Thermal Conductivity of Deuterium

THE thermal conductivity of deuterium extracted from heavy water containing 99·2 per cent D has been determined.

To prepare the deuterium gas a measured small quantity of the heavy water was first converted into NaOD by adding it to the requisite amount of sodium peroxide (gentle heating dispelling the oxygen gas). The deuterium was then obtained by heating the NaOD with sodium oxalate in molecular proportions and the purification of the gas accomplished by the usual procedure of passing it directly into the evacuated conductivity apparatus through the wall of a heated 'degassed' palladium tube.

A series of determinations of the thermal conductivity at 0° C. were made over the pressure range 44–15 cm. Hg, the maximum mean temperature of the gas in the series being 1·6° C. Over this range of pressures the conductivity was constant within the limits of experimental error, the mean of seven determinations being

$$k_D = (32{\cdot}94 \pm 0{\cdot}04) \times 10^{-5} \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1},$$

as compared with the value of $k_H = 41{\cdot}3 \times 10^{-5}$ for hydrogen.

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March 17.

Measurement of the Thermal Conductivity of Gases

DR. KANNULUIK used in the above measurement a method[1] which was devised a few years ago for measuring the thermal conductivity of a gas and was used by him and Dr. Martin to measure its value for a number of gases. In it a thick electrically heated wire co-axial with a vertical metal tube, which contains the gas, is used. A wire of very pure platinum and an accurately lapped stainless steel tube were used in the experiment on deuterium described in the previous letter.

The advantages of this method seem to have escaped attention, and I take this opportunity of directing attention to them. To do this it is necessary to recall the characteristics of other methods. Dr. Hercus and I devised an electrically heated parallel plate method, in which the horizontal layer of gas is heated at its upper surface (which prevents convection); in a recent development of this method radiation is eliminated by using two thicknesses of gas. Now, when heat crosses the interface between a gas and a solid, there is a discontinuity of temperature, but in the parallel plate method its effect is negligible. Although the plate method is very simple in principle, in practice considerable skill and time is needed to attain the steady temperatures, which are assumed in the theory of these steady state processes, and a large volume of gas is required.

An electrically heated *thin* wire has been extensively used for measuring the conductivities of gases. Steady temperatures are readily attained, and only a small quantity of gas is required The gradient of temperature near a thin wire is, however, necessarily large, and this in turn means the effect of the temperature discontinuity at the surface of the wire is large. There is difficulty, too, in eliminating convection by reducing the pressure of the gas, for molecular conduction may set in before convection is eliminated. The method has other difficulties.

Dr. Kannuluik introduced the use of a *thick* wire and gave the mathematical theory needed to enable such a wire to be used. Prof. T. M. Cherry has added to this theory, which now appears to be complete.

Using a thick wire the effect of temperature discontinuity at the wire surface is almost negligible, and can be calculated. Convection of heat can be eliminated before molecular conduction sets in. Kannuluik and Martin have shown that the method gives for the thermal conductivity of air a value which agrees with that found by careful observations with the parallel plate method[2] to the accuracy of such measurements. It agrees, too, with Weber's value for air obtained with a thin wire, but it should be added other recent determinations[3] made with thin wires are about 2 per cent higher than the values found with a thick wire and with the parallel plate methods. I believe this difference is not significant as showing a systematic difference between the methods, and that it arises from experimental errors such as those arising in eliminating temperature discontinuity and in measuring the diameter of the wire used, etc.

T. H. LABY.

London.
April 8.

[1] G. W. Kannuluik, *Proc. Roy. Soc.*, A, **131**, 320 (1931), and G. W. Kannuluik and L. H. Martin, ibid., A, **141**, 144 (1933) and A, **144**, 496 (1934).

[2] T. H. Laby, ibid., A, **144**, 494 (1934), and Hercus and Sutherland, ibid., A, **145**, 599 (1934).

[3] Awbery: article on Heat in "Reports on Progress in Physics" vol. 2, 195 (1936).

Effect of Œstrogenic Hormones on Lactation in the Cow

THERE is evidence[1] that administration of œstrogenic hormones to lactating animals causes inhibition of milk secretion. In the case of the work cited, largely owing to the difficulty of making accurate measurements of milk secretion rate and of changes in milk composition in experiments on small animals, the evidence that inhibition occurs is not so conclusive as might be desired, nor have accompanying changes in milk composition been studied. The above difficulties are obviated by use of the lactating cow as experimental animal.

In the course of studies of the hormonal control of lactation now in progress at this Institute, the effect of the administration of massive doses of œstrogenic hormones to the lactating cow has been investigated*. Fig. 1 shows the most interesting of the results obtained when a lactating Guernsey cow was given, by intramuscular injections spread over three days, a total of 500 mgm. œstrone and 50 mgm. œstradiol benzoate. Injection into a control cow of equal amounts of the oil in which the hormones were dissolved showed this to be without effect on lactation.

It will be seen that while œstrogenic hormone caused a marked diminution in the daily milk yield (an inhibition of approximately 20 per cent) the non-fatty solids content of the milk was raised by more than 10 per cent. This finding, taken in conjunction with the fact that thyroxine administration leads to an increase in milk non-fatty solids content[2], gives reason to hope that in the near future the factors controlling the level of non-fatty solids in milk will be further elucidated, and a method of treatment

* This work has been made possible by the kindness of Messrs. Organon Laboratories and Messrs. Schering Ltd., who have given generous supplies of œstrone and œstradiol benzoate respectively.