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Eilhard Wiedemann

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ON THE CONDENSATION OF FLUIDS ON SOLID BODIES.

BY EILHARD WIEDEMANN.

Wilhelmy*, from experiments on capillarity, concluded that upon glass surfaces which dip into water the latter is condensed in large quantity. Later experiments, however, by Röntgen†, Schleiermacher‡, and Volkmann§, who ascertained the specific gravity of the same body first in whole pieces and then in a state of fine division, showed that the weight of the condensed layer is extremely slight, and not determinable. The latter result is also in perfect accordance with what the newer investigations of Van der Waals|| on the magnitude of the molecular forces have taught us, as I intend, in what follows, to show.

The condensation of the liquid upon the side is owing to this—that the forces emanating from the side, and rapidly diminishing with the distance from it, compress the fluid within a layer the thickness a of which is equal to the sphere of action of the molecular forces. We can conceive the layer in question resolved into thinner ones, each of the thickness dx , within which the molecular force κ can be regarded as constant. If we further assume that the coefficient α of compressibility is independent of the pressure, if s is the specific gravity of the fluid, upon the unit of surface a quantity

$$d = \int_a^0 \kappa s \alpha dx$$

is condensed.

If we put the force κ exerted by the side upon the fluid equal to the pull K exerted by a fluid, in consequence of the molecular forces, upon its superficial parts, we assume a force at any rate of the same order of magnitude as that which acts between the fluid and the side at the surface of contact. But if in the above expression we substitute K for κ , we obtain much too high a value for the amount d condensed, since κ diminishes very quickly with increasing distance from the wall. Consequently we have

$$d < K \alpha s a.$$

For water, $K=10000$ atmospheres, $\alpha=\text{about } 5 \times 10^{-5}$, and, according to Quincke¶, $a=0.0000005$ centim.; so that $d < 10000 \times 0.000005 \cdot 0.0000005 \text{ g.} = 25 \times 10^{-8} \text{ g.}$ Accordingly even $K \alpha s a$, and therefore more certainly d , is a completely inappreciable quantity.

Volkmann's** value for the thickness of the bounding layer, on the assumption of which the laws of the heights to which fluids ascend in capillary tubes and on solid plane sides are valid, cannot be applied to these reasonings, because the real existence of so thick a boundary layer different in constitution from that of the free fluid has not actually been verified.—Wiedemann's *Annalen*, vol. xvii. pp. 988–990 (1882).

* Pogg. *Ann.* cxix. p. 117 (1863), cxxii. p. 1 (1864).

† Wied. *Ann.* iii. p. 321 (1878).

‡ Wied. *Ann.* viii. p. 52 (1879).

§ Wied. *Ann.* xi. p. 182 (1880).

|| 'The Continuity of the Gaseous and Liquid States,' German translation by F. Roth.

¶ Pogg. *Ann.* cxxxvii. p. 402 (1869).

** Wied. *Ann.* xi. p. 117 (1880).