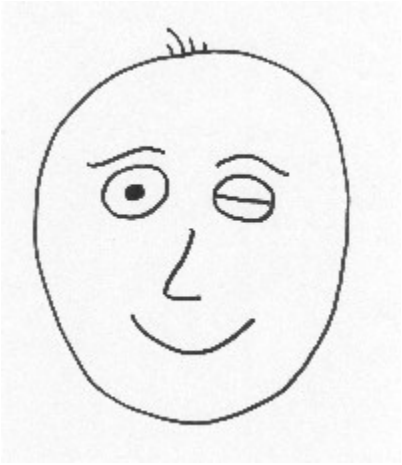
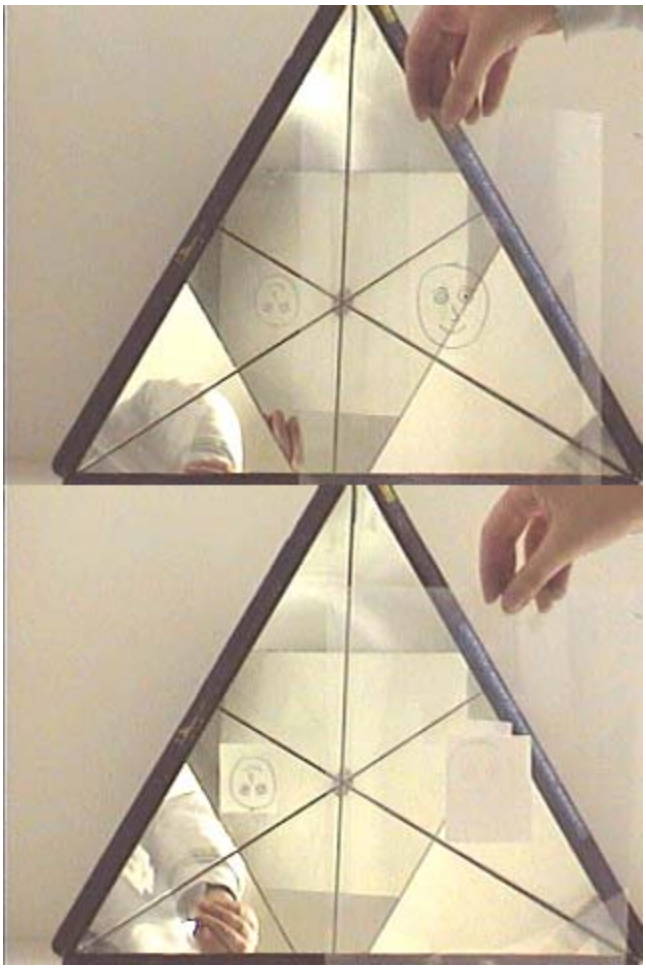
Answer #108

We will review the three problems in the order they were presented in the question. Here is Otto:



- 1. **A three-mirror corner reflector**: Otto will stand at short distance in front of the corner of the three orthogonal mirrors, so that an observer *at the corner* would see Otto's face as in the photograph above.

  The image will appear as image (b), as seen in the photograph below.

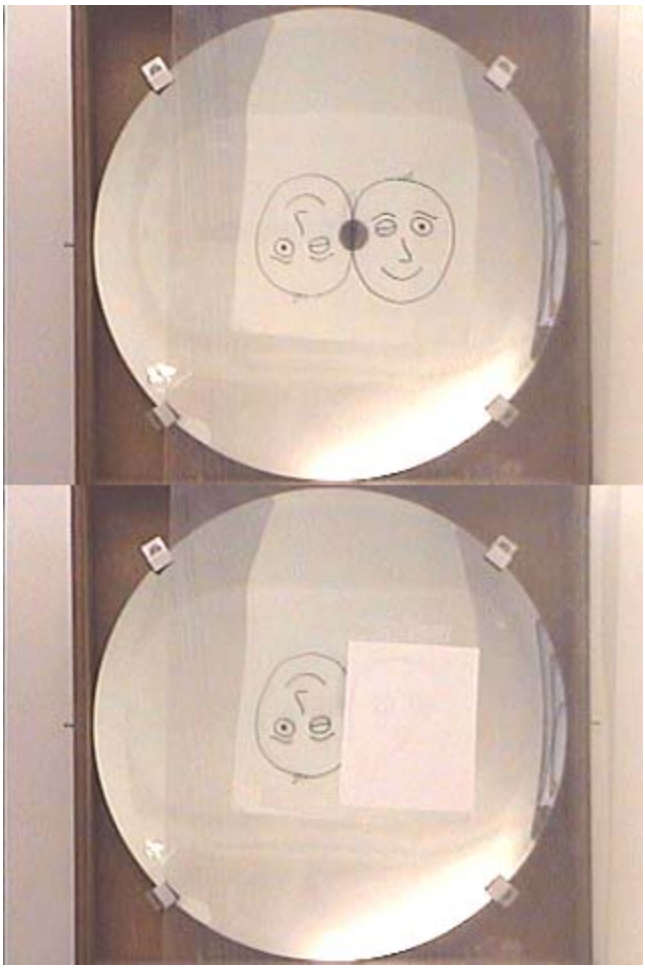


You must view the image from behind Otto, so in the picture Otto appears horizontally inverted from how he looks when you are facing him. The image is virtual, is located behind the corner reflector, and is the same size as the object (Otto). In the photograph at the right a paper mask has been attached to Otto's back so that only the image is visible. Otto's image appears smaller because the image is farther from the camera. The camera is obscured by a white cardboard mask so that the image will be seen more clearly; the black circle at the corner of the corner reflector is the reflection of the camera lens sticking out of the mask.

An interesting exercise in geometry is to prove that any ray striking one mirror of the corner reflector will come out parallel to the incoming ray.

- 2. **A parabolic concave mirror**: Otto will stand at a distance of twice the focal length in front of a spherically symmetric concave mirror, so that an observer at the mirror would see Otto's face as in the photograph above.

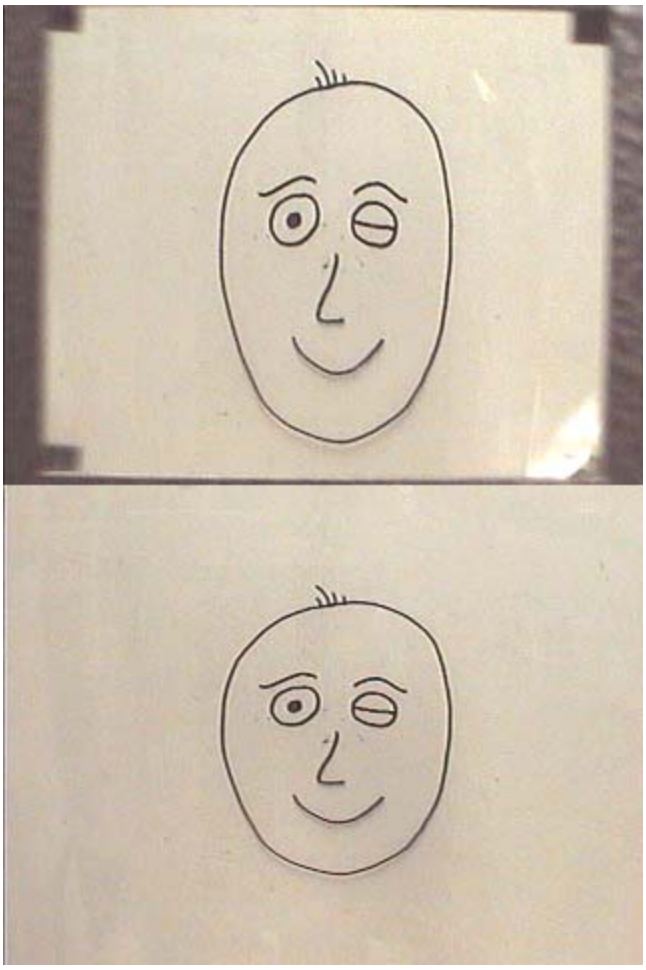
  The image will appear as image (b), as seen in the photograph below.



You must view the image from behind Otto, so in the picture Otto appears horizontally inverted from how he looks when you are facing him. In the photograph at the right a paper mask obscures the back of the object so that the image can be readily identified. The image is real, is located at a distance of twice the focal length in front of the mirror (at the same position as Otto), and has a magnification of -1 (same size as object but inverted). This type of mirror is sometimes used as a magic trick to produce objects that are not there, such as this light bulb. A five-foot diameter mirror identical to one used as a solar collector on an earth satellite produces interesting images when the object is near the focal point of the mirror. As in the case of the corner reflector, the black spot between the object and the image is the reflection of the camera lens sticking out from its white cardboard mask.

- 3. **A vertically focusing cylindrical convex lens**: Otto will stand at a distance equal to one-half of the focal length from a vertically focusing cylindrical convex lens, oriented like a horizontal log in front of Otto. He again faces the lens so that an observer at the lens would see Otto's face as in the photograph above.

  The image will appear as image (m), as seen in the photograph at the left below. The photograph at the right shows Otto with the lens removed for comparison.



You must view the image looking through the lens toward Otto. The image will be virtual, located at a position equal to the focal distance behind the lens (on the same side as Otto) and have a magnification of two in the vertical direction. The image looks less than twice the height of Otto because it is farther from the camera.

Archive 6

Question of the Week

Outreach Index Page

Lecture-Demonstration Home Page

For questions and comments regarding the *Question of the Week* contact Dr. Richard E. Berg by e-mail or using phone number or regular mail address given on the Lecture-Demonstration Home Page.