4 ions per c.c. per second at 17° C., they will produce 2 at 130° C., and 6 at −20° C. It should be noted that the above formula only includes the "negative" condition for an ionizing collision, *i. e.* the normal velocity must be below a certain value. A factor representing the "positive" condition should also be introduced, *i. e.* the tangential velocity must be greater than a certain value. To do this we may proceed as follows:—

The expression for the total number of collisions per c.c. per second is obtained by Boltzmann as follows. We assume the presence of two kinds of molecules of masses m and m_1 respectively; n and n_1 are the numbers of each kind per c.c.; $d\omega$ and $d\omega_1$ represent the products of the velocity components for each kind; and f, f_1, represent for the two kinds of molecules the values of the function

$$n\sqrt{\frac{h^3m^3}{\pi^3}}\,e^{-hmc^2}.$$

The conditions of a collision between a molecule m and a molecule m_1 can be characterized by the two parameters b and a defined as follows (fig. 4 a):—

Fig. 4 *a*.

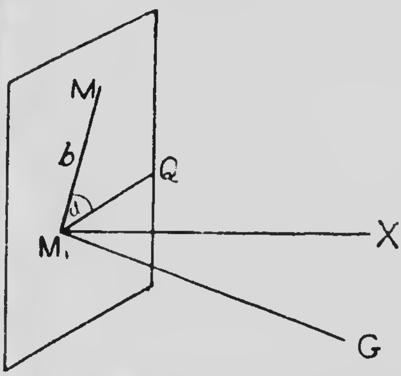
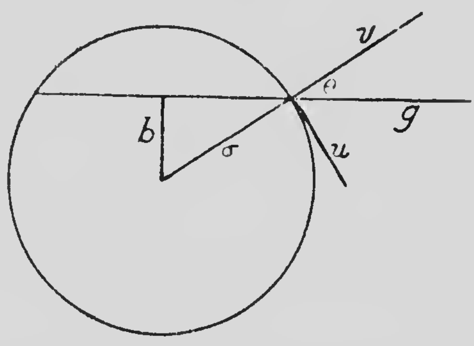


Fig. 4 *b*.



M_1 is the centre of the molecule of mass m_1. The molecule of mass m moves with a relative velocity g parallel to M_1G, and the projection of the centre of this molecule on the plane P drawn through M_1 perpendicular to M_1G lies at M. The line M_1Q represents the intersection of the planes P and GM_1X. Then $M_1M=b$, and the angle $MM_1Q=a$. The number of collisions per c.c. per second is then

$$\nu=\int ff_1\,gb\,d\omega\,d\omega_1\,db\,da;$$

or integrating for a from 0 to 2π,

$$\nu=2\pi\int b\,db\int gff_1\,d\omega\,d\omega_1.$$