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XXXIII. *Latent Heat of Evaporation of Zinc and Cadmium.*

By WILLIAM SUTHERLAND*.

IN an article on the Fundamental Atomic Laws of Thermochemistry (Phil. Mag. [5] vol. xl. 1895), certain principles as to molecular force were used to calculate the latent heats of evaporation of metals and compounds of metals. At the time of these calculations it escaped my notice that Barus, in his article on the Pressure-variation of certain High-pressure Boiling-points (Phil. Mag. [5] vol. xxix. 1890), had supplied data whereby the latent heats of vaporization of zinc and cadmium could be determined. It therefore seems desirable to show briefly now how the theoretical agrees with the experimental determinations.

The usual thermodynamical equation for the latent heat of evaporation of a gramme of liquid at absolute temperature θ and of volume v_1 into saturated vapour of volume v_3 at saturation-pressure p ,

$$\lambda = \theta \frac{dp}{d\theta} (v_3 - v_1) / J,$$

has been so thoroughly verified that it furnishes an experimental method of determining λ without the necessity of direct calorimetric measurements. Let M be the molecular mass of the substance, that of hydrogen being 2; then neglecting v_1 beside v_3 , we have

$$M\lambda = \theta \frac{dp}{d\theta} Mv_3 / J.$$

Now for 2 grammes of hydrogen under standard conditions Mv_3 is 22,400 c. c.; so that for a vaporized metal at a pressure of 1 atmo and at θ the value of Mv_3 is $22400\theta/273$.

For the relation between p and θ for Zn and Cd, Barus gives formulæ which represent his experimental results satisfactorily, and enable one to calculate $dp/d\theta$ at values of p from 1 atmo down to a fraction thereof. Using the constants of the formula at p. 152 of his paper, we find for $(dp/d\theta)\theta/p$ when p is 1 atmo the value 11.9 for Zn, and 14.2 for Cd, the corresponding values of θ being 1200 for Zn and 1050 for Cd. Thus, then, taking 1 atmo as 1.014×10^6 dynes per cm.², and J as 42×10^6 ergs, we obtain as the values of $M\lambda$ in kilocalories 28.3 for Zn and 29.6 for Cd: these are the heats of vaporization of gramme-molecules of these metals as liquids. Now Person's values (*Ann. de Ch. et de Phys.* [3] xxiv.) for the latent heats of fusion of Zn and Cd per gramme-molecule in kilocalories are 1.8 and 1.5; so that the total heats of volatilizing gramme-molecules of solid Zn and Cd are 30.1 and 31.1. These numbers include the heat used in expanding the evaporating

* Communicated by the Author.

metal against the atmospheric pressure, which for most liquids has been found to be about one-eleventh of the total latent heat. Thus for the vaporization of a gramme-molecule of solid Zn and of solid Cd, without performance of external work; we have the approximate values 27 and 28 respectively, while the value adopted on p. 18 of my paper is 29·6 for both of them. This agreement should increase the confidence to be placed in the estimates of the latent heats of the other metals and compounds given in that paper. It should interest thermochemists to learn that the work of Barus shows how a number of important latent heats can be determined experimentally with the aid of thermodynamics.

XXXIV. *Proceedings of Learned Societies.*

GEOLOGICAL SOCIETY.

[Continued from p. 260.]

May 18th, 1898.—W. Whitaker, B.A., F.R.S., President,
in the Chair.

THE following communications were read:—

1. 'The Garnet-actinolite Schists on the Southern Side of the St. Gothard Pass.' By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., V.P.G.S.

The author describes the field relations and the microscopic structures of a group of schists or gneisses characterized by the frequent presence of conspicuous garnets and actinolites, which are exposed on the southern slopes of the St. Gothard Pass and for some distance west and east, on the northern side of the Val Bedretto. These, called for purposes of reference the Tremola Schists, he has examined from time to time since 1878, the last occasion being the summer of 1897, when he was accompanied and aided by Mr. John Parkinson, F.G.S. These rocks in the field might be regarded as highly-altered sedimentary strata (as the author once thought) or as a group of igneous rocks (originating possibly in magmatic differentiation) affected by fluxion-movements anterior to consolidation. To the latter view he now inclines, but considers the schistosity and the peculiar minor structures to be the results of crushing (generally without marked shearing) followed by very considerable mineral reconstruction. The garnets he holds to be anterior to this crushing, but the larger biotites and the conspicuous actinolites to be posterior to it. These minerals, in his opinion, throw some light on processes of crystallization in rocks more or less pulverized, or, in other words, in the presence of various impediments. He thinks it probable that the Tremola Schists assumed their present form prior to the great Tertiary earth-movements which gave rise to the existing Alpine chain.

2. 'On the Metamorphism of a Series of Grits and Shales in Northern Anglesey.' By C. Callaway, M.A., D.Sc., F.G.S.

These rocks occur in a patch about 3 miles square, situated south-west of Amlwch, and extending from Llanfechell and Rhos-