

TABLE II  
HEATS OF VAPORIZATION,  $\Delta H_{\text{vap}}$ , AT THE NORMAL BOILING  
POINT OF NON-METALS AND METALS, IN CAL./G.-ATOM

	Non- metals		Metals
H <sub>2</sub>	107.9	Hg	14,137
N <sub>2</sub>	667.5	Na	21,280
O <sub>2</sub>	815	Zn	27,560
F <sub>2</sub>	781	Pb	42,880
Cl <sub>2</sub>	2439	Ag	60,690
Br <sub>2</sub>	3585	Sn	69,400
I <sub>2</sub>	4985	Fe	83,900
S	2300	Zr	139,000
		Mo	142,000
		W	191,000

terminated the vapor pressure up to 1700°K. and finally, thirty years ago, Birch,<sup>10</sup> at Bridgman's laboratory at Harvard, succeeded in determining the critical temperature and pressure. By correlating all the experimental data,<sup>1-3</sup> which show a great (although not perfect) degree of internal consistency, the following values for the critical constants are obtained. They are compared with those obtained from Gates and Thodos' relationship.<sup>11</sup>

	Experimental	Gates and Thodos' relationship
$T_c$ , °K.	1733 ( $\pm 50$ )	1135
$P_c$ , atm.	1587 ( $\pm 50$ )	134
$D_c$ , g./cm. <sup>3</sup>	4.70 ( $\pm 0.20$ )	0.19
$V_c$ , cm. <sup>3</sup> /g.-atom	42.7 ( $\pm 2.0$ )	202.4

Thus, we see that the experimental values for Hg are off by large factors from Gates and Thodos' estimates, particularly for  $D_c$ ,  $V_c$ , and  $P_c$ .

Furthermore, all the experimental evidence ob-

(10) F. Birch, *Phys. Rev.*, **41**, 641 (1932).

(11) Meissner and Redding's estimates are similar.

tained recently at the Institute on the liquid densities of various metals, such as Pb,<sup>12</sup> Ag,<sup>12</sup> Cu,<sup>13</sup> Sn,<sup>14</sup> In,<sup>12</sup> Bi,<sup>14</sup>, and Mg,<sup>13</sup> up to their respective normal boiling points, eliminates still further the possibility that the estimates of Gates and Thodos can be correct. One example will suffice. Our experimental<sup>15</sup> and extrapolated values for the density of liquid and saturated vapor of lead are

	$T$ , °K.	$D_{\text{liq}}$ , g./cm. <sup>3</sup>	$D_{\text{id. gas}}$ , g./cm. <sup>3</sup>
Experimental values	1600	9.361	...
	2024 (N.B.P.)	8.803	0.0012
Extrapolated values	2500	8.167	0.008
	3000	7.49	0.029
	3500	6.79	0.072

If Gates and Thodos' value of 3584°K. for  $T_c$  of Pb is correct, there should be a sudden change in the whole density *vs.* temperature relationship for the liquid and saturated vapor beyond the normal boiling point, in contrast to all known liquids.

The knowledge of true critical temperatures permits us to establish a very simple density *vs.* temperature relationship<sup>1-3</sup> for most of the liquid range of any metal and also the change in surface tension or energy *vs.* temperature for any metal.<sup>16</sup>

It goes without saying that it would be highly desirable to determine the critical temperature of other metals besides mercury; some of them are certainly within reach of modern high temperature experimentation.

(12) *J. Inorg. & Nuclear Chem.*, in press.

(13) *J. Phys. Chem.*, in press.

(14) A. D. Kirshenbaum, Final Report, "High Temperature Inorganic Chemistry," National Science Foundation, Research Grant 15540, Research Institute of Temple University, October 31, 1961.

(15) A. D. Kirshenbaum, J. A. Cahill, and A. V. Grosse, *J. Inorg. & Nuclear Chem.*, **22**, 33 (1961).

(16) A. V. Grosse, *J. Inorg. & Nuclear Chem.*, in press.

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