



XLIV. On the specific heat of basalt

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after a finality of knowledge has been responsible for numerous fruitless speculations in the past, and it seems only too probable that the impatience of the mind with its own ignorance is the principal foundation of much of the theory of to-day. The satisfaction derived from the contemplation of simple and comprehensive laws may suffice perhaps to prove that the powers of the mind are limited, but hardly that the processes of nature are simple.

XLIV. *On the Specific Heat of Basalt.* By W. C. ROBERTS-AUSTEN, C.B., F.R.S., and A. W. RÜCKER, F.R.S.*

HAVING been asked by the Rev. O. Fisher to determine for him the latent heat of basalt, we made some experiments on a specimen which was furnished to us by Prof. Judd.

Fragments of the rock were melted in a platinum crucible, and the junction of a thermal couple consisting of platinum with platinum containing 10 per cent. of rhodium was immersed in the pasty mass, which was then allowed to cool. The scale of the galvanometer had previously been standardized by an observation on the solidifying-point of pure gold, and the pyrometer was standardized from time to time by the same means. When the index spot of light reached the desired point the wires were nipped off close to the basalt, and the crucible and its contents were plunged into 1000 grams of water contained in a silver calorimeter. The water was stirred by a screw or fan of silver which was rotated by an electric motor. The temperature was read by means of a mercurial thermometer which had been carefully corrected.

The two main sources of error in the experiments are probably an uncertainty as to the mean temperature of the basaltic mass owing to its being a bad conductor of heat, and the fact that in the processes of heating and cooling it undergoes more or less important changes of constitution.

The first error was reduced to small proportions by using small quantities of basalt, the mass employed rarely much exceeding 20 grams.

The second error is in part unavoidable. The rapidly cooled basalt was always glassy like olivine. We also found that frequent heatings and coolings, and the nature of the flame—whether oxidizing or reducing—employed to heat the mass appeared to affect the results very seriously.

In some experiments the crucible was heated in the flame

* Communicated by the Authors.

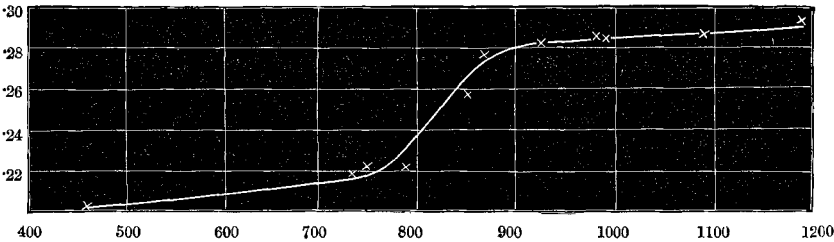
of a small gas-furnace, in others in a coke-furnace. All the former were consistent with each other, and those of the latter group in which fresh specimens of basalt were used were in agreement with them. The results obtained with specimens which had been heated two or more times in the coke-furnace were, however, very irregular, and have been discarded.

As we have not definitely proved what was the cause of these discrepancies, we publish our conclusions with a certain amount of reserve.

In the following table T is the temperature (Cent.) of the basalt at the moment of immersion, C is the mean specific heat between about 20° C and T.

T.	C.	T.	C.
467	0·199	860	0·277
747	·217	924	·282
759	·223	977	·284
792	·220	983	·283
846	·257	1090	·285
		1192	·290

These results are plotted in the figure.



If C_{12} be the mean specific heat between two temperatures t_1 and t_2 we have the relation

$$C_{13}(t_3 - t_1) = C_{12}(t_2 - t_1) + C_{23}(t_3 - t_2).$$

If, then, we take the mean specific heat from 20° C.

to 470° to be ·199
to 750 „ ·216
to 880 „ ·278
and to 1190 „ ·290

we get the following results :—

The mean specific heat between

20 ° and	470° is	0.199
470 and	750 is	.243
750 and	880 is	.626
880 and	1190 is	.323.

As Mr. Fisher was anxious to use our results in some calculations, we supplied him with approximate numbers before all our observations were completed. They do not, however, differ much from the above.

The general result seems to be that the specific heat of basalt follows the ordinary rule that the specific heat of a substance is greater in the liquid than in the solid state. There is a large absorption of heat in the neighbourhood of 800°, which raises the mean specific heat between 750° and 880° to the large value of 0.636.

XLV. *The New Theories of Solution.*

By JAMES WALKER, D.Sc., Ph.D., F.R.S.E.*

SINCE the theories of osmotic pressure and of electrolytic dissociation were in 1887 made generally accessible by their publication in the *Zeitschrift für physikalische Chemie*, they have in Germany and elsewhere on the Continent enjoyed an ever-increasing favour and popularity. In this country they have mostly been met with a passive resistance; but in one or two cases where they conflict with rival theories they have encountered active opposition.

Mr. S. U. Pickering, in particular, has subjected them to unfavourable criticism, in the pages of this Magazine, at the Leeds meeting of the British Association, and elsewhere. His attack is twofold. In the case of osmotic pressure he compares the deductions from theory with the results of experiment, and endeavours to show discordance between them: against the dissociation hypothesis he seeks to raise "theoretical objections of a fundamental character."

First, with regard to osmotic pressure, Mr. Pickering singles out the freezing-point of solutions from the many phenomena which have received an explanation from this theory†, as the ground for his attack. The hypothesis of

* Communicated by the Author.

† Taking the osmotic-pressure theory in conjunction with his own, Arrhenius (Phil. Mag. xxviii. p. 36) enumerates seventeen heads under which these phenomena may be arranged—a number already too small to include the later researches of Nernst and others on solutions.