indications of a small number of ions per c.c. per second produced by the collisions of thermal agitation, but more refined experiments are required to confirm this point. In addition a formula has been derived for the number of thermal collisions in a gas per c.c. per second producing ionization which agrees with the experimental results if the number of such collisions is small.

Theory.—The question of ionization by the collisions of thermal agitation has been investigated theoretically by Langevin and Rey*. In this paper the authors obtained an expression for the number of collisions in a gas per c.c. per second for which the relative velocity of the colliding molecules normal to the sphere of shock was greater than an arbitrary standard. If we denote the number of these "effective" collisions by K, then

$$K = \nu e^{-\frac{1}{4}hmv^2},$$

where ν = total number of collisions per c.c. per second.

$$h = \frac{3}{4\epsilon T}, \text{ and } \epsilon = 2{\cdot}02 \times 10^{-16},$$

v = arbitrary minimum velocity.

According to this formula K would vary very rapidly with the temperature, a prediction which is contradicted by experiment.

Exception was taken to Langevin's work by Wolfke †, who suggested that the potent factor in producing ionization at the collision of two molecules was not their relative velocity normal to the sphere of shock, but rather their relative velocity tangential to it. Indeed he suggested that the normal component would rather prevent ionization by pushing the electron further into the atom, although it is difficult to judge of the value of this suggestion on account of the very conjectural nature of our knowledge of the mechanism of an atom. However, on this ground Wolfke suggested that the number of effective collisions would depend on the relative velocity of the molecules normal to the sphere of collision being less than a certain value, v. The formula obtained for the number of effective shocks is

$$\nu(1 - e^{-\frac{1}{4}hmv^2}),$$

where the symbols have the same meaning as before. From this Wolfke calculated that if the collisions in air produce

* Langevin and Rey, *Le Radium*, x. p. 142 (1913).
† Wolfke, *Le Radium*, x. p. 265 (1913).