



Figure 16
The parabolic objective mirror in a Cassegrain reflector focuses incoming light.

Reflecting telescopes employ a parabolic mirror (called an *objective mirror*) to focus light. One type of reflecting telescope, called a *Cassegrain reflector*, is shown in **Figure 16**. Parallel light rays pass down the barrel of the telescope and are reflected by the parabolic objective mirror at the telescope's base. These rays converge toward the objective mirror's focal point, F , where a real image would normally form. However, a small curved mirror that lies in the path of the light rays reflects the light back toward the center of the objective mirror. The light then passes through a small hole in the center of the objective mirror and comes to a focus at point A . An eyepiece near point A magnifies the image.

You may wonder how a hole can be placed in the objective mirror without affecting the final image formed by the telescope. Each part of the mirror's surface reflects light from distant objects, so a complete image is always formed. The presence of the hole merely reduces the amount of light that is reflected. Even that is not severely affected by the hole because the light-gathering capacity of an objective mirror is dependent on the mirror's area. For instance, a 1 m diameter hole in a mirror that is 4 m in diameter reduces the mirror's reflecting surface by only $\frac{1}{16}$, or 6.25 percent.

SECTION REVIEW

1. A steel ball bearing with a radius of 1.5 cm forms an image of an object that has been placed 1.1 cm away from the bearing's surface. Determine the image distance and magnification. Is the image virtual or real? Is the image inverted or upright? Draw a ray diagram to confirm your results.
2. A spherical mirror is to be used in a motion-picture projector to form an inverted, real image 95 times as tall as the picture in a single frame of film. The image is projected onto a screen 13 m from the mirror. What type of mirror is required, and how far should it be from the film?
3. Which of the following images are real and which are virtual?
 - a. the image of a distant illuminated building projected onto a piece of heavy, white cardboard by a small reflecting telescope
 - b. the image of an automobile in a flat rearview mirror
 - c. the image of shop aisles in a convex observation mirror
4. **Critical Thinking** Why is an image formed by a parabolic mirror sharper than the image of the same object formed by a concave spherical mirror?
5. **Critical Thinking** The reflector of the radio telescope at Arecibo has a radius of curvature of 265.0 m. How far above the reflector must the radio-detecting equipment be placed in order to obtain clear radio images?