

Citation:

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Chemistry. — “*The Temperature-coefficients of the free Surface-energy of Liquids, at Temperatures from -80° to 1650° C.: IV. Measurements of some Aliphatic and Aromatic Ethers.*”
By Prof. F. M. JAEGER and JUL. KAHN. (Communicated by Prof. P. VAN ROMBURGH.)

§ 1. In this communication the results obtained in the measurements of the free surface-energy of a number of ethers, are recorded by us. With respect to the purification-methods and the determination of the specific weights, we can refer to communication II of this series¹⁾; also the arrangement of the data and the significance of the diagrams are completely the same as indicated before. This series includes the following aliphatic terms:

Amylacetate; *Diethyl-Oxalate*; *Diethylmalonate*; *Diethylbromomalonate*; *Diethyl-Ethylbenzylmalonate*; *Dimethyl* and *Diaethyltartrates*; and the following aromatic substances:

ortho-Nitroanisol; *Methyl-, Ethyl-, and Phenyl-Salicylates*; *Methyl-Cinnamylate*.

I.

Amylacetate: $CH_3 \cdot CO \cdot O(C_5H_{11})$.					
Temperature in $^{\circ}$ C.	Maximum Pressure H		Surface- tension γ in Erg. pro cm^2 .	Specific gravity $d_{4^{\circ}}$	Molecular Surface- energy μ in Erg. pro cm^2 .
	in mm. mer- cury of 0° C.	in Dynes			
-70°	1.099	1465.8	34.6	0.968	907.8
-21	0.915	1220.1	28.7	0.918	780.0
0	0.850	1132.6	26.6	0.896	734.9
25.8	0.771	1028.6	24.1	0.869	679.5
46	0.712	949.4	22.2	0.847	636.8
66.5	0.653	870.3	20.3	0.827	591.6
86.5	0.600	799.5	18.6	0.808	550.5
106	0.549	732.9	17.0	0.790	510.8
125	0.506	674.6	15.6	0.774	475.1
146	0.461	614.6	14.2	0.752	440.9

Molecular weight: **130.11**. Radius of the Capillary tube: 0.04803 cm.
Depth: 0.1 mm.

The boilingpoint of the carefully dried compound lies at 148.04° C.;
at this temperature γ is **14.0** Erg. pro cm^2 .

¹⁾ F. M. JAEGER and M. J. SMIT, These Proc. (1914) p. 365.

II.

Diethyl-Oxalate: $(C_2H_5)O.CO.CO.O(C_2H_5)$.					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension χ in Erg. pro cm^2 .	Specific gravity d_{40}°	Molecular Surface- energy μ in Erg. pro cm^2 .
	in mm. mer- cury of $0^{\circ}C$	in Dynes			
-20.7	1.177	1569.9	37.0	1.139	941.0
0	1.111	1482.5	34.9	1.110	903.0
26	1.025	1366.5	32.1	1.074	848.8
46	0.952	1278.4	30.0	1.050	805.5
66.7	0.896	1195.1	28.0	1.025	764.0
86.5	0.818	1091.0	25.5	1.001	706.8
106	0.768	1024.4	23.9	0.977	673.3
125	0.717	955.9	22.2	0.954	635.4
145.5	0.650	866.6	20.1	0.930	581.1
166	0.568	757.3	17.6	0.905	521.8
184	0.478	637.3	14.6	0.883	440.0

Molecular weight: 146.08. Radius of the Capillary tube: 0.04803 cm.
Depth: 0.1 mm.

The substance boils at 99.5 C. constantly, under a pressure of about 12 mm. In solid carbon dioxide and alcohol it soon solidifies, and melts at -41.05 C. Above 160° C. the ether seems to decompose slowly.

III.

Diethylmalonate: $(C_2H_5)O.CO.CH_2.CO.O(C_2H_5)$.					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension χ in Erg. pro cm^2 .	Specific gravity d_{40}°	Molecular Surface- energy μ in Erg. pro cm^2 .
	in mm. mer- cury of $0^{\circ}C$.	in Dynes			
-19.9	1.237	1649.2	35.5	1.095	985.3
0.7	1.167	1555.8	33.5	1.075	941.2
8.5	1.142	1523.2	32.9	1.068	928.4
25.2	1.077	1435.9	31.0	1.050	884.8
34.5	1.044	1391.9	30.0	1.041	861.2
50.1	0.994	1325.2	28.5	1.025	826.6
69.2	0.920	1226.8	26.3	1.005	772.9
102	0.804	1071.8	23.0	0.969	692.5
124.5	0.723	963.9	20.6	0.945	630.7
144	0.660	880.2	18.8	0.924	584.3
148.7	0.649	866.4	18.5	0.919	577.1
171	0.571	761.6	16.2	0.896	513.9

Molecular weight: 160.1. Radius of the Capillary tube: 0.04385 cm.
Depth: 0.1 mm.

The compound boils constantly at 197.03 C.; after crystallisation, it melts at -50° C. At 25° C. the specific gravity was 1.0518; at 50° C.: 1.0254. At the boilingpoint the value of χ is: 13.7 Erg pro cm^2 .

IV.

Diethyl-Bromomalonate: $(C_2H_5)O \cdot CO \cdot CHBr \cdot CO \cdot O(C_2H_5)$.					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension γ in Erg. pro cm 2 .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm 2 .
	in mm. mer- cury of $0^{\circ}C$.	in Dynes			
-20.7	1.250	1666.5	39.1	1.464	1168.2
0	1.165	1553.2	36.4	1.436	1101.6
26	1.065	1419.9	33.2	1.401	1021.5
45.5	0.999	1332.5	31.1	1.375	968.9
66.6	0.943	1257.6	29.3	1.347	925.4
86.5	0.896	1195.1	27.8	1.320	890.0
106.5	0.853	1136.8	26.4	1.293	856.9
126	0.815	1086.8	25.3	1.266	832.8
146	0.780	1039.9	24.2	1.240	807.7

Molecular weight: 239.09. Radius of the Capillary tube: 0.04803 cm.;
Depth: 0.1 mm.

Under reduced pressure (ca. 20 mm.) the substance boils constantly at $121^{\circ}C$.; at $-54^{\circ}C$. it becomes a jelly, but does not crystallize. Above $150^{\circ}C$. it begins to be tinged brownish, apparently by beginning deposition. The specific weight at $25^{\circ}C$. is: 1.4022; at $50^{\circ}C$.: 1.3688; at $75^{\circ}C$.: 1.3359; At $t^{\circ}C$.: $d_{40} = 1.4361 - 0.001356t + 0.0000004t^2$.

V.

Diethyl-Ethylbenzylmalonate: $(C_2H_5)O \cdot CO \cdot C(C_2H_5)(C_7H_7) \cdot CO \cdot O(C_2H_5)$.					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension γ in Erg. pro cm 2 .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm 2 .
	in mm. mer- cury of $0^{\circ}C$.	in Dynes			
-20.2	(2.174)	(2898.4)	(68.8)	1.086	(2775.0)
0	1.241	1654.5	39.0	1.072	1586.7
26	1.121	1494.9	35.2	1.052	1450.1
45.5	1.050	1399.9	32.9	1.035	1370.2
66.6	0.984	1311.7	30.8	1.016	1298.7
86.7	0.940	1253.4	29.4	1.001	1252.1
106	0.901	1201.2	28.1	0.986	1208.8
126	0.853	1136.8	26.6	0.971	1156.0
146	0.805	1073.2	25.1	0.956	1102.2
166	0.759	1011.9	23.6	0.941	1047.3
184	0.690	920.3	21.4	0.927	959.2
206.5	0.637	849.5	19.7	0.911	893.3

Molecular weight: 278.18. Radius of the Capillar tube: 0.04803 cm.
Depth: 0.1 mm.

Under 12 mm. pressure, the substance boils constantly at $189^{\circ}C$.; at $-79^{\circ}C$. the liquid becomes a feebly opalescent glass. Already at $-20^{\circ}C$. the viscosity is enormous, and at $0^{\circ}C$. again very great. The grow of the gas-bubbles at $0^{\circ}C$. lasted about 40 seconds. The specific gravity at $25^{\circ}C$. is: $d_{40} = 1.0531$; at $50^{\circ}C$.: 1.0322; at $75^{\circ}C$.: 1.0098. At $t^{\circ}C$. in general: $d_{40} = 1.0725 - 0.000746t - 0.0000012t^2$.

VI.

Dimethyltartrate: $(CH_3)_2O.CO.CH(OH).CH(OH).CO.O(CH_3)_2$.					
Temperature in ° C.	Maximum Pressure H		Surface- tension in Erg. pro cm ² .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm ² .
	in mm. mer- cury of 0° C.	in Dynes			
45°	1.490	1986.6	43.2	1.306	1144.6
70.7	1.405	1873.1	40.7	1.281	1092.2
90.7	1.340	1786.5	38.8	1.261	1052.2
116.2	1.255	1673.2	36.3	1.235	998.2
135.5	1.200	1599.5	34.7	1.216	964.1
*159.6	1.046	1395.0	32.7	1.192	920.7
*190	0.974	1299.2	30.4	1.151	876.1
*210.3	0.929	1238.5	28.9	1.131	842.7

Molecular weight: 178.08. Radius of the Capillary tube: 0.04439 cm.; in the observations indicated with *, it was: 0.04803 cm.
Depth: 0.1 mm.

The compound boils under 12 mm. pressure, at 180° C. constantly; at -79° C. it becomes a glass, which crystallizes with extreme slowness; the solid substance melts at +48° C. Even at 25° C. the ether is so viscous, that no reliable measurements were possible.

VII.

Diethyltartrate: $(C_2H_5)_2O.CO.CH(OH).CH(OH).CO.O(C_2H_5)_2$.					
Temperature in ° C.	Maximum Pressure H		Surface- tension μ in Erg. pro cm ² .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm ² .
	in mm. mer- cury of 0° C.	in Dynes			
25°	1.317	1755.5	37.6	1.210	1155.4
45.3	1.241	1654.4	35.4	1.191	1099.3
74.3	1.134	1512.0	32.3	1.164	1018.5
91.1	1.082	1443.0	30.8	1.147	980.8
110.1	1.024	1364.9	29.1	1.129	936.5
134.7	0.948	1263.8	26.9	1.105	878.2
150.1	0.899	1199.4	25.5	1.091	839.6
160.3	0.872	1162.7	24.7	1.081	818.2
192.7	0.765	1019.9	22.0	1.050	743.1
212.7	0.716	955.9	20.2	1.032	690.2

Molecular weight: 206.11. Radius of the Capillary tube: 0.04352 cm.
Depth: 0.1 mm

Under circa 16 mm. pressure, the boilingpoint is 166.5 C. At -79° the liquid becomes glassy, and crystallizes very slowly at -20° C.: only after 5 or 6 hours all has got crystalline. The meltingpoint is 15° C. At 0° and lower temperatures the liquid is too viscous, to make reliable measurements possible.

Molecular Surface-energy
in Erg pro cm².

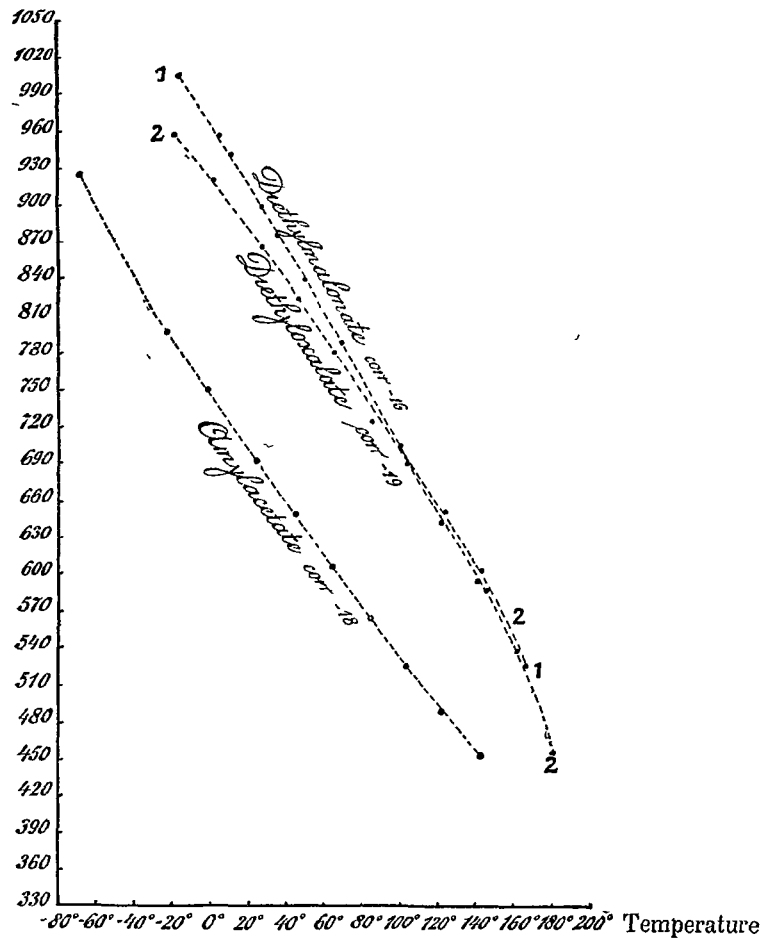


Fig. 1.

Molecular Surface-energy
in Erg pro cm².

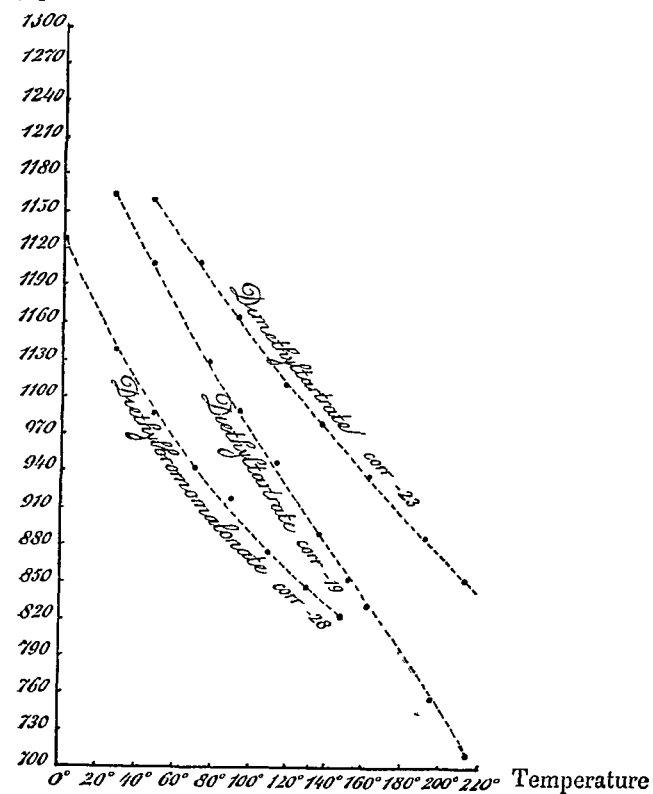


Fig. 2.

VIII.

ortho-Nitro-Anisol: $(CH_3) O. C_6H_4. (NO_2)$.					
(1) (2)					
Temperature in °C.	Maximum Pressure H		Surface- tension γ in Erg. pro cm ² .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm ²
	in mm. mer- cury of 0° C.	in Dynes			
0°	1.613	2150.4	50.8	1.273	1237.6
25.4	1.537	2048.8	48.4	1.247	1195.4
44.9	1.480	1973.8	46.6	1.227	1165.1
70.1	1.390	1853.0	43.7	1.202	1106.1
85.3	1.340	1786.4	42.1	1.187	1074.6
117	1.227	1635.8	38.4	1.156	997.6
138.2	1.160	1546.5	36.3	1.135	947.3
156	1.109	1478.2	34.7	1.118	921.8
172	1.043	1390.8	32.6	1.102	874.4
191.5	0.968	1290.5	30.2	1.083	819.4
212	0.850	1133.0	26.5	1.062	728.8

Molecular weight: 153.07. Radius of the Capillary tube: 0.04803 cm.
Depth: 0.1 mm.

The substance boils constantly at 272° C.; at - 20° it solidifies, and melts at + 10° C. Above 165° C. a slow decomposition begins. The specific weight at 25° C. is: $d_{40} = 1.2472$; at 50° C.: 1.2218; at 75° C.: 1.1970; at t° generally: $d_{40} = 1.2732 - 0.001052t + 0.00000048t^2$.

IX.

Methylsalicylate: $C_6H_4(OH). CO. OCH_3$.					
(1) (2)					
Temperature in °C.	Maximum Pressure H		Surface- tension γ in Erg. pro cm ² .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm ² .
	in mm. mer- cury of 0° C.	in Dynes			
-19.8	1.518	2023.8	44.2	1.220	1102.9
0.3	1.436	1914.8	41.8	1.202	1053.4
* 25	1.372	1829.0	39.1	1.179	998.1
** 45	1.303	1737.2	37.1	1.158	956.4
** 74.7	1.193	1590.1	33.9	1.128	891.7
* 94	1.124	1498.2	31.9	1.110	848.3
114.5	1.031	1374.2	29.8	1.092	801.2
135.2	0.968	1290.5	27.9	1.073	758.4
160.5	0.867	1155.9	24.9	1.050	686.7
192.9	0.760	1013.7	21.8	1.021	612.6
212.2	0.696	928.1	19.8	1.003	562.9

Molecular weight: 152.06. Radius of the Capillary tube: 0.04439 cm.;
in the observations, indicated by *, it was 0.04352 cm.
Depth: 0.1 mm.

The substance boils at 217.6° C. constantly; it can be undercooled as far as - 50° C., and crystallizes to a solid mass, which melts at - 16° C. At the boilingpoint γ is: 19.3 Erg. pro cm². The density at 25° C. is: $d_{40} = 1.1787$; at 50° C.: 1.1541; at 75° C.: 1.1285. At t° C.: $d_{40} = 1.2023 - 0.000924t - 0.0000008t^2$.

X.

Ethylsalicylate: $C_6H_4(OH) \cdot CO \cdot O(C_2H_5)$					
(1) (2)					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension γ in Erg. pro cm^2 .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm^2 .
	in mm. mer- cury of $0^{\circ}C$.	in Dynes			
0 ^o	1.346	1794.5	39.1	1.154	1073.8
* 25	1.275	1700.4	36.3	1.130	1011.0
* 45.1	1.206	1608.5	34.3	1.110	966.7
* 74.1	1.110	1479.8	31.5	1.082	903.0
* 94.3	1.047	1395.9	29.7	1.063	861.6
115.1	0.963	1284.1	27.8	1.043	816.7
135.2	0.906	1207.4	26.1	1.024	776.2
159.8	0.828	1103.8	23.8	1.001	718.6
193	0.723	964.2	20.7	0.980	633.9
212.5	0.669	892.1	19.1	0.962	592.2

Molecular weight: 166.08. Radius of the Capillary tube: 0.0439 cm. in the observations, indicated with * it was: 0.04352 cm.
Depth: 0.1 mm

The substance boils at 231.2 C. constantly; at $-20^{\circ}C$. it solidifies and melts at ca. $-10^{\circ}C$. At the boilingpoint γ is 17.6 Erg pro cm^2 . The specific weight at $25^{\circ}C$ is: 1.1298; at $50^{\circ}C$.: 1.1053; at $75^{\circ}C$.: 1.0806. At t° it is calculated from: $d_{40} = 1.1541 - 0.000968 t - 0.00000016 t^2$.

XI.

Phenylsalicylate (Salol): $C_6H_4(OH) \cdot CO \cdot O(C_6H_5)$					
(1)					
Temperature in $^{\circ}C$.	Maximum Pressure H		Surface- tension γ in Erg pro cm^2 .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm^2 .
	in mm. mer- cury of $0^{\circ}C$.	in Dynes			
-20.1°	(2.613)	(3482.8)	(76.5)	1.221	(2396.4)
0	1.571	2095.1	45.7	1.202	1446.7
25	1.485	1980.6	43.2	1.179	1385.2
45	1.419	1892.3	41.2	1.160	1305.1
72	1.335	1779.7	38.7	1.136	1272.0
90.1	1.272	1695.8	36.8	1.120	1221.1
116	1.193	1590.4	34.5	1.098	1160.0
135	1.132	1509.3	32.7	1.078	1130.3
* 160	0.971	1295.0	30.3	1.055	1046.3
* 189.8	0.890	1186.7	27.7	1.026	974.5
* 211.6	0.846	1128.5	26.3	1.006	637.5

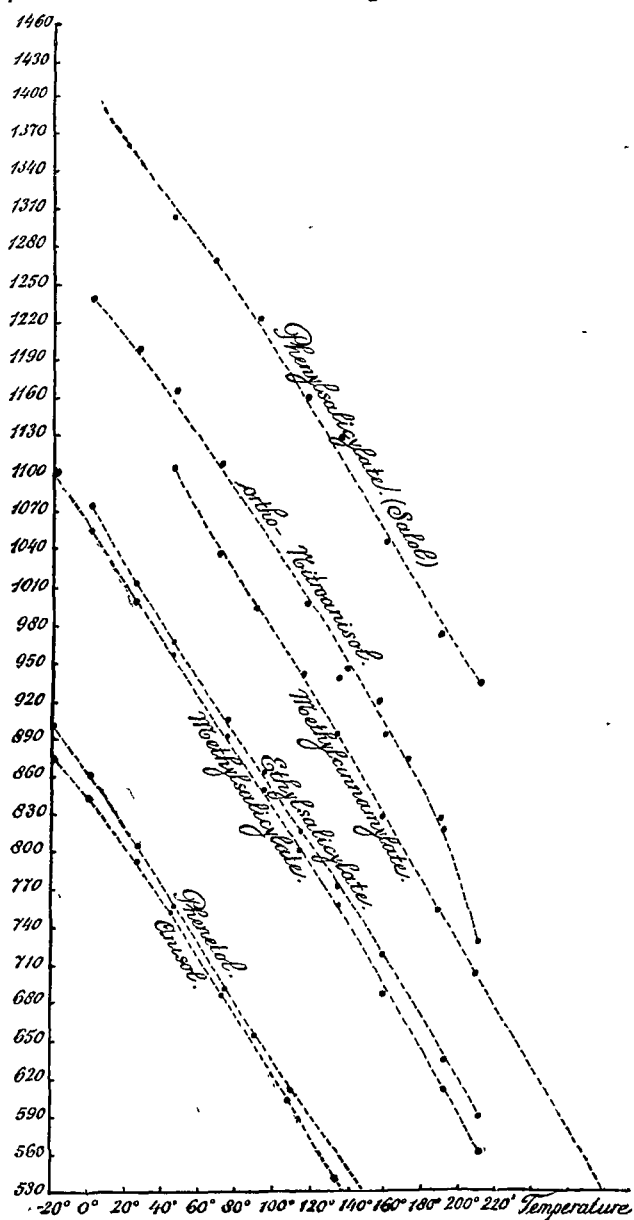
Molecular weight: 214.08. Radius of the Capillary tube: 0.04439 cm.; in the observations, indicated with * it was: 0.04803 cm.
Depth: 0.1 mm.

Under 12 mm. pressure, the salol boils at $173^{\circ}C$.; at $-33^{\circ}C$. it crystallizes spontaneously, and melts at $+42^{\circ}C$. It can be under-cooled to a very high degree, and possesses a small velocity of crystallisation. At $35^{\circ}C$. the specific gravity is: 1.1697; at $50^{\circ}C$.: 1.1553; at $75^{\circ}C$.: 1.1330

Some other derivatives of aromatic phenoles: *Anisol*, *Phenetol*, *Anethol*, *Guajacol*, *Resorcine-Mono-*, and *Dimethylethers*; *Hydrochinon-Dimethylether* have been described before by the first of us¹⁾. The temperature-coefficients of these compounds are however also reviewed in the present communication, because they were not mentioned in the one referred to. (Vid. also the preceding communications.)

Molecular Surface energy
in Erg pro cm².

Fig. 3.



¹⁾ F. M. JAEGER, These Proc., Comm. I. (1914) p. 354 seq.

XII.

Methyl-Cinnamate: $C_6H_5 \cdot CH : CII \cdot CO \cdot O(CH_3)$.					
Temperature in °C.	Maximum Pressure H		Surface- tension χ in Erg. pro cm ² .	Specific gravity d_{40}	Molecular Surface- energy μ in Erg. pro cm ² .
	in mm. mer- cury of 0° C.	in Dynes			
45°	1.329	1771.8	38.7	1.062	1105.2
71	1.230	1639.8	35.8	1.038	1038.1
90.6	1.166	1554.5	33.9	1.020	994.5
116.2	1.092	1455.2	31.7	0.997	944.2
135.4	1.024	1365.2	29.7	0.980	894.9
* 159.7	0.868	1157.6	27.1	0.958	829.0
* 190.5	0.777	1035.9	24.2	0.930	755.1
* 210.9	0.712	949.4	22.1	0.911	699.1

Molecular weight: **162.08**. Radius of the Capillary tube: **0.04433** cm.;
in the observations, indicated by * it was:
0.04803 cm.
Depth: 0.1 mm.

The ether boils at 253.°5 C., and melts at 36.°5 C. At the boiling-
point χ is: **18.6** Erg. pro cm². The specific gravity at 35° C. is:
 $d_{40} = 1.0700$; at 50° C.: 1.0573 at 75° C.: 1.0340.

§ 3. Values of the Temperature-coefficients of the molecular surface-energy μ of the studied compounds.

<i>Amylacetate.</i>		<i>Diethyl-Oxalate.</i>	
Temperature-interval: $\frac{\partial \mu}{\partial t}$ in Erg:		Temperature-interval: $\frac{\partial \mu}{\partial t}$ in Erg:	
between — 70° and — 21°	2,59	between — 20° and 0°	1,8
— 21° and + 66°	2,14	0° and 66°	2,02
66° and 106°	2,03	66° and 106°	2,2
106° and 148°	1,73	106° and 146°	2,3
		146° and 184°	3,6
		Above 146° a decomposition seems slowly to set in.	
<i>Diethylmalonate.</i>		<i>Diethylbromomalonate.</i>	
between — 20° and + 171°	2,52	between — 21° and 0°	3,20
		0° and 26°	3,08
		26° and 46°	2,67
		46° and 67°	2,04
		67° and 86°	1,75
		86° and 106°	1,63
		106° and 126°	1,35
		126° and 146°	1,23

Diethyl-Ethylbenzylmalonate.

Temperature-interval:	$\frac{\partial \mu}{\partial t}$ in Erg:
between -20° and 0°	cannot be determined independently of the viscosity.
0° " 26°	5,2
26° " 66°	3,7
66° " 106°	2,25
106° " 126°	2,6
126° " 146°	2,7
146° " 166°	2,75
166° " 206°	3,85

Above 166° a slow decomposition begins to make itself perceptible.

o-Nitroanisol.

between 0° and 45°	1,61
45° " 172°	2,29
172° " 192°	2,82
192° " 212°	4,45

Above 170° a gradual decomposition sets in, which proceeds very slowly

Ethylsalicylate.

between 0° and 212°	2,23
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Methylcinnamylate.

between 45° and $210^{\circ},9$	2,44
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Phenetol.

between -12° and 0°	2,0
0° " $74^{\circ},3$	2,29
74° " 160°	2,13

The curve is almost a straight line, with $\frac{\partial \mu}{\partial t} = 2,14$.

Guajacol.

between 26° and 146°	2,17
146° " 206°	2,66

Dimethyltartrate.

Temperature-interval:	$\frac{\partial \mu}{\partial t}$ in Erg:
between 45° and 117°	2,08
117° " 160°	1,77
160° " 210°	1,53

Diethyltartrate.

between 25° and $74^{\circ},3$	2,75
74° " 213°	2,35

Methylsalicylate.

between $-19^{\circ},8$ and 212°	2,30
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Phenylsalicylate. (Salol).

between -20° and $211^{\circ},6$	2,43
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Anisol.

between -21° and $+45^{\circ}$	1,88
45° " 91°	2,14
91° " 151°	2,63

Anethol.

between $24^{\circ},7$ and $75^{\circ},1$	2,53
75° " 213°	2,25

Resorcine-Monomethylether.

between -20° and 0°	cannot be determined independently of the viscosity.
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0° " 26°	4,3
26° " 46°	2,45
46° " 184°	1,82
184° " 206°	2,97

Above 184° a decomposition sets in slowly.

<i>Resorcine-Dimethylether.</i>		<i>Hydrochinon-Dimethylether.</i>	
<i>Temperature-interval:</i>	$\frac{\partial \mu}{\partial t}$ in Erg:	<i>Temperature-interval:</i>	$\frac{\partial \mu}{\partial t}$ in Erg:
between -22° and 0°	2,83	between 66° and 106°	2,11
0° " 210°	2,25	106° " 166°	2,46
		166° " 206°	2,88
		Up to 166° , this ν - t -curve coincides practically with that of <i>guajacol</i> and of <i>resorcine-dimethylether</i> .	
<i>Pyridine.</i>		<i>o-Picoline.</i>	
between -79° and -20°	1,79	between -70° and $-20^{\circ},7$	2,83
-20° " $+25^{\circ}$	2,04	$-20^{\circ},7$ " $+126^{\circ}$	2,02
25° " 92°	1,60		
<i>Chinoline.</i>			
between -21° and $+45^{\circ},2$	1,92		
45° " 115°	2,10		
115° " 230°	2,33		

§ 5. Also for these substances one can state, that a decomposition of the compound causes an extraordinarily rapid decrease of the values for χ or μ with increasing temperature: $\frac{\partial \mu}{\partial t}$ becomes much larger in such cases with rising temperature. Furthermore it can be seen from the cases of *salol*, *diethylbenzylmalonate*, *resorcine-monomethylether*, etc., that an extraordinarily great viscosity of the liquid can appreciably diminish the accuracy of the measurements; however the case of *dimethyltartrate* on the contrary proves, that sometimes reliable results can be obtained, even with very high values of the internal friction.

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of the University.

Chemistry. — “*The Temperature-coefficients of the free Surface-energy of Liquids, at Temperatures from -80° to 1650° C.: V. Measurements of homologous Aromatic Hydrocarbons and some of their Halogenderivatives*”. By Prof. Dr. F. M. JAEGER. (Communicated by Prof. P. VAN ROMBURGH.)

§ 1. In order to answer also the question of an eventual dependence between the chemical constitution of liquids and the values of their free surface-energy and of its temperature-coefficient, in