Chemistry. — *The Exact Measurement of the Specific Heats of Metals at Higher Temperatures. XII. The Specific Heat of metallic Rhenium.* By F. M. JAEGER and E. ROSENBOHM.

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§ 1. Metallic *rhenium* (mpt: ca. 3160° C.), obtained from the *Chemische Fabriken* in *Leopoldshall* was enclosed in an evacuated platinum crucible of the usual form and thus used for the determination of the specific heats by means of the metal calorimeter formerly described. *Rhenium* crystallizes in the hexagonal system [1]): it has a closest hexagonal packing with two atoms within its parallelopipedic elementary cell; $a_0 = 2{,}752$ Å.U.; $c_0 = 4{,}448$ Å.U.; $a:c = 1:1{,}616$. The specific weight of the metal at 0° C. is: 21,04; its atomic weight: 186.31.

Although the measurements of the specific heats do not betray any allotropic change within the interval of temperatures considered, i.e. between 0° and 1200° C., some particulars observed are worth mentioning. The maximum temperature of the calorimeter was between 0° and 1000° C. reached within 1,5 minutes; but on heating above 1000° C. an appreciable dilatation of the crucible was observed, perhaps as a setting free of occluded gases. Analysis proved the specimen to contain 99,19 % *Re* and 0,81 % oxygen, — which corresponds to about 3,5 % of the volatile Re_2O_7; potassium was not present in any appreciable amount. The gas developed may, therefore, be the oxide. The maximum temperature of the calorimeter then proved to be reached no sooner than within 2,5—3 minutes. Above 1200° C. the deformation of the crucible became so appreciable, that it appeared advisable to stop the measurements at higher temperatures. A meating at 1300° C. for one hour proved to have no influence upon the specific heats found at lower temperatures.

The increase of the temperature Δt of the calorimeter above 20° C. in function of the E. M. F. E of the thermoelements is expressed by: $\Delta t = 4{,}15999 \cdot 10^{-5} \cdot E - 6{,}3085 \cdot 10^{-11} \cdot E^2 + 6{,}1399 \cdot 10^{-15} \cdot E^3$.

As the crucibles did not contain more than 7,4520 grammes of *rhenium* and its specific heats are only small, — being about the same as those of platinum, — the results obtained are less accurate than in other cases hitherto studied: the numbers for Q_0 are exact only within about 0,5 % of their values. However, they are sufficiently exact to state the linear

[1]) V. M. GOLDSCHMIDT, Zeits. f. phys. Chemie, *B*, **2**, (1929), 244; C. AGTE, H. ALTERTHUM, G. HEYNE, K. MOERS und K. BECKER, Zeits. f. anorg. Chem., **196**, (1931), 129; K. MOELLER, *Die Naturwiss.*, **19**, (1931), 575.

dependance of c_p on the temperature, as can be seen from the data collected in the following Table:

Mean specific Heats of Rhenium between 0° and 1201° C.					
Temperature t in °C.:	Final temperature t' of the Calorimeter:	Δt of the Calorimeter in M.V.:	Heat developed Q'_0 between t and t' by 1 Gr. of rhenium:	Heat Q_0 developed between $t°$ and 0° by 1 Gr. of the metal:	Q_0 calculated from the formula:
393°.58	20°.53	81.559	12.659	13.328	—
393.72	20.77	85.500	12.662	13.332	—
630.64	21.39	136.181	21.135	21.834	21.847
631.74	20.85	136.268	21.108	21.788	—
631.80	20.82	136.564	21.188	21.867	21.891
801.58	21.12	176.990	27.461	28.149	28.225
801.68	21.01	177.348	27.541	28.226	28.227
1062.2	21.55	242.215	37.662	38.364	38.319
1063.2	21.27	242.211	37.625	38.319	38.357
1064.9	21.26	242.518	37.618	38.311	—
1200.4	22.26	277.530	43.128	43.854	43.864
1200.8	21.46	277.272	43.174	43.874	

The mean specific heat between 0° and 20° C. was: 0,03262.

From these measurements, the quantities of heat Q_0 developed by 1 gr. of *rhenium* between $t°$ and 0° C. can be calculated by means of the formula:

$$Q_0 = 0{,}03256\,.\,t + 0{,}000003312\,.\,t^2.$$

Therefore, the mean specific heats can be expressed by:

$$\bar{c}_p = 0{,}03256 + 0{,}3312\,.\,10^{-5}\,.\,t$$

and the true specific heats c_p by:

$$c_p = 0{,}03256 + 0{,}6625\,.\,10^{-5}\,.\,t.$$

The atomic heats C_p are, therefore, given by:

$$C_p = 6{,}0661 + 0{,}12342\,.\,10^{-2}\,.\,t.$$

Some of the values of $\bar{c}_p$, c_p and C_p are thus calculated:

Temperature t in °C.:	Mean specific Heat $\bar{c}_p$:	True specific Heat c_p :	Atomic Heat C_p :
0°	0.03256	0.03256	6.066
100	0.03289	0.03322	6.189
200	0.03322	0.03388	6.312
300	0.03355	0.03455	6.437
400	0.03388	0.03522	6.562
500	0.03422	0.03587	6.683
600	0.03455	0.03653	6.806
700	0.03488	0.03720	6.931
800	0.03521	0.03786	7.054
900	0.03554	0.03852	7.177
1000	0.03587	0.03918	7.299
1100	0.03620	0.03985	7.424
1200	0.03653	0.04051	7.547

The value of $3R$ calories is, for C_p, already surpassed at about — 66° C. From the measurements of the linear coefficient of the thermal dilatation by BECKER (loco cit.), the value of the mean cubic coefficient of dilation 3α can be deduced; between 15° and 1917° C. v_t can thus be calculated from the formula: $v_t = v \ (1 + 21{,}79 \, . \, 10^{-6} \, . \, t)$.

As, however, no data for k are available in the literature, c_v and C_v cannot be determined with any appreciable degree of certainty.

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Geology. — *Structure of the Sierra de Baza and adjacent regions in southern Spain.* By H. A. BROUWER and H. JANSEN.

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To the east of the basin of Guadix the older rocks of the Sierra Nevada extend northward in the Sierra de Baza, where the overthrust sheets of the Alpujarrides — which are covered by young deposits in the basin of Guadix and only locally appear along its southern margin — have a great extension.