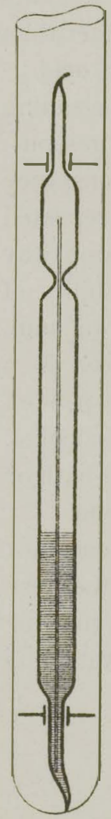
Dr. E. C. DE VRIES. *Measurements on the influence of temperature on the capillary elevation of ether between the critical state and the boiling-point of ethylene* [1].



Taking into account the law of corresponding states and denoting by θ VAN DER WAALS's reduced temperatures, these observations give approximately the rate of variation of the surface-tension for all substances between $\theta = 0{,}366$ and $\theta = 0{,}9772$. The measurements of the elevations were made by means of a thick glass tube, closed by melting, and filled in a vacuum with such a quantity of ether that at the critical temperature the disappearance of the meniscus could be observed about the middle of the tube. In the closed tube is placed a thin cappillary tube in which the rise of the liquid is measured. In order to keep it in a central position the thick wider tube is narrowed in fit places. The

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[1] Short account of my dissertation published under the same title. Leiden, 1893.

bottom by which the capillary tube is supported is inclined, so that the tube is open below. The thick tubes with which at first several auxiliary apparatuses are connected by melting them together and the capillary tubes they contain are cleaned with the utmost care, for which purpose they are repeatedly rinsed and boiled with various liquids which are carefully made dust-free in apparatuses purposely constructed and which can only arrive into the principal tube and accessory auxiliary tubes connected with them by melting.

The cleanness obtained in this way was so great that by the retardation of ebullition, shown by water and alcohol, more tubes burst by overheating the water than when boiling them with concentrated sulphuric acid.

The result of all the precautions taken in cleaning the glass-walls and in getting rid of every (also gaseous) foreign admixture in the ether was a complete constancy of the capillary elevation in this tube even after repeated heating and for months afterwards, in the same way as EÔTVÖS obtained in his method the invariability of the capillary constants by closing his tubes in a vacuum. The tube destined for the experiment was placed in a wider one containing methyl-salicylate which is suspended in a vapour-bath heated by the vapours of ethyl-alcohol, amyl-alcohol, terebene or aniline or in a liquid-bath or finally in an apparatus for boiling liquid ethylene.

The utmost care was taken in maintaining a constant temperature during a very long time, because otherwise drops of liquid settle easily in the capillary tube or vapour-bubbles are formed by which all observation is rendered impossible.

The arrangement for maintaining a constant temperature also permits the capillary tube to be seen in an illuminated part of the field of the telescope, the small meniscus being otherwise difficult to observe. The arrangement for the observations at higher temperatures is described in the academical thesis; about the contrivance for the observation in the ethylene which boils at — 102°, I shall ask permission for a following communication to your Section.

The capillary tube being placed in a wider tube which would give a capillary elevation itself, it is necessary to correct the observed rise, a correction however for which only an approximate value could be given.

The results of the measurements, corrected as well as possible, are

$\rho_v - \rho_d$	temperature	VAN DER WAALS's reduced temperature	Capillary rise (relative)	Surface-energy (relative)
0	193°.6	1	0	0
1.61	182.92	0.9772	2.81	4.52
2.38	159.31	0.9265	8.59	20.45
2.96	125.58	0.8542	16.09	47.54
3.505	71.8	0.754	26.10	91.48
3.965	19.56	0.627	38.44	152.41
4.57	—102.	0.366	63.69	291.07

From —100° to + 160° the capillary rise h can be satisfactorily represented by a linear function of the temperature, according to

$$h = 1 - 0{,}004960\, t$$

in which the rise at 0° is put 1, while the curve by which h is graphically represented as a function of the temperature evidently ends logarithmically near the critical temperature. The walls of the tube were found to be wetted at all temperatures, in opposition to RAMSAY's statement. By using RAMSAY and YOUNG's data on the density of the liquid ρ_v and of the vapour ρ_d above 0° (for the critical temperature they found also ~~103.0~~, which agrees perfectly) and an interpolation-formula deduced from PIERRE's formule and a determination of the density at —71,°5 by Dr. KUENEN

H193,°0

$$\frac{\rho^\circ}{\rho} = 1 + 15172 \times 10^{-7} t + 22.55 \times 10^{-7} t^2 + 0,2119 \times 10^{-7} t^3 + 0,00470 \times 10^{-7} t^4$$

by which the density at —102° can be found by extrapolation, we can calculate the relative value of the surface-energy H given in the last column. EÖTVÖS's formula (Wied. Ann. 27) does not agree with these results. From the data in his paper we can calculate the relative value of the surface-tension of ether at 120°, 62°, 0°, which he determined by another method not dependent on the angle of contact. If we were allowed (the density of the vapour ρ_v and the way in which the influence of the vapour is taken into account not being mentioned at all) to multiply this surface-tension by $\rho_v - \rho_d$ his measurements would approach nearer to those of ours. If H is graphically represented as a function of θ, the curve, near the critical temperature, proves to turn its convex side to the T-axis in

such a way that by a regular continuation of this part it might end touching the T-axis. Undoubtedly an accurate knowledge of its form in this part is of high theoretical importance. An investigation thereof is now being undertaken.