AND FLUX DENSITY: GAUSS'S LAW

blems to introduce another vector more
E. If we define

E (1)

: charge is radial and independent of the
omponent D_r by the area of a sphere of

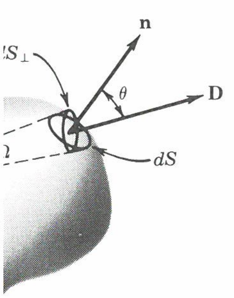
= q (2)

charge (in coulombs) so that it may be
D may then be thought of as the *electric*
; also known as the *displacement vector*

bitrarily shaped closed surface as in Fig.
er the surface surrounding a point charge
in which the fluid passing surface S of
ising plane $S_\perp$ perpendicular to the flow.
end upon the shape of the surface used
the same source. By superposition, the
charges or a continuous distribution of

l surface = *charge enclosed* (3)

from Coulomb's law for simple media,
thus a most general and important law.
ore carefully at the role of the medium.
between charges depends upon the pres-
ectron clouds and the nuclei of the atoms
t of the presence of the isolated charges.



ary surrounding surface.

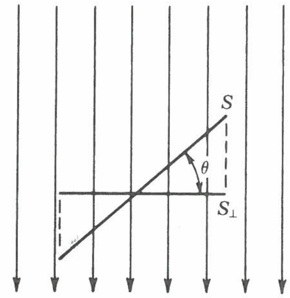


FIG. 1.3*b* Flow of a fluid through surfaces S and $S_\perp$.

Thus the atoms are distorted or *polarized*. There is a shift of the center of symmetry of the electron cloud with respect to the nucleus in each atom as indicated schematically in Fig. 1.3*c*. Similar distortions can occur in molecules, and an equivalent situation arises in some materials where naturally polarized molecules have a tendency to be aligned in the presence of free charges. The directions of the polarization are such for most materials that the equivalent charge pairs in the atoms or molecules tend to counteract the forces between the two isolated charges. The magnitude and the direction of the polarization depend upon the nature of the material.

The above qualitative picture of polarization introduced by a dielectric may be quantified by giving a more fundamental definition than (1) between **D** and **E**:

$$\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P} \tag{4}$$

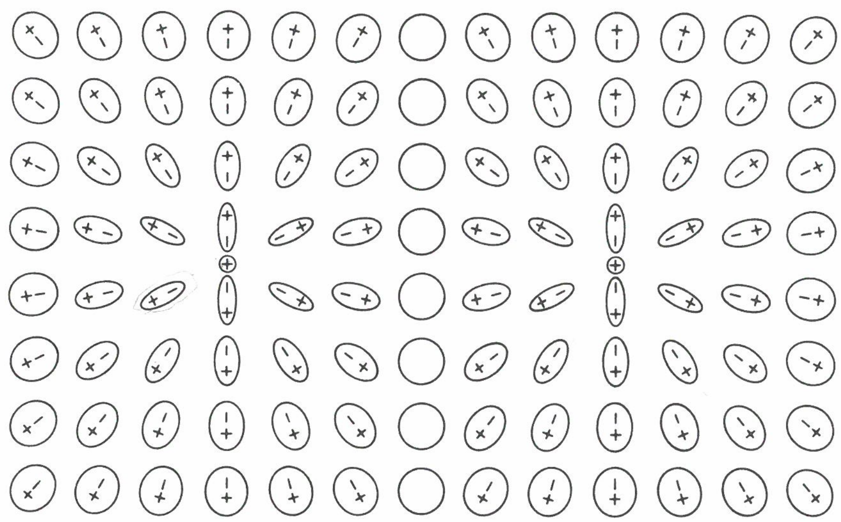


FIG. 1.3*c* Polarization of the atoms of a dielectric by a pair of equal positive charges.