

VIII.—A Dynamic Method for measuring Vapour Pressures, with its Application to Benzene and Ammonium Chloride. By Alexander Smith and Alan W. C. Menzies.

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THE simple "submerged bulblet" apparatus for determining vapour pressures, previously described in these *Proceedings* (vol. xxx. p. 437), may be modified to assume the form shown in fig. 1. The substance,

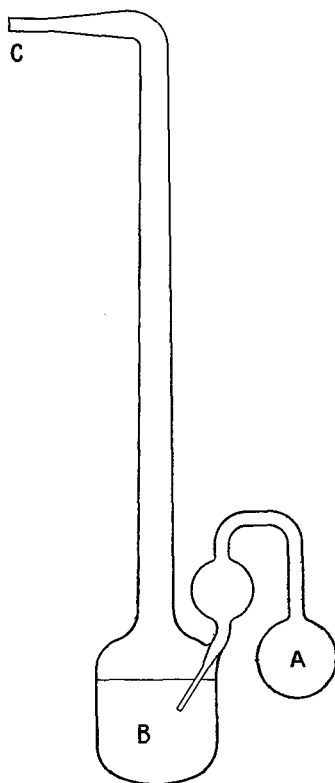


FIG. 1.

solid or liquid, is placed in the bulb A of this dynamic isotenoscope. The advantages gained are, that the new apparatus may be used for high pressures, that the confining fluid (bulb B) is reduced in amount, and that the thermometer is inserted directly in the bath and its bulb

is, therefore, no longer in a region of varying pressures (*Proc.*, p. 436). The bath liquids, the mode of operation, and the corrections for submerged depth and capillary ascension are the same as before. Most of the advantages of this method of determining vapour pressures have already been enumerated (*l.c.* and *Proc.*, 434). The chief of these is that the vapour pressures of solids and of substances which interact with mercury may be determined, since any suitable material may be used as confining fluid. The apparatus has the advantage over the static isotenoscope (*Proc.*, 523) that here the confining fluid may have a considerable vapour pressure of its own, and the substance may be soluble in the confining fluid. Even interaction of the substance with the confining fluid does not necessarily interfere with the success of the measurements.

In the determinations given below, the bath, stirrer, gauge, and platinum resistance thermometer used with the static isotenoscope were employed. The temperatures, on the thermodynamic scale (S.B.P. assumed  $445^{\circ}$ ), are accurate to  $\pm 0.01^{\circ}$  below  $120^{\circ}$  (benzene), and to  $\pm 0.1^{\circ}$  above  $120^{\circ}$  ( $\text{NH}_4\text{Cl}$ ).

*Vapour Pressures of Benzene.*—In previous determinations, which are numerous, guarantees, either of the purity of the benzene or of the exactness of the experimental method, or both, are lacking. Sulphuric acid was used as confining fluid, and the values found were:—

<i>t.</i>	<i>p.</i>	<i>t.</i>	<i>p.</i>	<i>t.</i>	<i>p.</i>
65°	463	85°	879	105°	1542
70	551	90	1018	110	1751
75	650	95	1180	115	1983
80	757.5	100	1348	120	2240

*Vapour Pressures of Ammonium Chloride.*—In the previous determinations of Horstmann the temperatures are uncertain  $\pm 5^{\circ}$ . In those of Ramsay and Young great experimental difficulties were encountered, and considerable divergences exist amongst the data, so that one may doubt whether the errors of  $\pm 1^{\circ}$  at the lower temperatures and  $\pm 2^{\circ}$  at the higher were not considerably exceeded. F. M. G. Johnson's measurements afford no assurance whatever of accuracy. At  $335^{\circ}$ , an error of  $\pm 1^{\circ}$  corresponds to an error of  $\pm 15$  mm. in the pressure. The existing values appear, therefore, to stand in need of confirmation or revision.

In our measurements, the mixture of potassium and sodium nitrates

was used in the bath and as confining fluid. Since the vapour of the salt gave, by interaction with the confining fluid, a continuous stream of nitrous oxide, the method had to be modified, and the pressure at which the gas-evolution reached a minimum was taken. The error on

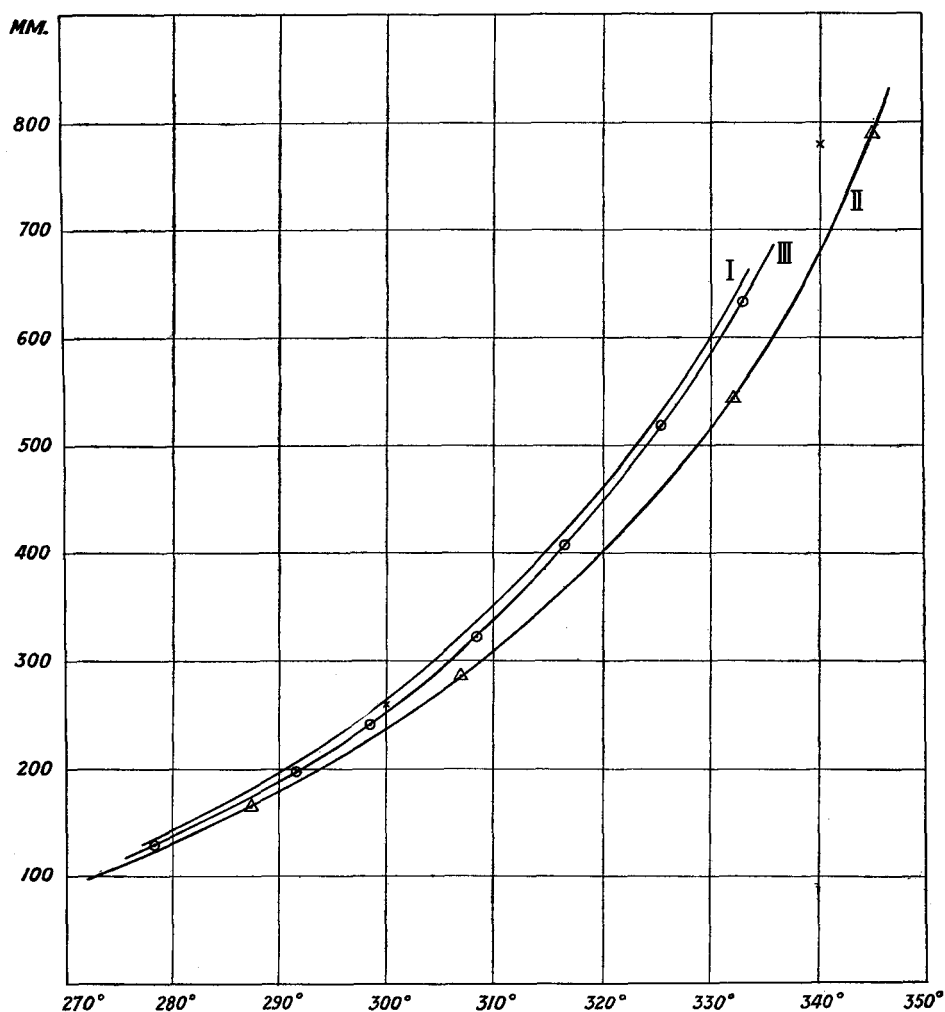


FIG. 2.

this account, which was not over 5 mm., was the greatest involved. The results of Horstmann (H.), Ramsay and Young (R. and Y.), including their final curve as well as the separate series by their static and dynamic methods, Johnson (J.), and ourselves (S. and M.) are given in the following table:—

t.	H.	R. and Y.			J.	S. and M.
		Curve.	Observations.			
			Static.	Dynamic.		
280°	...	143	140·5	147	132	138
290	...	195·5	189	200	178	189
300	259·5	264·5	251	275	237	252
310	...	350	333·5	367	309	336
320	...	460·5	443·5	500	401	447
330	...	599·5	596	675	518	587
333·5	...	661	653	750	566	642
340	778·1	777	759·5	...	678	...

The curves (fig. 2) show the results graphically : I. is R. and Y.'s curve, II. gives Johnson's results, III. gives our own. Two points (×) are from Horstmann's data.

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