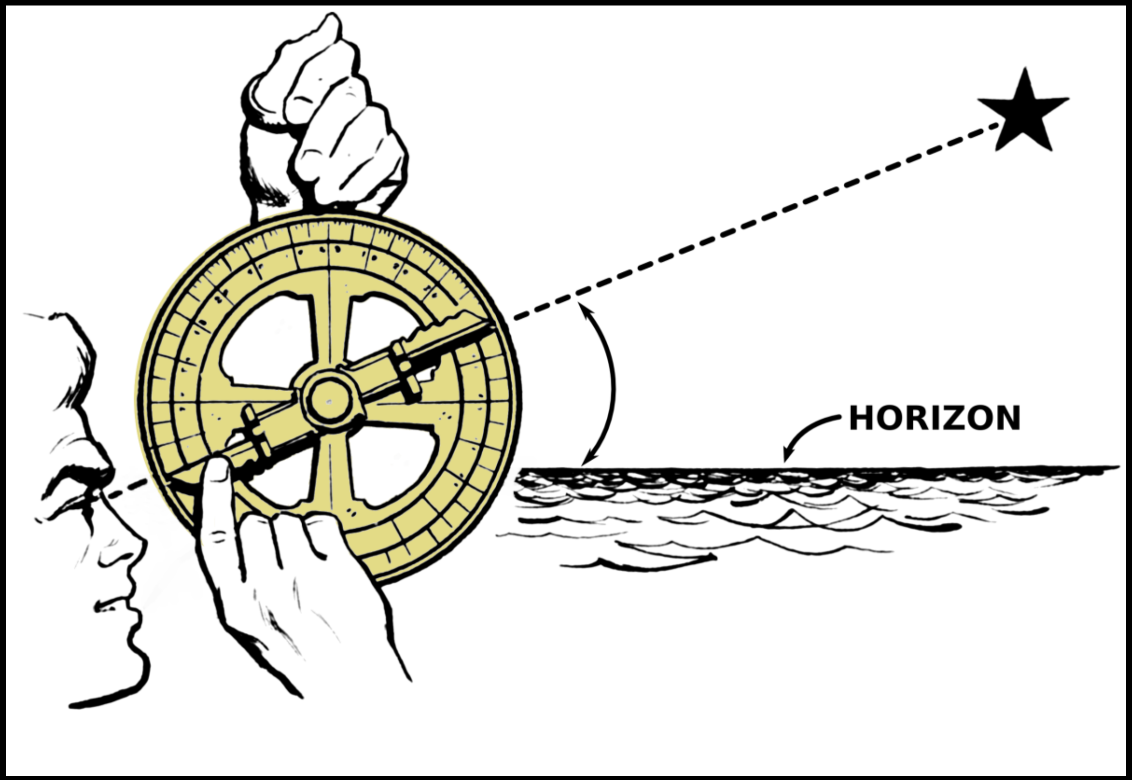
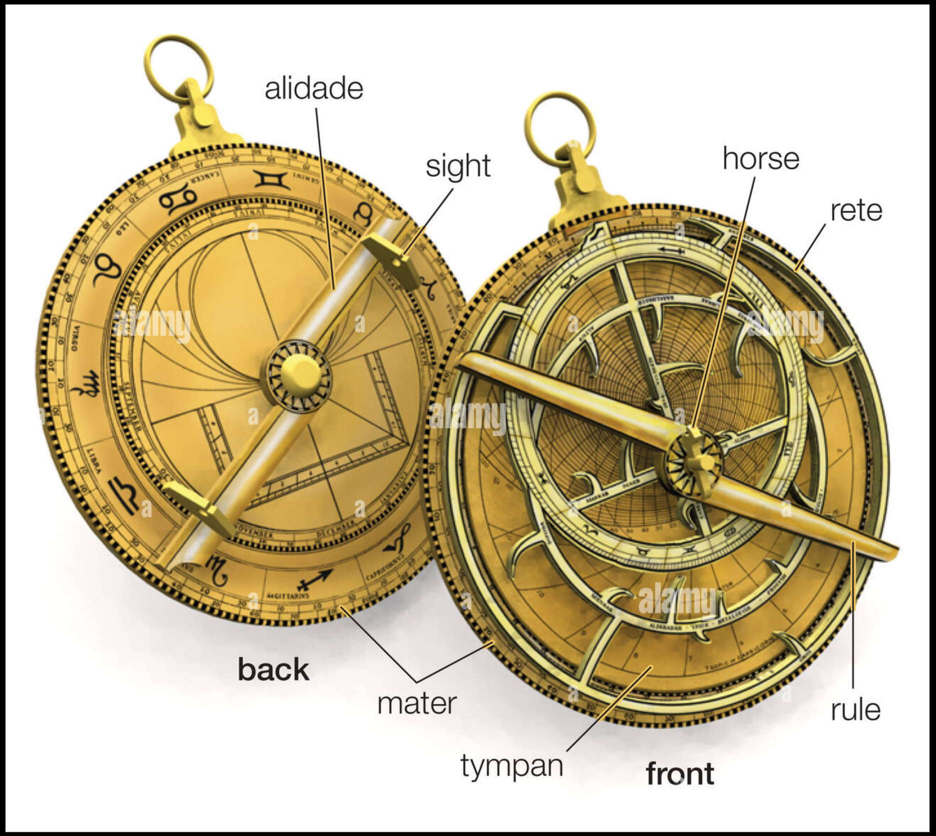


The armillary sphere takes its name from the Latin armilla, meaning a bracelet or metal ring. With the Earth located at the center, the rings trace out what an observer sees in the night sky without a telescope. The outer band, that supports the device, shows the observers horizon and the meridian. Inside these bands is a cagelike assembly of rings that rotate to display the diurnal motion of the stars. The zodiac is represented by a broad band marked with the 12 signs.



A quadrant acquires its name by its ability to measure within a quarter circle. Using spherical trigonometry, the zenith distance could then be used to calculate a stars celestial longitude and latitude. Quadrants made of metal allowed finer intervals to be ruled for more precise measurements.

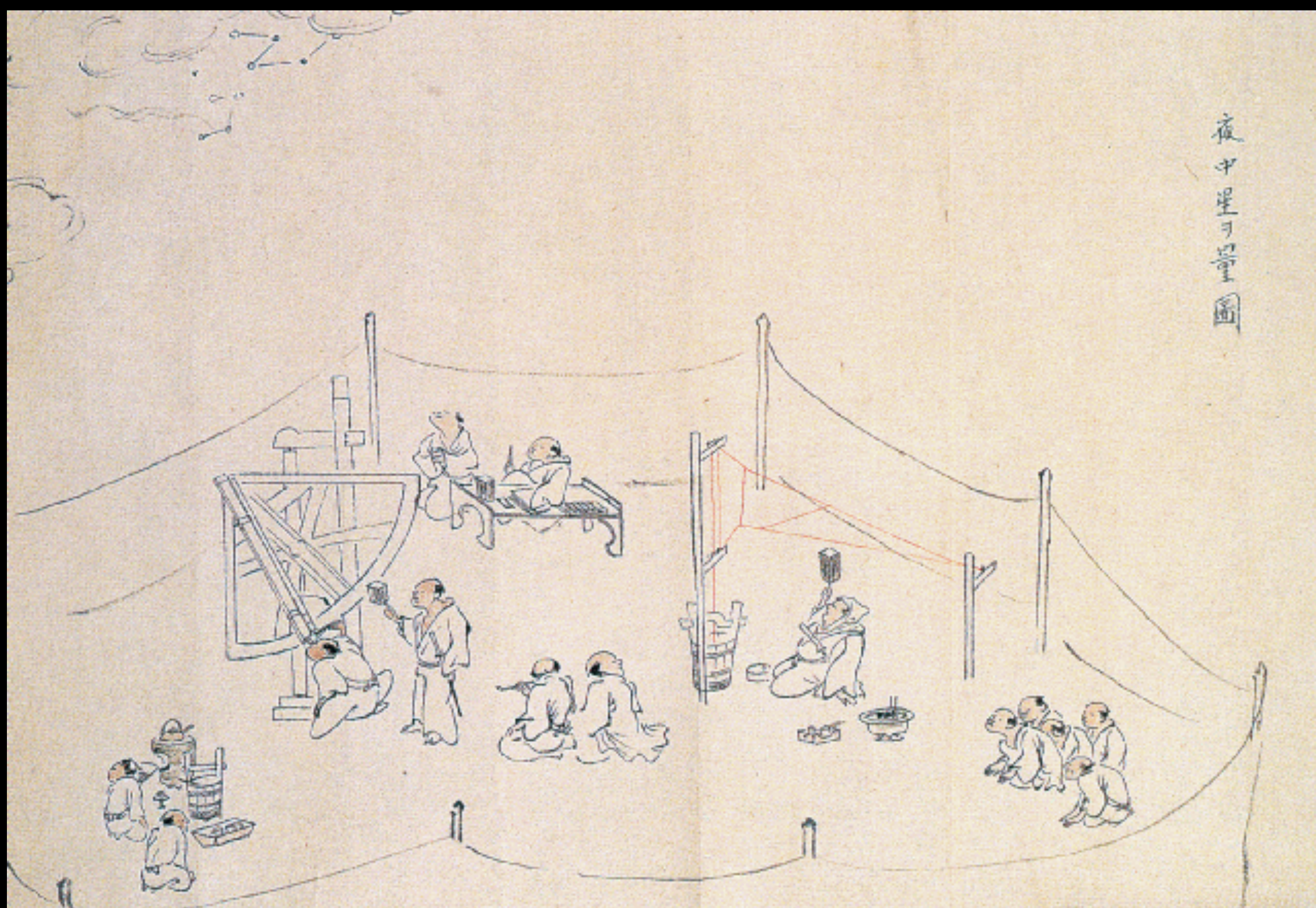


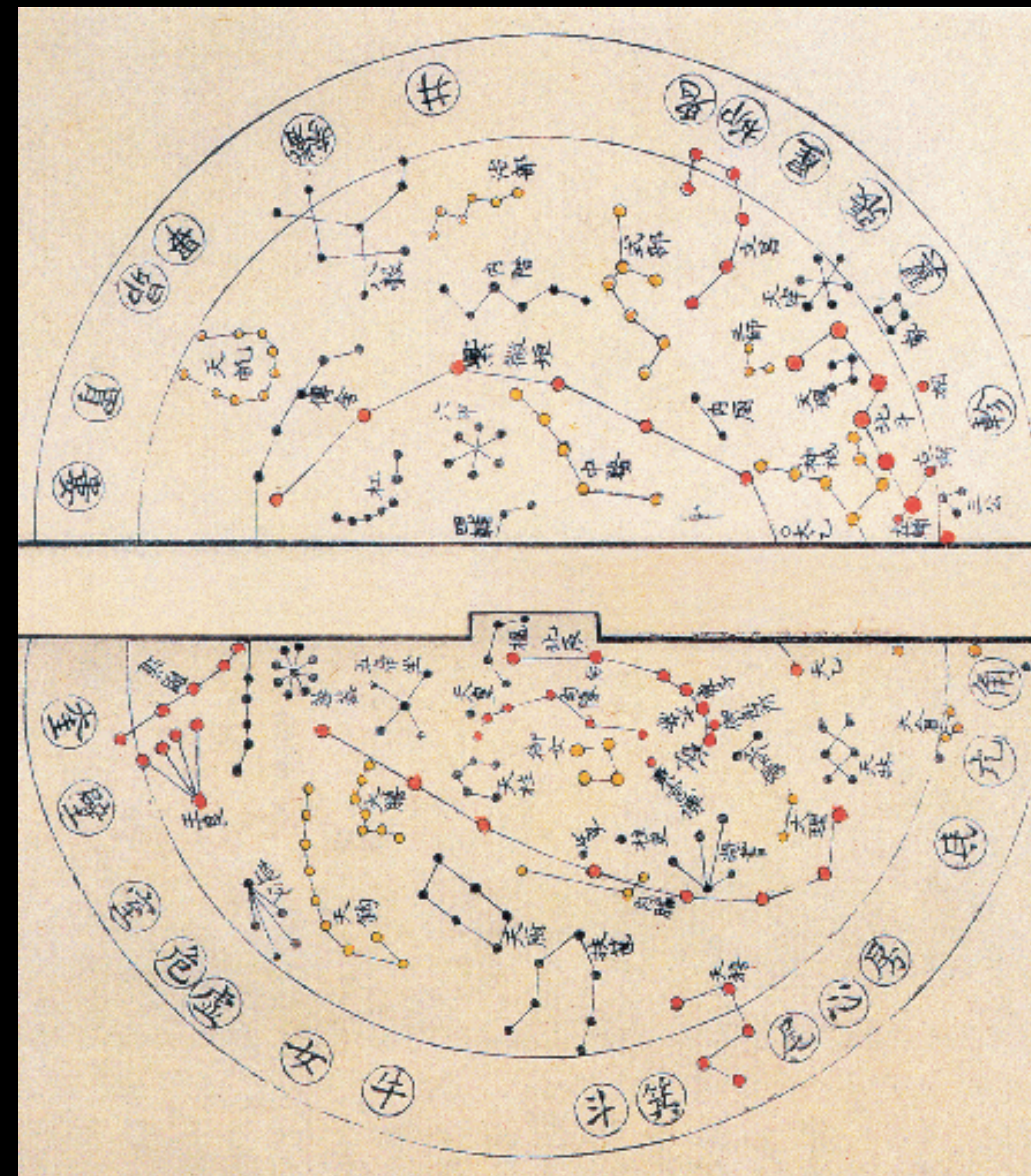


The astrolabe was a sophisticated time-telling instrument of late antiquity. It was an all-in-one tool for calculating the position of the Sun (thus, local time) and various stars. The typical astrolabe has a rotating cutaway disk, called the rete, that represents the heavens as they revolve around us. Labeled points represent stars, the solid band is the zodiac. A plate, or tympan, is fixed beneath the rete and is inscribed with altitude and azimuth coordinates for the particular latitude where the astrolabe is used. Since the astrolabe displays the coordinates of various bright stars, it can also be used to determine the time at night when the Sun is not visible.

The mechanized planetarium, one of the most popular scientific tools of the 1700's, displayed the motion of the planets around the Sun. The operation of the device's carefully crafted mechanisms inspired awe and wonder at the sense of the Universe's divinely imposed stable order.

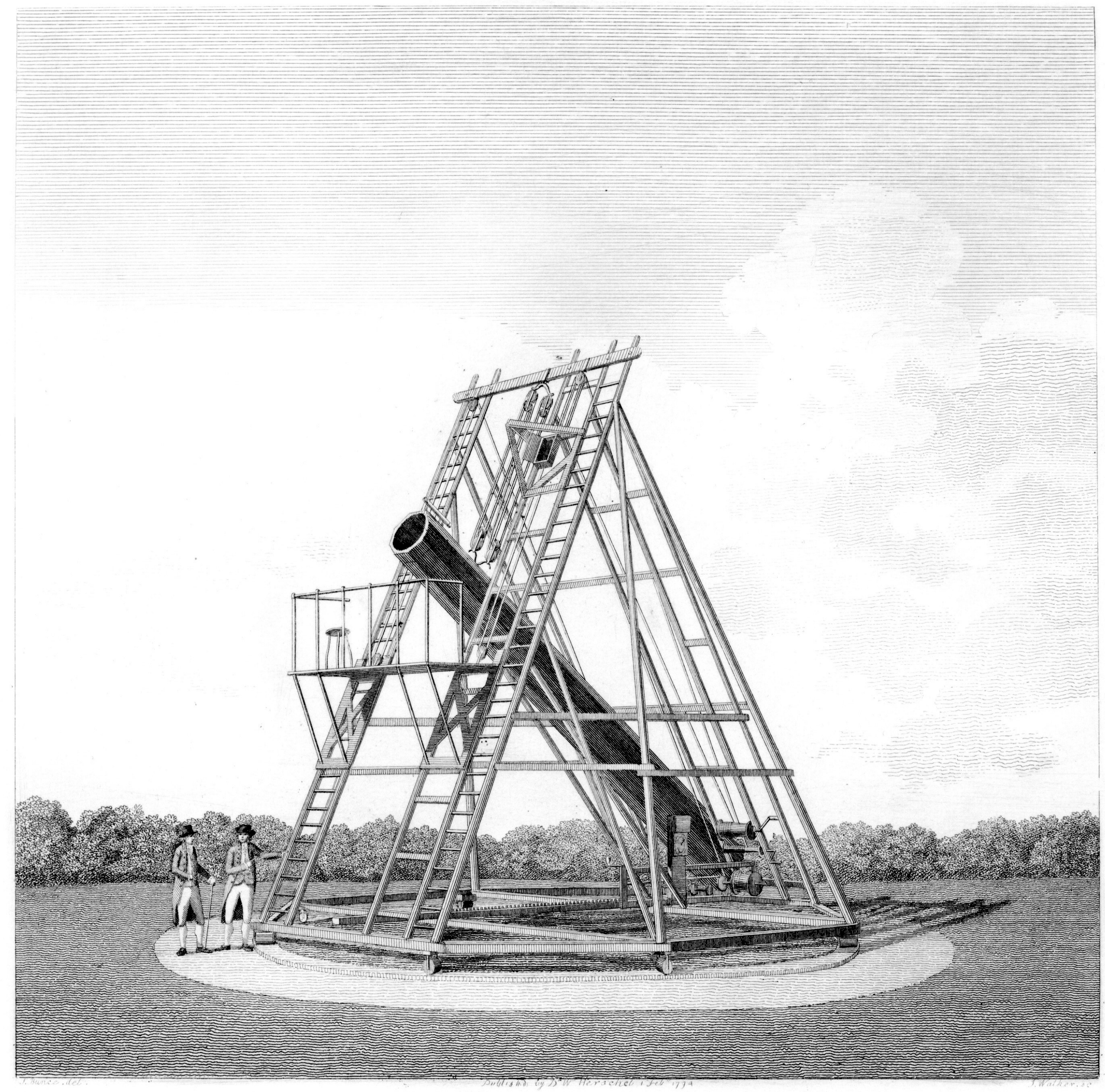
Because both Asian and European astronomers lived in the norther hemisphere, constellations were missing around the South Celestial Pole until expeditions to the New World. Shown below, astronomer Amerigo Vespucci maps the Southern Cross (Crux) in 1589.





In ancient China, astronomers held high social position with close connections to the imperial court. Many of the same astronomical instruments used in Europe were also used by Chinese astronomers

Galileo revolutionized astronomy when he applied the telescope to the study of extraterrestrial bodies in the early 17th century. Until then, magnification instruments had never been used for this purpose.



In 1668, Isaac Newton devised a reflecting telescope. Instead of a lens, it used a single curved main mirror, together with a smaller flat mirror. In the next century, huge instruments descended from Newton's design turned out to be especially useful for studying very faint objects, such as the dim patches of light known as nebulae.

Stars now filled the areas of the sky that previously seemed empty. By the start of the 19th century, pictorial celestial atlases became impractical, even though astronomers continued to make up new constellations.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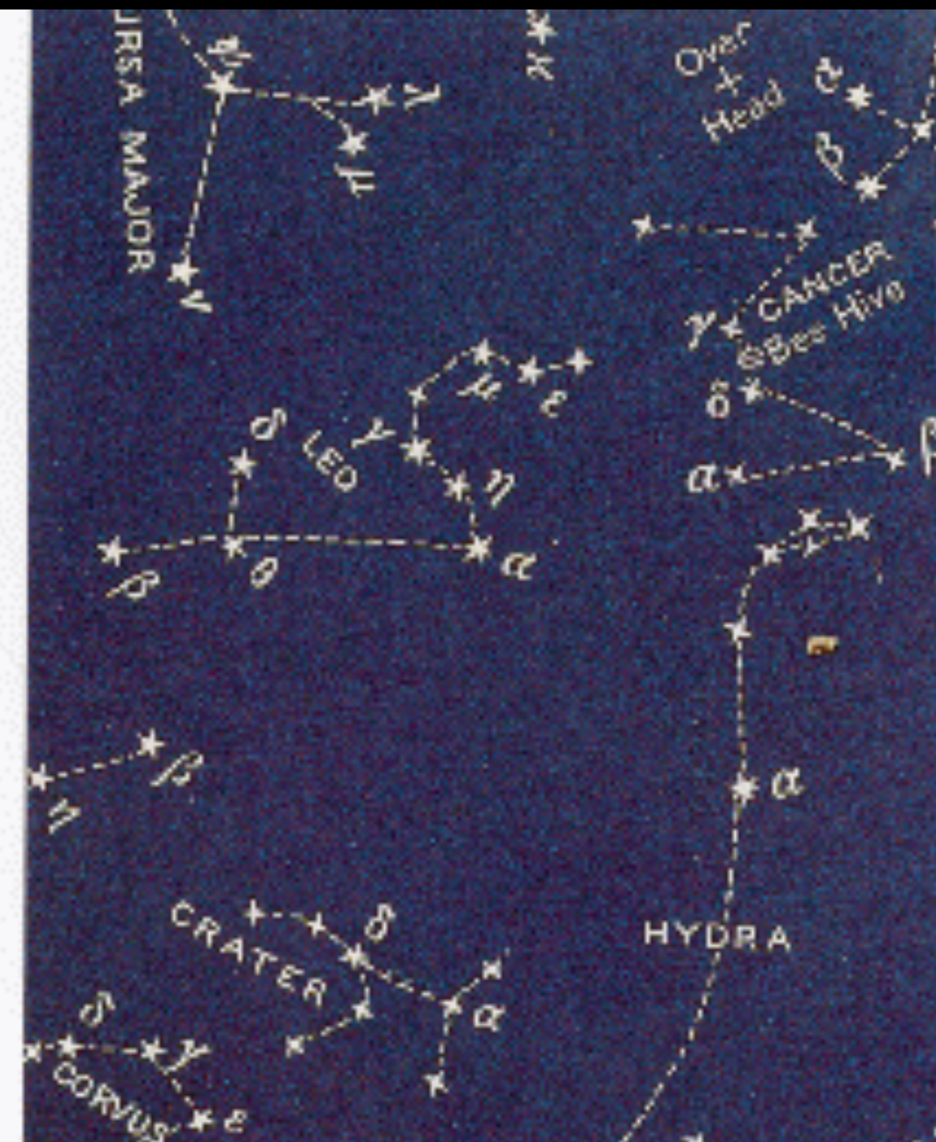
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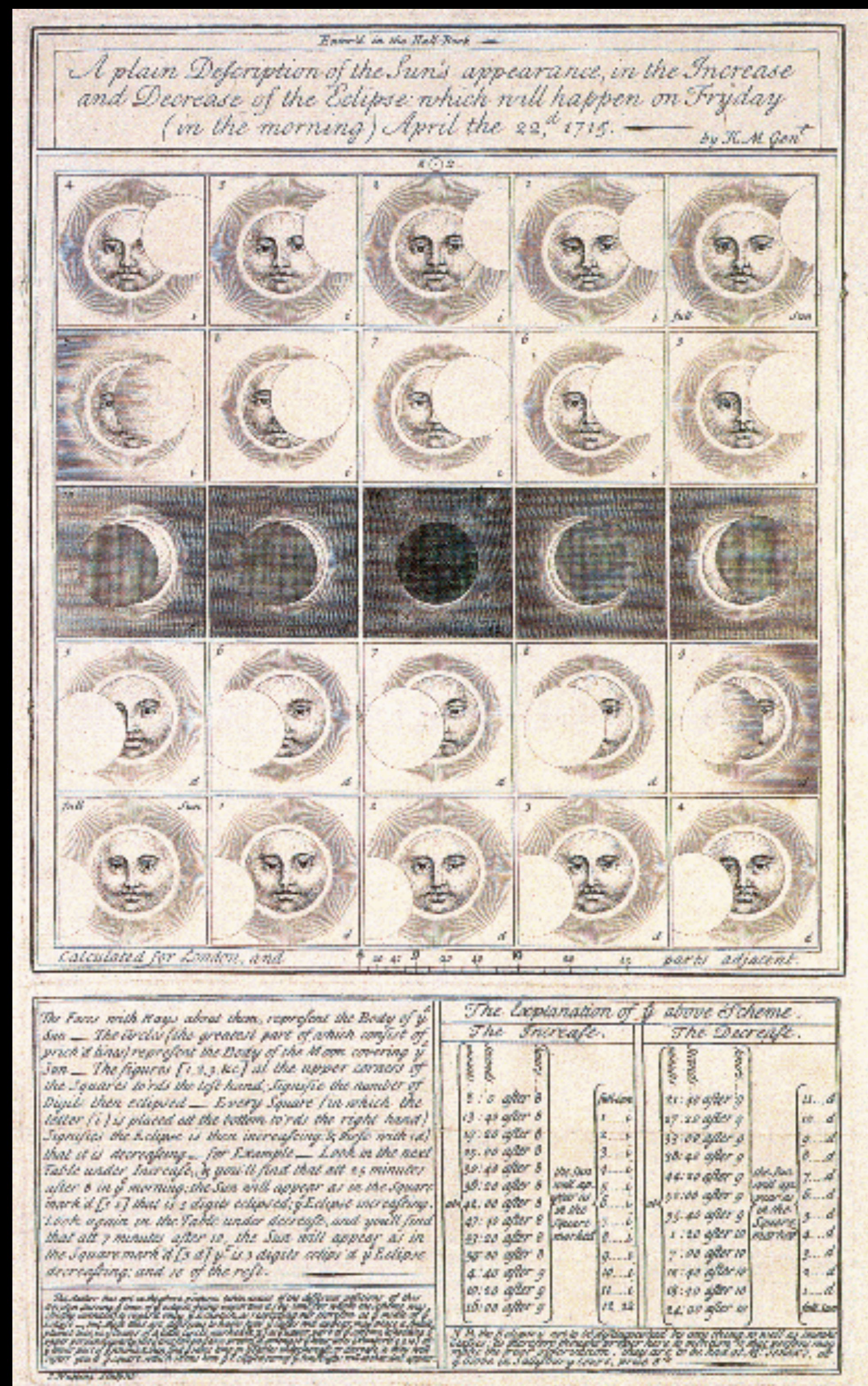
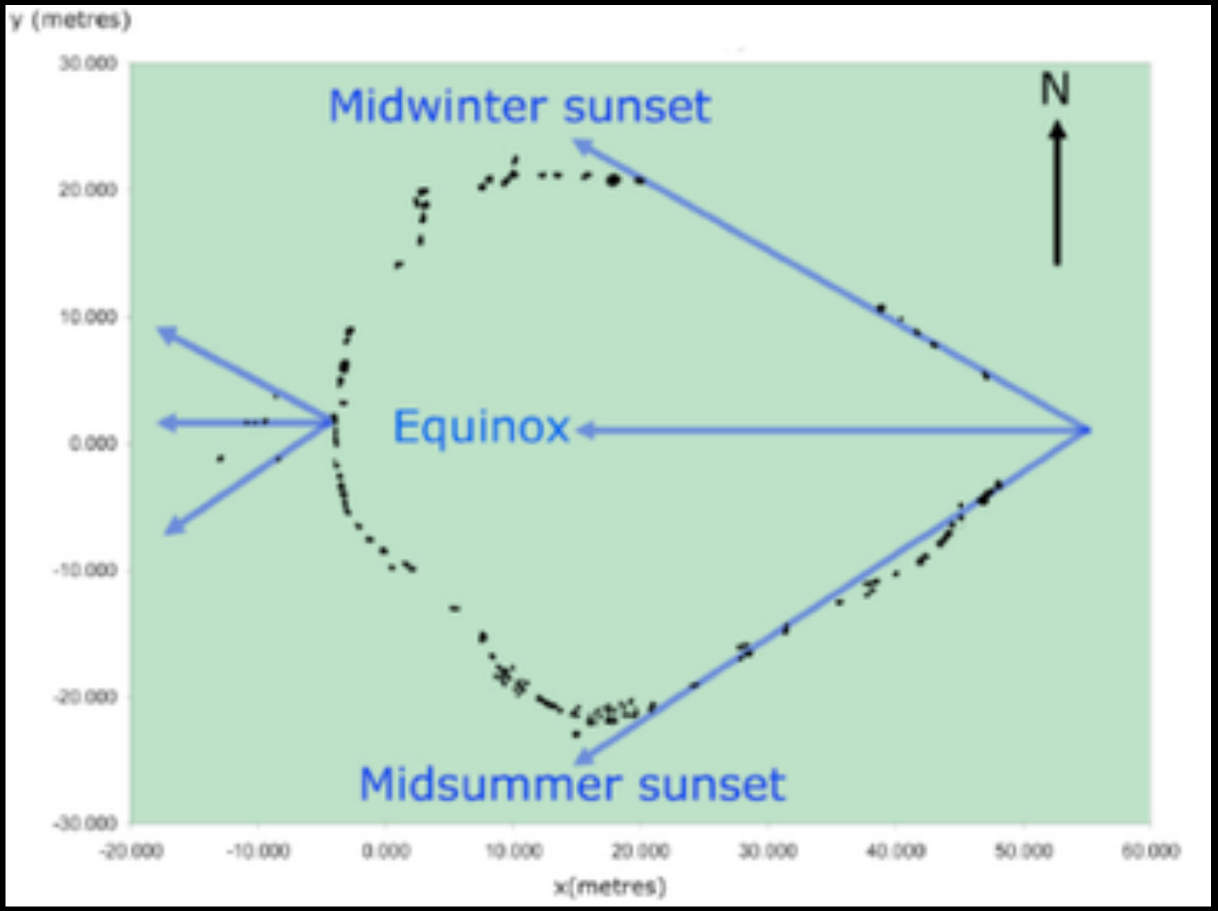
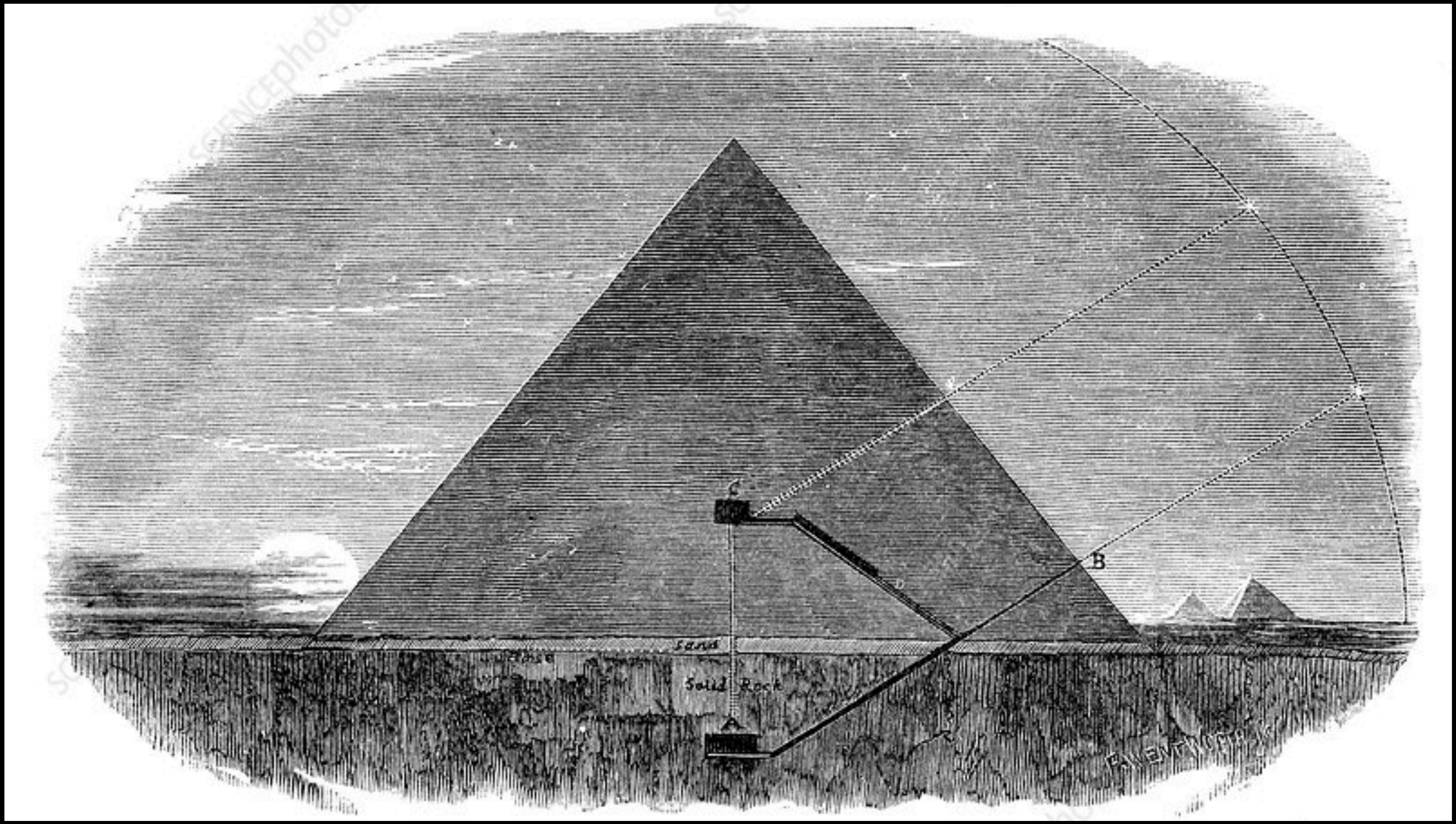
One of the jobs for astronomers in the 17th and 18th centuries was to educate the public on unusual astronomical events, such as comets and eclipses. Typically this was done using printed information sheets called broadsides. The broadside below explains the science behind a total eclipse of the Sun.



Wurdi Youang is the name attributed to an Aboriginal stone arrangement located in Victoria in Australia.



The stone arrangement takes the form of an irregular egg-shape or ovoid about 50 m (164 ft) in diameter with its major axis aligning east-west.[3] It is composed of about 100 basalt stones, ranging from small rocks about 200 mm (8 in) in diameter to standing stones about 1 m (3 ft) high



The Egyptians constructed the pyramids for tracking Sirius, the Dog Star, in the sky. When Sirius became visible above the horizon, then it was known that the Nile was going to flood, an important time to plant crops.

The first modern observatory was constructed in Denmark by Tycho Brahe in 1576.

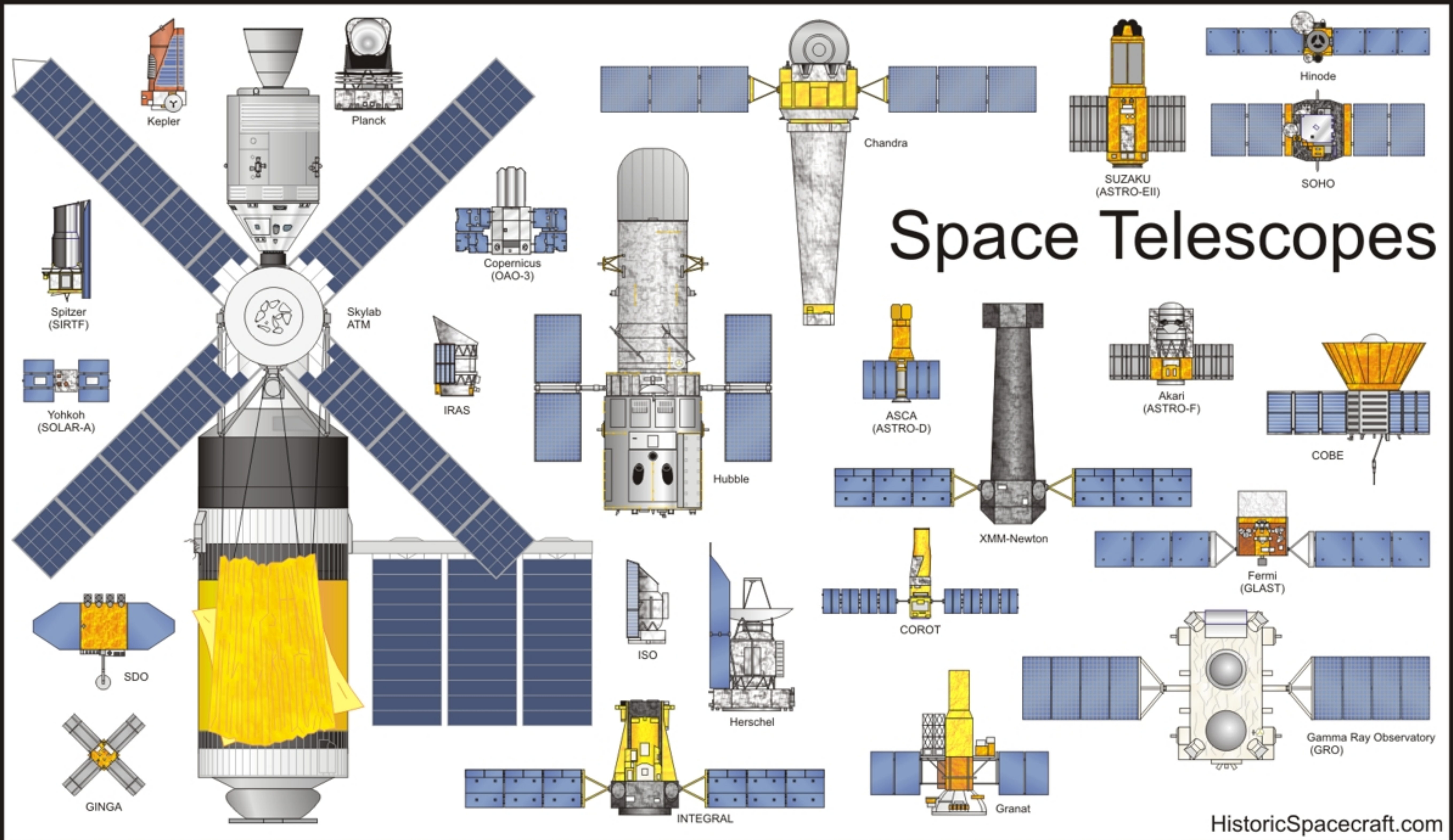
Telescopes serve to 1) magnify nearby planets, to study surface features, 2) collect light to detect faint stars and 3) transfer light to recording instruments, such as a photographic plate to take a picture, or to a spectrograph to take a spectrum.

Due to effects of the atmosphere, telescopes are typically located on mountain tops because

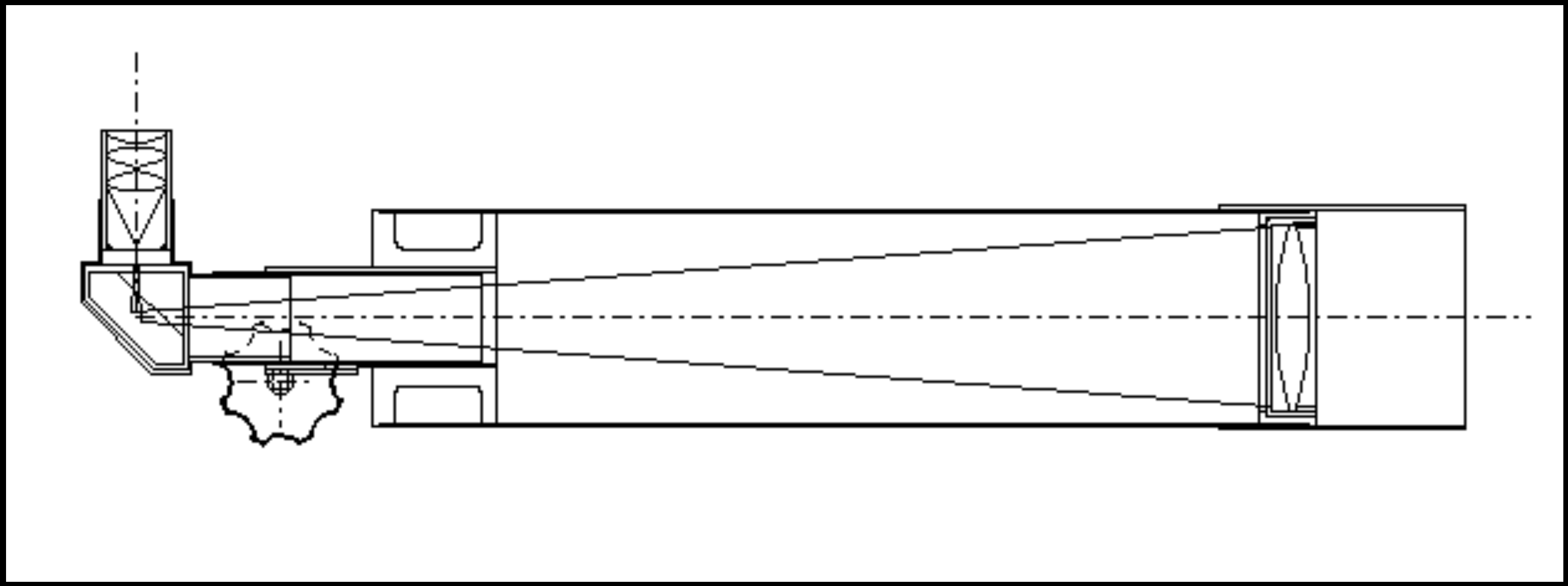
1) they are dry sites (few clouds),
2) high above the thick currents of air so the images are clear and steady and
3) to allow more UV (ultraviolet) and IR (infrared) photons which are blocked by lower atmosphere.

Radio telescopes gather radio waves from stellar objects. Since radio waves are reflected by metal, they are typical made of solid aluminum or steel mesh.

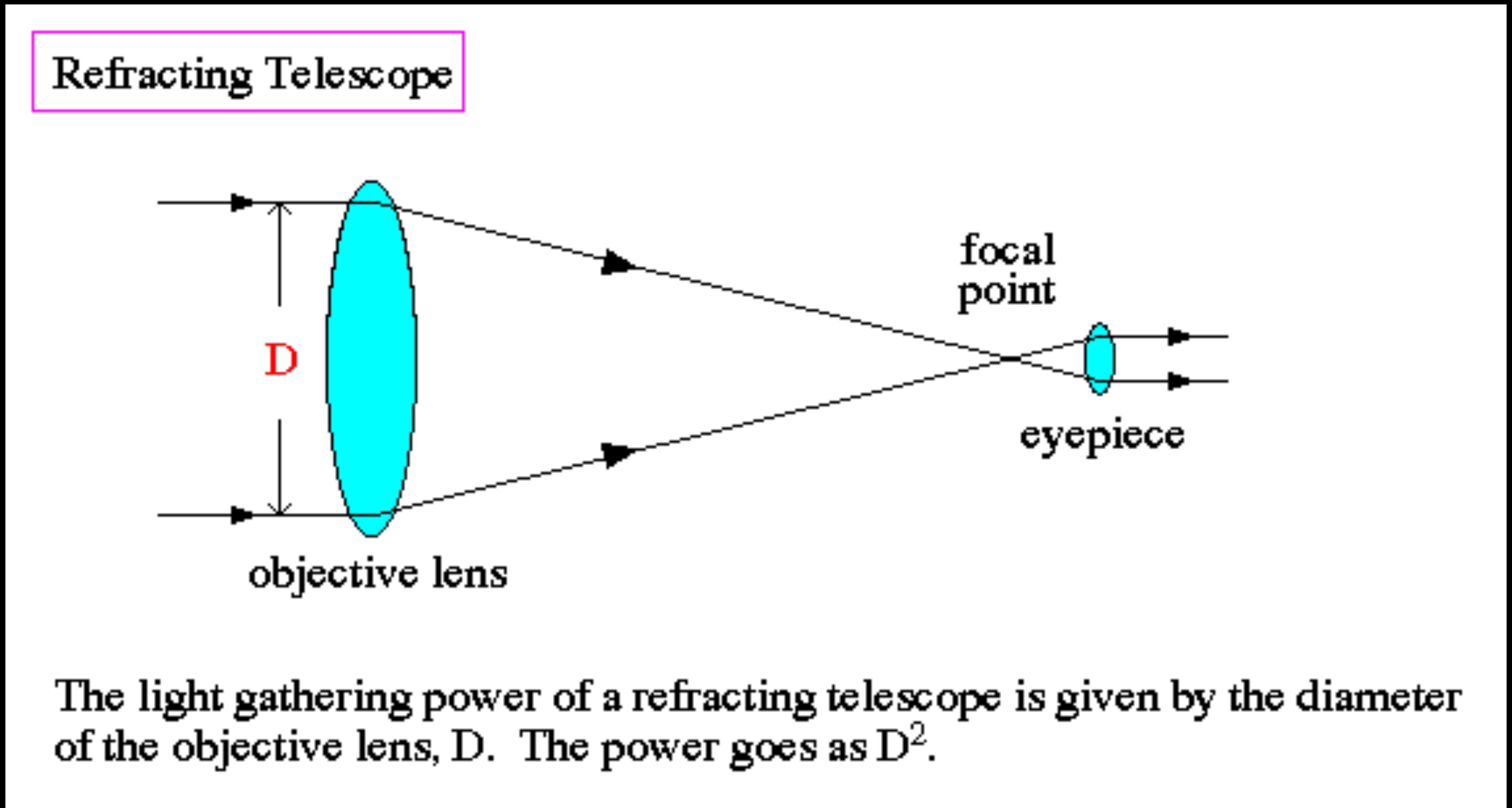
The difference wavelength of the light in the radio region (centimeters and meters) means a different technology to analysis them. In the case of radio astronomy, a sophisticated radio receiver is used such that the power of the telescope is determined by the area of the antenna and the sensitivity of the electronics.

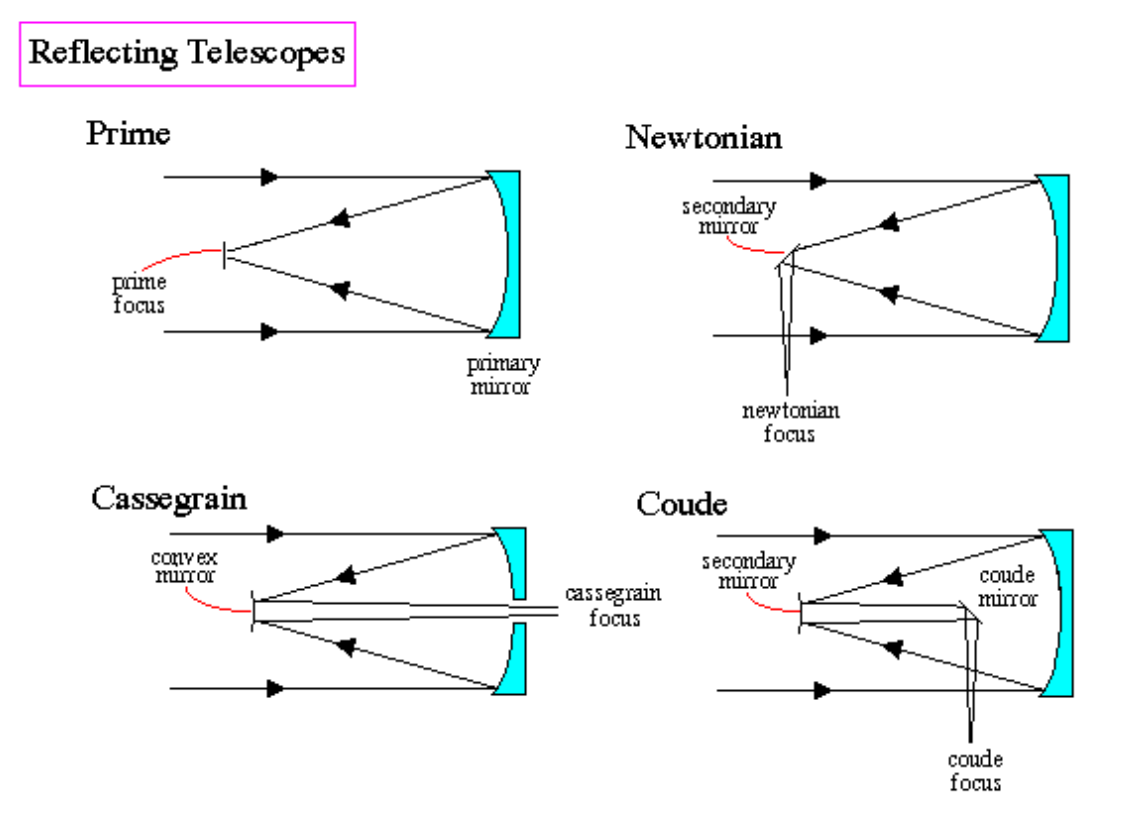


To observe at high energies (gamma and x-rays) or in the far-IR and microwave regions of the spectrum, the telescope must be located above the Earth's atmosphere.



The simplest telescope is two lens separated by a tube. Since the objective lens (the front lens) refracts the incoming light, this kind of instrument is called a refracting telescope.





In order to build larger telescopes to gather more light to see fainter stars, most optical telescopes employ a reflecting telescope design invented by Newton. In this case, a large concave mirror reflects the incoming light into a focal point. Four different reflecting designs are used, depending on where the focal point is placed.