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# This Week's Citation Classic®

**Derjaguin B & Landau L.** Theory of the stability of strongly charged lyophobic sols and of the adhesion of strongly charged particles in solution of electrolytes. *Acta Physicochim. URSS* 14:633-62, 1941.

[Acad. Sci. USSR, Inst. Colloid- and Electrochemistry, Lab. Thin Films, and Inst. Physical Problems, Moscow, USSR]

The interaction of colloid particles was theoretically calculated. The effect of Van der Waals's forces usually makes the particles clump together; however, when these particles approach one another they are repelled by the overlapping of the diffuse ionic atmospheres that surround each of them. Accordingly, conditions were established in which rapid coagulation of colloid particles occurs as a result of Brownian motion. The study examined strongly charged particles for the first time, in addition to weakly charged particles. [The *SCI*® indicates that this paper has been cited in over 490 publications since 1955, making it the most-cited paper for this journal.]

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In 1935 I simultaneously initiated the theory of colloid stability with research into the "disjoining pressure" of liquid thin layers. This was carried out jointly with the late M.M. Kusakov at my Laboratory of Thin Films in the Institute of Colloid- and Electrochemistry (now the Institute of Physical Chemistry of the Academy of Sciences of the USSR). I published papers containing the calculation of repulsion (disjoining pressure) due to the overlapping of ionic atmospheres in an interlayer between colloid particles for small surface potentials; this yielded a theory of stability of weakly charged colloids.[1-3]

These works were reported in 1939 at the P.L. Kapitza Colloquium at the Institute of Physical Problems, and L.D. Landau became interested in them. He suggested considering the opposite case of extremely high potentials of particles, taking into account the molecular attraction. I wrote a paper describing not only earlier but also new, detailed calculations. Landau approved it, and the paper was submitted to press.

World War II interfered with the publication of the paper abroad (although it had been reviewed in *Chemical Abstracts*). E.J.W. Verwey, J.T. Overbeek, and K. van Nes had been luckier, having published a monograph on that subject in 1948 that received rapid and extensive publicity.[4] In 1954 I reported on the theory of heterocoagulation of colloids,[5] which markedly expanded the application of the theory. I also indicated that the main results of the Verwey book had been published by us earlier. My most recent review of the subject was published in 1979.[6]

At the invitation of D.D. Eley, I wrote a monograph, *Theory of Stability of Colloids and Thin Films*, for publication by Pergamon Press. However, in 1981 Pergamon cancelled my contract as well as those of 30 other Soviet scientists because of certain changes in its financing policies. The Russian version of this monograph was published in 1986.[7]

I think that the extensive citation of our paper is due to its concern with a central problem of colloid science. Our paper, based on a rigorous physicomathematical approach, formulated quantitative laws specifying the empirical Hardy-Schulze laws widely used by colloid scientists.

The citations might have been much more numerous if World War II had not interfered, the issues of *Acta Physicochimica URSS* had been less scarce, and our paper had been cited in the Verwey book, as well as in the old colloid-chemistry textbooks.

1. **Derjaguin B.** A theory of interaction of particles in presence of electric double layers and the stability of lyophobe colloids and disperse systems. *Acta Physicochim. URSS* 10:333, 1939. (Cited 55 times since 1955.)
2. ----------. On the repulsive forces between charged colloid particles and on the theory of slow coagulation and stability of lyophobe sols. *Trans. Faraday Soc.* 36:203-11, 1940. (Cited 150 times since 1955.)
3. ----------. Addendum to paper by author. *Trans. Faraday Soc.* 36:730-1, 1940. (Cited 75 times since 1955.)
4. **Verwey E J W, Overbeek J T & Nes K.** *Theory of the stability of lyophobic colloids: the interaction of sol particles having an electric double layer.* New York: Elsevier, 1948. 205 p. (Cited 1,825 times since 1955.)
5. **Derjaguin B V.** A theory of the heterocoagulation, interaction and adhesion of dissimilar particles in solutions of electrolytes. *Disc. Faraday Soc.* 18:85-98, 1954. (Cited 60 times since 1955.)
6. ----------. Stability of colloid systems. *Usp. Khim. SSSR* 48:675-721, 1979.
7. ----------. *The theory of stability of colloids and thin films.* Moscow: Nauka, 1986.