



**FIGURE 29** When an instantaneous, temporary dipole develops in a helium atom, it induces a dipole in a neighboring atom.

## London Dispersion Forces

Even noble-gas atoms and molecules that are nonpolar experience a weak intermolecular attraction. In any atom or molecule—polar or nonpolar—the electrons are in continuous motion. As a result, at any instant the electron distribution may be slightly uneven. The momentary, uneven charge creates a positive pole in one part of the atom or molecule and a negative pole in another. This temporary dipole can then induce a dipole in an adjacent atom or molecule. The two are held together for an instant by the weak attraction between the temporary dipoles, as illustrated in **Figure 29**. *The intermolecular attractions resulting from the constant motion of electrons and the creation of instantaneous dipoles are called **London dispersion forces**, after Fritz London, who first proposed their existence in 1930.*

London forces act between all atoms and molecules. But they are the *only* intermolecular forces acting among noble-gas atoms and nonpolar molecules. This fact is reflected in the low boiling points of the noble gases and nonpolar molecular compounds listed in **Table 7**. Because London forces are dependent on the motion of electrons, their strength increases with the number of electrons in the interacting atoms or molecules. In other words, London forces increase with increasing atomic or molar mass. This trend can be seen by comparing the boiling points of the gases helium, He, and argon, Ar; hydrogen, H<sub>2</sub>, and oxygen, O<sub>2</sub>; and chlorine, Cl<sub>2</sub>, and bromine, Br<sub>2</sub>.

## SECTION REVIEW

1. What two theories can be used to predict molecular geometry?
2. Draw the Lewis structure and predict the molecular geometry of the following molecules:
  - a. SO<sub>2</sub>
  - b. Cl<sub>4</sub>
  - c. BCl<sub>3</sub>
3. What factors affect the geometry of a molecule?
4. Explain what is meant by  $sp^3$  hybridization.

5. What type of intermolecular force contributes to the high boiling point of water? Explain.

### Critical Thinking

6. **INFERRING RELATIONSHIPS** What experimental property directly correlates with the strength of the intermolecular forces? Briefly explain your answer.