

## Young's Paradox, and the Attractions of Partly Immersed Parallel Plates

Robert Finn

**Abstract.** A seemingly paradoxical prediction, for behavior of objects with non-constant contact angles when dipped into fluids, is clarified in a new way. The method is then applied to the problem of determining the attraction (or repulsion) of two parallel vertical plates immersed partly into an infinite liquid bath. A criterion is given for determining whether the plates attract or repel each other, and estimates for the forces are obtained that are asymptotically exact for small plate separations. It is shown that regardless of the data, each of the plates experiences the same net force magnitude as does the other. Finally a new and more precise and inclusive clarification is given for a phenomenon described in 1806 by Laplace, who noted conditions under which repelling forces can change abruptly into (much larger) attracting forces.

As a corollary of the reasoning, a new refutation is obtained for a “surface tension” diagram, originally proposed by Thomas Young in 1805, which remains prevalent in fluid mechanics literature and in widespread use by engineers. The present reasoning supports earlier refutations obtained in other ways, and which have been subject to some dispute.