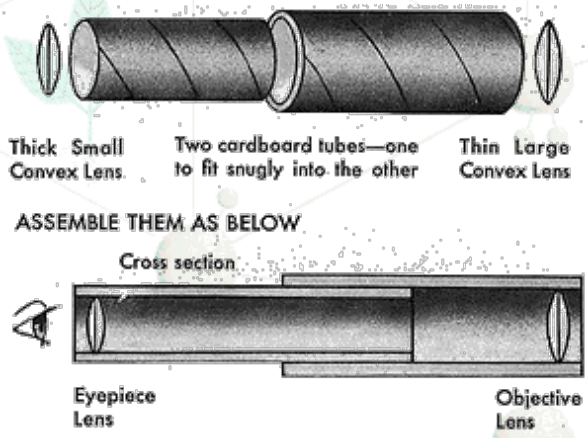
Simple telescopes

It is not difficult to construct a simple refracting astronomical telescope. All that is required are two convex lenses (thicker in the middle) and an appropriate mounting. As a general rule, the objective lens should be large and fairly weak, and the eyepiece should be small and strong. Try starting with an eyepiece of about 2 or 3 centimeters in focal length, and an objective lens of about 25 to 50 centimeters in focal length. A lens' focal length is the distance between the lens' optical center and the image plane when the lens is focused on an object at infinity (for practical purposes, over 100 feet or 30 meters away). Longer focal length lenses are larger and heavier, which is an important factor when designing an instrument that is to be primarily hand held. The lenses should be of good quality and as free from optical distortions (chromatic and spherical) as possible. Chromatic distortions are the tendency lenses have to separate light into its component colors (as does a prism); spherical distortions are best exhibited by the curving of a straight line in an image formed by a curved lens.

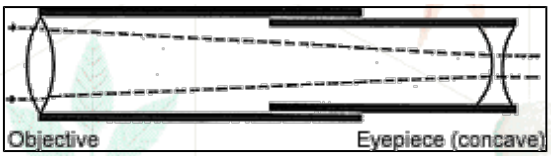


The lenses are mounted usually in two tubes, which can be slid in and out from one another in order to focus. The objective lens will be set in the end of the larger tube, and the eyepiece will be set in the end of the smaller. To determine how far the lenses are to be mounted from one another, hold the smaller lens to your eye. Hold the larger one up in front of it, and try to focus a clear image of a distant object. Measure how far the lenses are at this point. That should be about midrange for the combined length of the tubes.

The lenses can be held in place with epoxy, taking care not to spill any epoxy on the faces of the lens. If the lens is smaller than the opening, a gasket can be improvised from wood, cork, heavy cardboard, or some such. Make certain that the lenses are aligned with one another, that is, they are both set in the same plane vertically and horizontally (center to center) before fixing in place. Look through the eyepiece. If you see no image or only a partial image, then the lenses are not aligned. The finished product will be adequate for exploring the moon's surface. Don't look at the sun with it! It will severely damage your eye.

Two convex lenses will create an upside down image, which is exactly what the telescope described above does. Some telescopes and binoculars use rectifiers, an optical system usually incorporating a prism, to turn the image right way up again. An upside down image really doesn't matter so much when you are exploring the surface of the moon. What you sacrifice in orientation you more than make up for in lightness and power.

If you are building a terrestrial telescope, or "spy glass", you



probably don't want an upside down image. Substitute a concave lens (thinner in the middle) for the eyepiece. The telescope won't be as strong, but it will be adequate for most land use. This type of telescope is also known as a Galilean telescope, because it was first built by Galileo and used by him when he discovered the moons of Jupiter.

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