

XLVII.—*The Vapour-pressures of Quinoline.*

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FOUR years ago Dr. Ramsay and I communicated to the Society (Trans., **47**, 640) the results of determinations of the vapour-pressures of chlorobenzene, bromobenzene, aniline, methyl salicylate, and bromonaphthalene, and in the following year (*ibid.*, **49**, 37) of mercury. We have constantly made use of these liquids, as well as of carbon bisulphide and ethyl alcohol, the vapour-pressures of which have been determined by Regnault, for obtaining constant known temperatures—the tube or vessel to be heated being placed in the vapour of the liquid boiling under known pressure. This method of heating possesses the two great advantages that the temperature can be kept constant for any length of time, or it can be altered by a definite amount in a very few minutes.

With the exception of methyl salicylate, these liquids have given excellent results, but the salicylic ether is open to several objections; it is not easy to obtain a product of constant boiling point; the ether is hygroscopic, and the moisture, besides being difficult to remove, causes slow hydrolysis, so that the liquid, after being used for some time, is always found to be contaminated with salicylic acid. Good results have, indeed, been obtained with methyl salicylate, but its employment has involved considerable loss of time owing to the necessity for frequent redistillation of the liquid, besides the preliminary very tedious fractionation. It appeared advisable, therefore, if possible, to substitute some other liquid less open to objection, and it occurred to me that quinoline might give good results. This substance is supplied by Kahlbaum in a pure state at a moderate price; although it is hygroscopic, the water has no action on the compound, and is rapidly expelled on distillation; lastly, the boiling point (237.5°) is not far from midway between those of aniline and bromonaphthalene. Determinations were made with two samples of quinoline, one (K) obtained from Kahlbaum, the other (H) from Messrs. Harrington Brothers of Cork; the second sample required fractionation, but was easily obtained pure, and identical results were obtained with both. In the course of distillation, the following determinations of boiling point were made:—

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	Pressure.	Temperature observed.	Corrected to 760 mm.
K.....	749·2	236·9°	237·55°
H.....	750·4	237·0	237·55
H.....	751·6	237·0	237·5
K.....	758·3	237·4	237·5

Calculated from constants for Biot's formula 237·45°

These determinations agree fairly well with that of Skraup, 237·1° at 746·8 mm., or 237·8° at 760 mm. At low pressures the determinations were made with the apparatus described by Dr. Ramsay and myself; at higher pressures the thermometer was placed in the vapour of the liquid boiling under known pressures.

The temperatures are those of an air thermometer; the pressures are in millimetres of mercury at 0°. The thermometer was one of the two employed in my work on benzene and its halogen-derivatives (p. 489).

Experimental Results.

Series I (K).

Pressure.	Temp.	Pressure.	Temp.	Pressure.	Temp.	Pressure.	Temp.
2·55	75·3°	9·3	102·1°	26·75	126·05°	70·0	152·15°
2·75	78·3	10·65	104·3	29·25	128·6	77·2	154·95
3·25	81·1	11·8	107·4	33·6	132·35	84·8	157·85
3·75	83·05	13·6	110·05	37·4	134·95	101·3	163·05
4·55	86·55	15·6	113·05	42·1	138·1	109·4	165·4
5·50	90·05	17·55	115·9	47·3	141·05	119·7	168·05
6·15	93·65	19·1	118·1	54·15	144·15	131·2	170·95
7·15	96·55	21·3	120·75	58·0	146·65	—	—
8·1	99·45	23·85	123·45	64·1	149·5	—	—

Series II (K).

101·7	162·3°	288·35	198·1°	428·45	213·2°	610·9	228·0°
115·65	166·85	313·95	201·2	460·0	216·05	656·0	231·1
232·55	190·1	339·35	204·1	493·0	218·9	701·7	233·95
249·5	192·65	368·1	207·2	528·8	221·9	745·3	236·65
269·2	195·55	395·8	210·1	568·3	224·95	—	—

Series III (H).

90·2	159·15°	159·8	177·35°	263·9	194·65°	500·0	219·35°
93·25	160·15	171·85	179·6	304·9	200·15	560·3	224·25
107·2	164·6	190·45	183·15	346·8	205·05	621·1	228·45
132·6	171·05	213·8	187·15	400·7	210·2	683·3	232·8
147·55	174·5	233·2	190·2	448·2	214·8	745·3	236·55

The logarithms of these pressures were mapped against temperature, and the logarithms of pressures corresponding to even temperatures read off. Constants for Biot's formula ($\log p = a + b\alpha^t + c\beta^t$) were then calculated, and from these constants the pressures corresponding to definite temperatures—each 10° from 80° to 180° and each degree from 180° to 240° —were recalculated.

The constants for Biot's formula are—

$$\begin{aligned} a &= 0.787142 \\ b &= 2.510713 & \log b &= 0.3997970 \\ c &= -2.806455 & \log c &= 0.4481581 \\ \log \alpha &= 0.00047375 & \log \beta &= 1.99682426 \\ t &= t^\circ \text{C} - 80. \end{aligned}$$

The calculated pressures are given in the following tables:—

I.

Temp.	Pressure.	Temp.	Pressure.	Temp.	Pressure.	Temp.	Pressure
80°	3.10	130°	31.02	180°	172.4	230°	641.3
90	5.21	140	45.49	190	230.4	240	804.6
100	8.48	150	65.31	200	303.4	—	—
110	13.42	160	91.90	210	394.2	—	—
120	20.66	170	126.9	220	505.7	—	—

II.

180°	172.4	196°	272.2	212°	414.7	228°	612.1
181	177.6	197	279.7	213	425.3	229	626.6
182	182.9	198	287.4	214	436.1	230	641.3
183	188.3	199	295.3	215	447.1	231	656.3
184	193.9	200	303.4	216	458.4	232	671.6
185	199.6	201	311.6	217	469.9	233	687.2
186	205.5	202	320.0	218	481.6	234	703.1
187	211.5	203	328.6	219	493.5	235	719.3
188	217.6	204	333.7	220	505.7	236	735.7
189	223.9	205	346.4	221	518.1	237	752.5
190	230.4	206	355.5	222	530.8	238	769.5
191	237.0	207	364.9	223	543.7	239	786.9
192	243.7	208	374.5	224	556.9	240	804.6
193	250.6	209	384.2	225	570.3	—	—
194	257.6	210	394.2	226	584.0	—	—
195	264.8	211	404.3	227	597.9	—	—