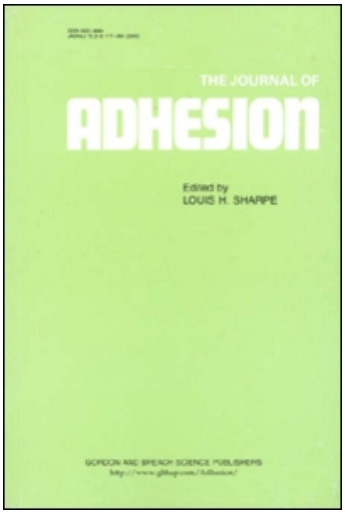

The Journal of Adhesion
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453635

Letter

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To cite this Article Derjaguin, B. V.(1976) 'Letter', The Journal of Adhesion, 8: 1, 99 — 100
To link to this Article: DOI: 10.1080/00218467608075074
URL: http://dx.doi.org/10.1080/00218467608075074

J. Adhesion, 1976, Vol. 8, pp. 99–100

Printed in Scotland

Letter

In *The Journal of Adhesion* **6**, 331 (1974), there was published a paper entitled "Capillary Attraction and Wetting Hysteresis" by J. J. Bikerman. The main object of this paper was to show that the force of interaction of two parallel, vertical plates that are partially immersed in a liquid varies depending upon whether the contact angle is equilibrium or not. Therefore, the author deems it necessary to take into account the presence of the hysteresis of the contact angle, and tries to draw conclusions therefrom concerning the direction of the interaction force and its dependence upon distance.

However, from the very beginning it is quite clear that when in the state of rest and capillary equilibrium, the forces applied to the surfaces of plates depend only upon the values of density, surface tension of the liquid, the contact wetting angles, which are existing at the present moment, and the position of the wetting perimeter. Doubting about it would mean ignoring the generally known and accepted fundamentals of mechanics and capillarity.

Therefore, here it is possible to avail oneself of the strict and accurate calculations that are set forth by Bakker on pages 80–83 in his work.[1]

From the formulas derived by Bakker, it follows univocally that when the meniscus of the liquid between plates does not intersect the surface of the "zero level", then at any distances the plates will be attracted by the force which is equal to

$$\tfrac{1}{2}g\rho h^2 S \tag{1}$$

where S is the breadth of the plates, g is the acceleration of gravity, ρ is the density of the liquid, h is the distance from the "zero level" of the meniscus point where the tangent to its surface is horizontal (see Figure 29 of Bakker).

In the case where the meniscus of the liquid intersects the zero level plane in a certain point B (see Figure 30 of Bakker), then the plates, according to Bakker's calculations, will mutually be repelled by a force equal to

$$F = \sigma(1-\sin\gamma) \tag{2}$$

where σ is the surface tension of the liquid, γ is the angle of inclination of the meniscus at the point B. The repulsion must take place independently of the distance (spacing) between the plates, provided the meniscus intersects the zero level. Such an intersection always takes place in the case considered by Bikerman, where the contact wetting angles of the both surfaces are in sum

equal to 180°; hence, his conclusion is definitely incorrect, that the repulsion force goes over into attraction as the distance between the plates grows. Erroneous also is Bikerman's expression for the force of the capillary attraction of similar plates, which exceeds the value as derived by Bakker.[1]

It will be easy to detect the main cause which has led Bikerman to obtain the qualitatively erroneous results.

Equalling the work of the force of the interaction of plates when these are removed at a distance $d\delta$ from each other, to the increment of the free energy of the system, Bikerman seems to forget that the free energy should be calculated for the *equilibrium* states of the system, and this is not done when the wetting perimeters are fixed and, hence, there is hysteresis present.

Consequently, Bikerman's paper is first of all useless, since all the correct results may be obtained from Bakker's work which was published more than 40 years ago.

Secondly, Bikerman's paper is grossly erroneous, and thus may mislead the reader. And finally, it will be not appropriate to accept Bikerman's suggestion that the experiment should substantiate the correctness of an interpretation, since there is no sense of verifying by an experiment the calculations that are definitely wrong.†

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† As regards the formulas (1) and (2), these may be written at once, by using the Stevin's hardening principle, without having resource to the equations defining the shape of the capillary surface of the heavy liquid.

1. G. G. Bakker, Kapillarität und Oberflüchensparkung, s.80, from: *Handbuch der Experimentalphysik Bd.* 6, Akad. Verlag, Leipzig, 1928.