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THE SESSILE LIQUID DROP I. SYMMETRIC CASE

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Quantitative estimates are derived, describing the size and shape of a symmetric (idealized) liquid drop, resting in gravitational equilibrium on a plane surface Π. The free surface interface is determined by the conditions that its mean curvature be a given (increasing) linear function of distance from Π, that it enclose with Π a prescribed volume V, and that the angle formed with Π be a prescribed constant γ. The estimates apply to drops of all sizes, and some are asymptotically exact in the limiting cases of large or small wetted area on Π. It is shown that a number of qualitative features of behavior are determined by the ratio $V/\sin\gamma/2$. This ratio is in turn related to a ratio that appears in the study of the circular capillary tube, thus indicating a reciprocity between the two problems, which becomes exact in both limiting cases.

As corollaries of the method, the uniqueness of the symmetric solution is proved, and a new proof of existence is given.

The results are compared with calculations and with measurements in some particular cases.

Contents

1. Introduction. The existence of a stationary (sessile) liquid drop of prescribed volume V and minimizing potential energy, rest-