

24.7.6 Making mirages

An optical device manufactured by Opti Gone Associates called *Mirage*, creates real images of objects using two concave paraboloidal mirrors. A paraboloidal surface is defined by the equation

$$y = a(x^2 + z^2), \tag{24.8}$$

where a is a constant. Paraboloids have the useful property that they focus all light that travels parallel to their central axis, to a single point called the *focus*, with coordinates $f = (0, 1/(4a), 0)$. See Figure 24.25. This is why they are sometimes used as telescope mirrors.

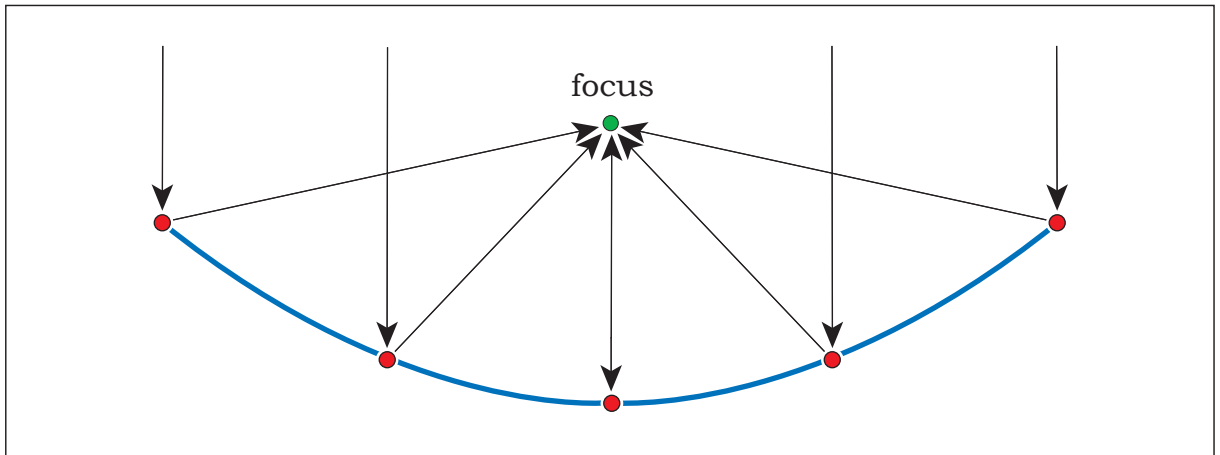


Figure 24.25 A paraboloidal surface focuses all light that hits it parallel to its central axis, to its focus point.

The *Mirage* device consists of two paraboloids as shown in Figure 24.26, with a circular hole in the top paraboloid. The *Mirage* device creates a real image of an object placed in the center of the bottom paraboloid from light that hits both paraboloids. This image floats in space above the opening.

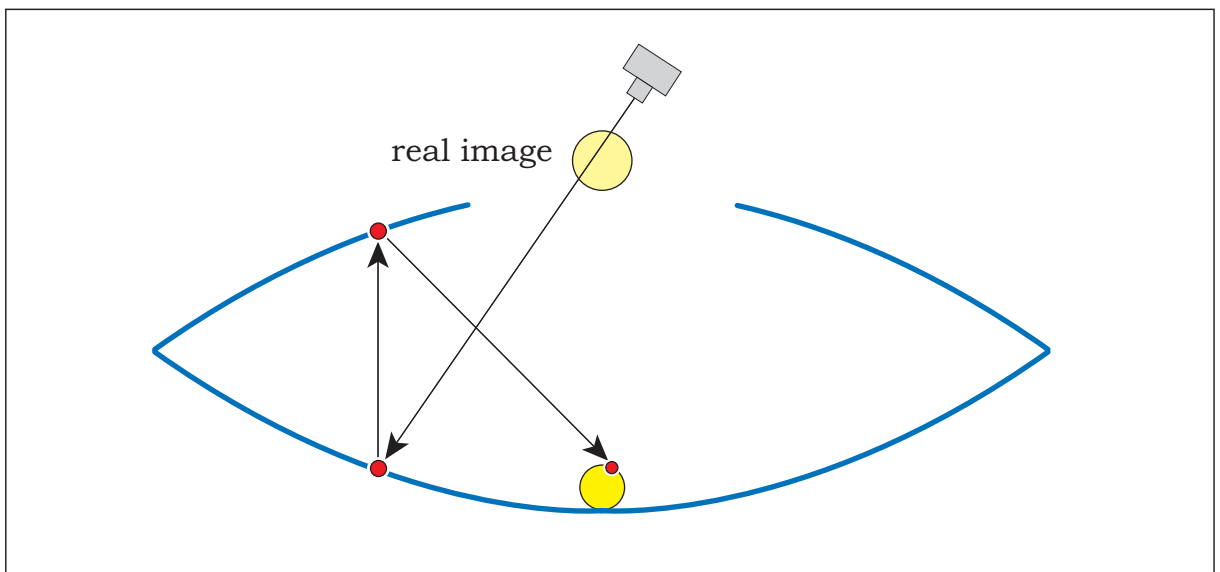


Figure 24.26 When we ray trace a model of the *Mirage* device, the real image of an object at the bottom is produced by rays that reflect off both paraboloids.

We can simulate this device by ray tracing the paraboloids with a maximum depth of at least 2; Figure 24.26 shows the path of a typical ray. Figure 24.27(a) shows a view of the device with a yellow reflective sphere inside that has grid lines on its surface. The sphere itself is not visible in this image, but its real image is. In part (b), the top has been removed to show the sphere sitting on the bottom paraboloid, and its reflections.

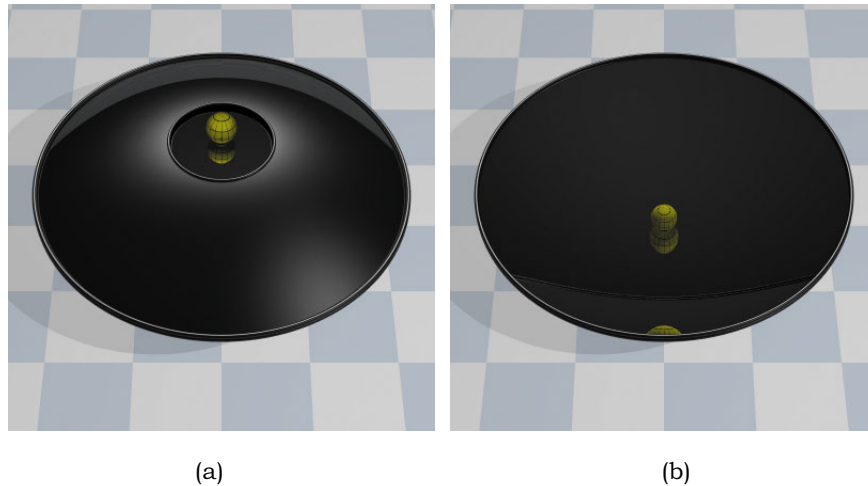


Figure 24.27 (a) Mirage device, (b) close up of the image and its reflection on the bottom paraboloid. Images courtesy of Tania Humphreys.

The best way to visualize the real image is with stereo pairs, as these allow you to view the image in 3D. See Figure 24.28. The image floats above the opening, as demonstrated in Figure 24.26.



Figure 24.28 Stereo pair of the Mirage device. Images courtesy of Tania Humphreys.

From the Further Reading Section:

The Opti Gone Associates website at <http://www.optigone.com> has specifications for the 9" *Mirage 2000* model that Figures 24.26 - 24.28 are based on. This site also has many useful links.