November 18, 1886.

THE PRESIDENT in the Chair.

In pursuance of the Statutes, notice of the ensuing Anniversary Meeting was given from the Chair.

The Right Hon. Lord Thurlow was admitted into the Society.

Professor Bonney, Sir James Cockle, Mr. Preece, Dr. Rae, and Mr. Stainton, having been nominated by the President, were by ballot elected Auditors of the Treasurer's accounts on the part of the Society.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On the Method of Condensation in Calorimetry." By J. Joly, B.E., Assistant to the Professor of Civil Engineering, Trinity College, Dublin. Communicated by Professor Fitzgerald, F.R.S. Received June 28, 1886.

(Abstract.)*

A substance at the initial temperature $t_1°$ of the atmosphere, suddenly immersed in a saturated vapour at the higher temperature $t_2°$, abstracts from it a quantity of heat equal to $WC(t_2° - t_1°)$, where C is the thermal capacity of the substance between the limits $t_1°$ and $t_2°$, and W its weight. There is then a weight w of the vapour precipitated, so that

$$WC(t_2° - t_1°) = w\lambda,$$

λ being the latent heat of the vapour.

By the observation of the weights and the temperatures, either c or λ may be the unknowns sought from the equation. The method is, in short, applicable to the determination of the specific heat of a substance or the latent heat of a vapour.

The paper contains an account of experiments illustrating the application of this method of condensation to the determination of the specific heats of substances. The condensation of steam is employed, its latent heat being accurately known, and its use affording

* This paper is printed in full at p. 352.

a considerable range of temperature. Two forms of the apparatus employed are described. The calorimeter consists essentially of a vessel of thin metal in which the substance is suspended by a fine wire, the wire issuing through an aperture in the top of the vessel and reaching up to one arm of a balance. The vessel is so constructed that steam can be passed through it from a small boiler, displacing the air around the substance. The substance rests on a light carrier of platinum wire provided with a little catchwater beneath to receive the drops of condensed water.

The manipulation involved is very simple. The substance being placed on the carrier which depends from the balance, is counterpoised. The calorimeter is then closed around it, the suspending wire passing freely through the aperture provided. This aperture is formed in an absorptive material (plaster of Paris), which ensures that it remains free of precipitated water. A thermometer reading to $\frac{1}{10}$ degree C. is inserted in the calorimeter, and allowed to remain with the substance for an interval sufficient to secure close equilibrium of temperature. The thermometer being read is removed, and the calorimeter suddenly placed in connexion with the boiler, which supplies a brisk current of steam and fills it immediately. It then remains to note the increment of weight when the substance has finally attained the temperature of the vapour. This stage is revealed in the persistent equilibrium of the balance. $t_2°$ is observed directly by a thermometer inserted in the boiler, or deduced by noting the height of the barometer and seeking the corresponding temperature of saturated steam from Regnault's tables. A correction is applied to the weight observed in experiment, necessitated by the difference of the weights of the displacement of the substance in air and in steam. In accurate experiments the value of λ is corrected according to Regnault's formula for its true value at $t_2°$.

The method is convenient for the reasons that it involves no preparations as in Bunsen's change of state method, no delicate thermometry, and the calorimeter being roomy permits of bodies of various shapes and bulks being dealt with. The apparatus, too, is of a simple and durable nature.

The experiments quoted in support of the method are (1) on the metallic elements, zinc, silver, lead, platinum, and aluminium. The results are in accord with those of Regnault, Bède, Mallett, &c. The degree of consistency between the experiments is greater than that attained in Regnault's researches. (2) On pure water sealed in thin glass bulbs. The results agree closely with the values deduced from Regnault's formula. (3) On mineral substances in various states of aggregation. It appears from these that the result is but little influenced by the extent of surface exposed to the steam.

The accuracy displayed by the method is explained on the probable

supposition that the substance is throughout the period of heating coated with a film of water adiathermanous and the external surface of which may be considered as appreciably that of the steam. The danger then of radiation error, that is, of steam condensing elsewhere than at the surface of the substance, is small. Condensation, in short, may be considered as taking place by abstraction of the energy of the molecule on impact with the water film.

II. "On the Specific Heats of Minerals." By J. JOLY, B.E., Assistant to the Professor of Civil Engineering, Trinity College, Dublin. Communicated by Professor FITZGERALD, F.R.S. Received June 28, 1886.

A number of experiments were made on minerals by the method of condensation, using the form of gravimetric calorimeter described in the beginning of the paper on calorimetry (p. 353). The condensation of steam being in all cases employed, the values recorded are the mean specific heats between atmospheric temperatures approximating to 12° C., and steam temperature, about 100° C. More exactly, the values recorded are the mean calorific capacities for a rise of one degree between the limits t_1 and t_2, tabulated in each case. The specimens dealt with were chosen as good samples of the mineral free from visible impurities.* But before detailing the particulars of the experiments a few notes on the discriminative value and physical interest attached to this application of calorimetry may not be amiss.†

It seems probable that the neglect of the use of the specific heat constant is to be ascribed to the difficulties besetting its determination. Certainly if its determination was as easily effected as we effect the determination of the specific gravity of a body, there are on the other hand sufficient reasons to recommend its use as in general of more physical value and interest than the much used specific gravity. There are cases indeed where specific gravity, as it is possible to obtain it, is misleading, and where specific heat gives at once valuable information on the probable chemical nature of the substance. Such cases would arise with bodies of loose vesicular or hollow structure. No misleading variations need be introduced into the thermal constant by mere conditions of volume.

The method of condensation permits of the determination of this constant with very little experimental difficulty. On the whole the

* I have to thank Professor Sollas for the loan of useful specimens from the Museum of Trinity College.

† In November, 1883, I suggested this use of calorimetry to the Experimental Science Association, Trinity College.—" On the Determination of Minerals by their Specific Heats."