(a) (b)

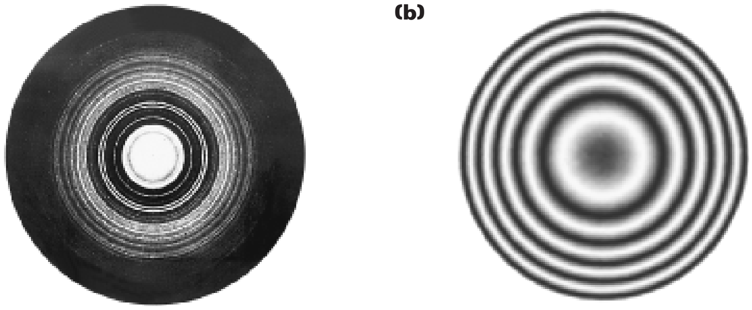

Figure 17
(a) Electrons show interference patterns similar to those of **(b)** light waves. This demonstrates that electrons sometimes behave like waves.

At first, de Broglie's proposal that all particles also exhibit wave properties was regarded as pure speculation. If particles such as electrons had wave properties, then under certain conditions they should exhibit interference phenomena. Three years after de Broglie's proposal, C. J. Davisson and L. Germer, of the United States, discovered that electrons can be diffracted by a single crystal of nickel. This important discovery provided the first experimental confirmation of de Broglie's theory. An example of electron diffraction compared with light diffraction is shown in **Figure 17.**

Electron diffraction by a crystal is possible because the de Broglie wavelength of a low-energy electron is approximately equal to the distance between atoms in a crystal. In principle, diffraction effects should be observable even for objects in our large-scale world. However, the wavelengths of material objects in our everyday world are much smaller than any possible aperture through which the object could pass.

SAMPLE PROBLEM D

De Broglie Waves

PROBLEM

With what speed would an electron with a mass of 9.109×10^{-31} kg have to move if it had a de Broglie wavelength of 7.28×10^{-11} m?

SOLUTION

Given: $m = 9.109 \times 10^{-31}$ kg $\quad \lambda = 7.28 \times 10^{-11}$ m

$h = 6.63 \times 10^{-34}$ J•s

Unknown: $v = ?$

Use the equation for the de Broglie wavelength, and isolate v.

$$\lambda = \frac{h}{mv} \quad \text{or} \quad v = \frac{h}{\lambda m}$$

$$v = \frac{6.63 \times 10^{-34}\ \text{J•s}}{(7.28 \times 10^{-11}\ \text{m})(9.109 \times 10^{-31}\ \text{kg})} = 1.00 \times 10^{7}\ \text{m/s}$$

$$\boxed{v = 1.00 \times 10^{7}\ \text{m/s}}$$