Figure 22
The 27 antennas at the Very Large Array in New Mexico are used together to provide improved resolution for observing distant radio sources. The antennas can be arranged to have the resolving power of a 36 km wide radio telescope.

Yet, even with their large sizes, radio telescopes cannot resolve sources as easily as visible-light telescopes resolve visible-light sources. At the shortest radio wavelength (1 mm), the largest single antenna for a radio telescope—the 305 m dish at Arecibo, Puerto Rico—has a resolution angle of 4×10^{-6} rad. The same resolution angle can be obtained for the longest visible light waves (700 nm) by an optical telescope with a 21 cm mirror.

To compensate for the poor resolution of radio waves, one can combine several radio telescopes so that they will function like a much larger telescope. An example of this is shown in **Figure 22.** If the radio antennas are arranged in a line and computers are used to process the signals that each antenna receives, the resolution of the radio "images" is the same as it would be if the radio telescope had a diameter of several kilometers.

It should be noted that the resolving power for optical telescopes on Earth is limited by the constantly moving layers of air in the atmosphere, which blur the light from objects in space. The images from the *Hubble Space Telescope* are of superior quality largely because the telescope operates in the vacuum of space. Under these conditions, the actual resolving power of the telescope is close to the telescope's theoretical resolving power.

SECTION REVIEW

1. Light passes through a diffraction grating with 3550 lines/cm and forms a first-order maximum at an angle of 12.07°.
   a. What is the wavelength of the light?
   b. At what angle will the second maximum appear?
2. Describe the change in width of the central maximum of the single-slit diffraction pattern as the width of the slit is made smaller.
3. Which object would produce the most distinct diffraction pattern: an apple, a pencil lead, or a human hair? Explain your answer.
4. Would orange light or blue light produce a wider diffraction pattern? Explain why.
5. **Critical Thinking** A point source of light is inside a container that is opaque except for a single hole. Discuss what happens to the image of the point source projected onto a screen as the hole's width is reduced.
6. **Critical Thinking** Would it be easier to resolve nearby objects if you detected them using ultraviolet radiation rather than visible light? Explain.