

Citation:

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Physics. — „*On a simplified theory of the electrical and optical phenomena in moving bodies*”. By Prof. H. A. LORENTZ.

(Will be published in the Proceedings of the next meeting).

Physics. — „*STOKES' aberration theory presupposing an ether of unequal density*”. By Prof. H. A. LORENTZ.

(Will be published in the Proceedings of the next meeting).

Physics. — „*Measurements on the system of isothermal lines near the plaitpoint, and especially on the process of the retrograde condensation of a mixture of carbonic acid and hydrogen*”. By Dr. J. VERSCHAFFELT. (*Continued*). (Communication n^o. 47 from the Physical Laboratory at Leiden by Prof. H. KAMERLINGH ONNES).

§ 5. *The course of the plaitpoint curve.*

Two other mixtures $x = 0,0995$ and $x = 0,1990$ were investigated in the way described in § 2. But in the case of these two mixtures the investigation could not be made so completely as in the case of the first mixture. For $x = 0,0494$ we could trace the isothermals pretty far above the plaitpoint-pressure; but for $x = 0,0995$ the plaitpoint was situated towards the end of the series of observations, and for $x = 0,1990$ the observations could only be made till near the critical point of contact. By means of these observations, the results of which are communicated in the tables III and IV, we can derive some information regarding the course of the plaitpoint curve in mixtures of hydrogen and carbonic acid in the neighbourhood of pure carbonic acid.

T A B L E III.

Mixture $x=0,0995$. Isothermal lines

Temp.	Volume. 0.0	Pressure.	Temp	Volume. 0.0	Pressure.	Temp	Volume. 0 0	Press.
16° .90	2774	32.24	22° .80 (cont.)	07185	81.60	25° .00	03974	110.8
	2490	35.25		06495	85.05	25° .45 (cr. p. of c. temp.)	06685	86.85
	2199	38.90		05955	87.80		06070	90.50
	2066	40.80		05325	91.95		04918	99.45
	1874	43.91		05260	92.45		04580	102.9
	1683	47.51		04171	104.1		04196	108.2
	1490	51.65		03612	114.6		03776	115.3
	1296	56.60	24° .20 (pl. p. temp.)	09145	73.45	26° .05	2069	42.82
	1106	62.25		07245	82.50		1873	46.27
	1067	63.50		06700	85.40		1685	50.20
	1029	64.85		06470	86.65		1486	54.90
	09940	66.00		06120	88.60		1300	60.25
	09565	67.30		05685	91.60		1107	66.85
	09145	68.30		05270	94.30		09185	74.50
	08800	69.10		04902	97.45		07240	84.20
	08360	70.25		04566	101.1		05300	96.90
	07990	71.35		04171	106.3		04566	103.9
	07165	74.00		03904	110.8		03806	115.8
	05240	84.20		03821	112.2	32° .30	2052	44.58
	03551	106.9	(pl. p.)	03738	114.2		1870	47.93
	03284	113.6	25° .00	07260	83.25		1675	52.20
22° .80	2061	42.20		06685	86.40		1479	57.15
	1877	45.40		06090	89.95		1297	62.85
	1683	49.26		05700	92.60		1109	96.95
	1480	53.90		05330	95.30		09145	78.60
	1293	59.10		04948	98.45		07220	89.70
	1110	65.15		04551	102.5		05255	105.4
	09145	72.55		04376	104.7		04249	118.1

T A B L E IV.

Mixture $x = 0,1990$. Isothermal lines.

Temp	Volume 0,0.	Pressure.	Temp	Volume 0,0.	Pressure	Temp	Volume 0,0	Press.
15°.35	2960	31.34	15° 35 (cont.)	<u>05180</u>	105 9	22°.80 (cont.)	1316	63.20
	2700	33.84		<u>04552</u>	117 4		1082	72.85
	2423	37.27	20°.90	07810	89 15		09025	82.45
	2142	41.26		07465	91.75		07115	96.05
	2031	43.03		07105	94.55		05255	116.0
	1844	46.58		06735	97 70		05140	117.6
	1653	50.75		<u>06335</u>	101 5		05070	118.8
	1461	55 70		<u>05965</u>	105.1		04965	120.6
	1276	61.55		<u>05575</u>	109.6	31° 80	2018	47.00
	1090	68.90		<u>05210</u>	114 2		1838	50 90
	1051	70.55	22°.20	06715	99.05		1651	55.50
	1016	72.10		06340	102.5		1465	61.15
	09745	73.95		<u>05965</u>	106.4		1275	68.20
	09385	75.80		<u>05585</u>	110 9		1090	77.00
	09020	77.75		<u>05240</u>	115 4		09020	88.10
	<u>08605</u>	79 75	22° 80	2030	44.79		07105	104.1
	<u>08275</u>	81 40		1833	48.78		05965	117.1
	<u>07860</u>	83.60		1651	53.00			
	<u>07125</u>	88.20		1461	58.35			

For the three mixtures the volumes and the pressures at the beginning and the end of the condensation were read on the $p-v-t$ diagrams, constructed by means of the data in the tables I, III and IV, and of which only one was given in the previous communication; these volumes and pressures are given in table V. Only for $x = 0,0494$ the end of the condensation was observed for temperatures at some distance from the critical point of contact; for $x = 0,0995$ the increase of pressure during the condensation was so great that for temperatures a little below the plaitpoint-temperature observations of the end of the condensation could not be made. In the case of the mixture $x = 0,1990$ no observations could be made on the liquid-branch of the border-curve.

T A B L E V.

Border-curves.

Temp.	Begin. condensation.		End condensation.	
	Volume.	Pressure.	Volume.	Pressure.
$x = 0,0494$				
15°.30	0.01111	57.20	0.002543	102.9
21°.50	0.008545	67.90	2892	100.0
26°.80	5850	81.75	3833	93.20
27°.10	5625	83.00	4063	91.85
(pl. p. t.) 27°.30	540	84.6	427	90.5
27°.50 (cr. p. of cont. temp.)	48	87.4	48	87.4
$x = 0,0995$				
16°.90	0.009440	67.80		
22°.80	6890	83.20		
24°.20	6255	87.90	0.003737	114.3
(pl. p. t.) 25°.00	565	92.9	412	108.4
25°.45 (cr. p. of cont. temp.)	47	101	47	101
$x = 0,1990$				
15°.35	0.008795	79.10		
20°.90	6335	101.5		
22°.20	560	110.9		
± 22°.8 (cr. p. of cont. temp.)	± 50	± 120		

Fig. 4 shows a graphical representation of table V. In this diagram t is abscissa, p ordinate and x parameter. As will be known this diagram consists of the vapour-pressure curves of the two pure substances, connected by the plaitpoint curve; in between are the loop-

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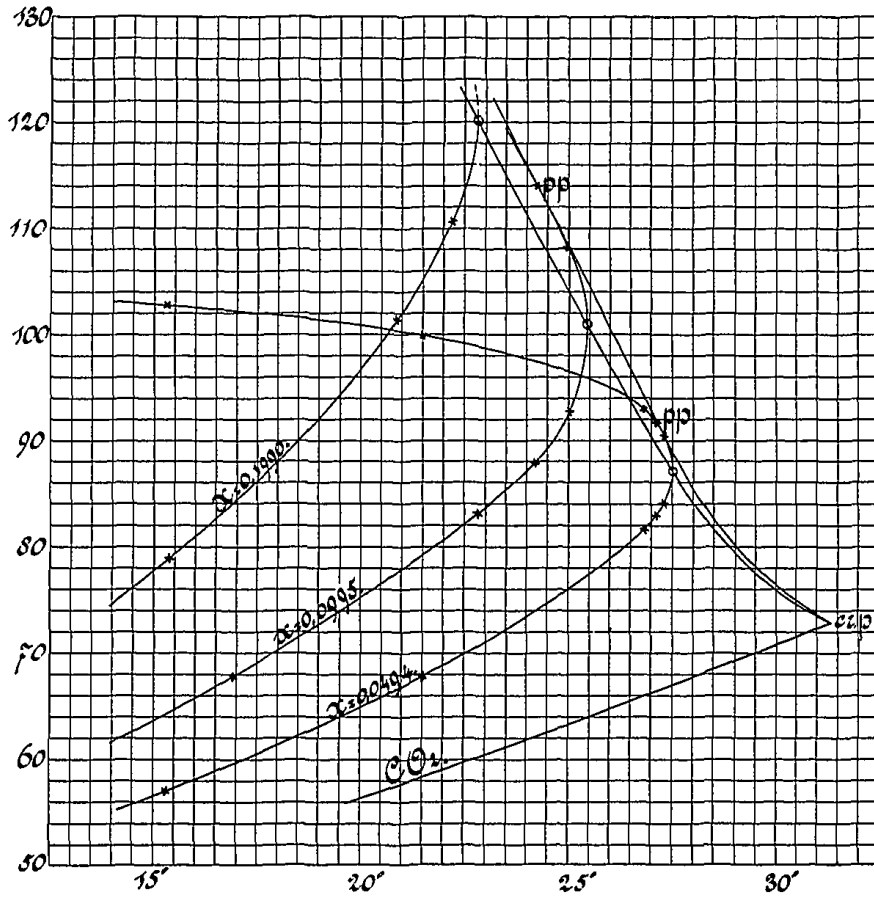


Fig. 4.

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shaped border-curves of the mixtures which touch the plaitpoint curve in the plaitpoint. In the critical point of contact the tangent is parallel to the p -axis.

In this figure I have also drawn the vapour-pressure curve of pure carbonic acid, as determined by AMAGAT ¹⁾. By connecting the plaitpoints with the critical point of carbonic acid: $t = 31^{\circ},35$, $p = 72,9$ atm., we obtain a part of the plaitpoint curve. This plaitpoint curve rises steeply. It is probable that it also rises steeply from the critical point of hydrogen: $t = -234^{\circ},5$, $p = 20$ atm. ²⁾.

The course of the plaitpoint curve found thus agrees with KUNDT's ³⁾ observations on the influence of the pressure of compressed hydrogen on the surface-tension of liquids in contact with it, if they are understood as VAN ELDIK ⁴⁾ has explained in his doctor-paper. VAN ELDIK points out that the pressure at which the surface-tension would become zero is the plaitpoint pressure which corresponds to the temperature of observation. Moreover he has investigated the law of the surface-tension as a function of the pressure. He concludes that the plaitpoint pressure for hydrogen and ether at the ordinary temperature would be no less than 750 atm, from which follows a steep rising of the plaitpoint curve for ether and hydrogen on the etherside.

The experiments communicated in this paper are not the first that have been made on the critical phenomena in mixtures of hydrogen and carbonic acid. CAILLETET ⁵⁾ has made experiments with a mixture containing about 5 mol. of CO₂ on 1 mol. of H₂. They were undertaken in order to show, with a view to JAMIN's explanation of the critical phenomena, that by increase of hydrogen-pressure the carbonic acid is bound to disappear. CAILLETET has found that this really occurred and this at a higher pressure as the temperature was lower; for instance at 245 atm. at 15°, and at 153 atm. at 25°. But when we have to construct the border-curves and the plaitpoint-curve we can set no value upon these observations, as CAILLETET did not secure the equilibrium of the phases by stirring; and only since KUENEN ⁶⁾ has avoided the appearing of

¹⁾ Comptes rendus, 114, p. 1093, 1892.

²⁾ See OLSZEWSKI, Wied. Ann, 56, p. 133, 1895.

³⁾ Ber. d. Kon. Acad. v. Wiss. Berlin, 21 Oct. 1880.

⁴⁾ VAN ELDIK, Dissertation, Leiden 1893. Communic. Leiden N^o. 39.

⁵⁾ Comptes rendus, 96, p. 1448, 1883.

⁶⁾ KUENEN, Dissertation, Leiden 1892. Communic. Leiden N^o. 4.

phenomena of retardation, the experimental investigation of the critical phenomena in mixtures has led to reliable results. That phenomena of retardation give rise to important deviations is shown by the fact that CAILLETET has observed condensation at 25° , whereas my experiments show that the critical point of contact of his mixture after equilibrium of the phases has been obtained, ought to be found at about 23° .

Physics. — „*Measurements on the change of pressure by substitution of one component by the other in mixtures of carbonic acid and hydrogen*”. By Dr. J. VERSCHAFFELT. (Communication N^o. 47 from the Physical Laboratory at Leiden by Prof. H. KAMERLINGH ONNES. (*Continued.*))

§ 1. *Change of pressure by substitution.*

Tables VI—X contain the results of the determination of isothermals in mixtures with a still larger quantity of hydrogen than those treated of in the former communications. In these mixtures no condensation-phenomena appeared in the area observed; and so they cannot reveal to us anything more about the further course of the plaitpoint-curve, but in connection with the results communicated before, they show us in what way, at a given temperature and a given volume, the pressure of the mixture depends on its composition.

With the aid of all the determinations communicated we have first calculated the coefficients of pressure, the values of which for different compositions and volumes are given in Table XI. Then we have calculated for one and the same temperature (18° C.) the isothermals of the different mixtures and represented them in a new diagram, the $p-v-x$ diagram. On this diagram we have read the pressures belonging to one and the same volume for different mixtures: table XII contains the values read in this way for some volumes.

As will be explained in § 2 we have chosen the units of volume for the different mixtures so that 1 c.m.³ of each mixture contains the same number of molecules, when the volumes of these mixtures expressed in the units accepted for this purpose, have the same value. Table XII therefore shows the change in pressure when, starting from one of the two substances in pure condition, we gradually substitute the molecules of this substance for an equal number of molecules of the other substance.