very favourably with the frequency 1250 cm.$^{-1}$ calculated from the theory of the molecular vibrations of three-particle systems put forward recently by Van Vleck and Cross[3]. It is interesting to note that a similar, but very feeble, band of frequency shift about 1650 cm.$^{-1}$ has been reported in the case of ordinary water[4].

3. A third band with a much lower frequency shift of 178 cm.$^{-1}$ is also noticed with both the 4358 A. and 4046 A. excitations. This frequency is far too low to be attributed to the internal vibrations of the D_2O molecule, and hence is presumably due to some sort of rotation or vibration of the molecule as a whole. The Raman spectrum of ordinary water also shows a band at approximately the same position. This band is evidently to be ascribed to the frequency of hindered rotation or oscillation of the liquid molecule, of which independent evidence is forthcoming from studies of dielectric constant[5], infra-red absorption[6], viscosity, etc.

A detailed paper on the subject will appear in the *Proceedings of the Indian Academy of Sciences*.

R. ANANTHAKRISHNAN.

Department of Physics,
Indian Institute of Science,
Bangalore.
Aug. 10.

[1] R. W. Wood, *Phys. Rev.*, **45**, 392; 1934.
[2] D. H. Rank, K. D. Larsen and E. R. Bordner, *J. Chem. Phys.*, **2**, 464; 1934.
[3] See B. Topley and H. Eyring, *J. Chem. Phys.*, **2**, 217; 1934.
[4] M. Magat, *J. Phys.*, **5**, 347; 1934. G. Bolla, *N. Cimento*, **10**, 101; 1933.
[5] P. Debye, *Phys. Z.*, **36**, 100, 193; 1935.
[6] C. H. Cartwright, NATURE, **135**, 872; 1935.

Diffusion of Heavy Water into Ordinary Water

W. J. C. ORR and D. W. Thomson[1] have found the velocity of diffusion of HDO into H_2O to be abnormally large, the diffusion constant D being 9×10^{-4} cm.^{2} sec.$^{-1}$ at 15° C., whereas for all simple substances in water, diffusion constants are of the order of magnitude 10^{-5} cm.^{2} sec.$^{-1}$. Since this result, if it were true, would be of considerable significance for the theory of the structure of water, experiments were made to verify it.

The velocity of diffusion was measured with a micropyknometer of E. S. Gilfillan and M. Polanyi[2]; the orifice was made larger than usual (namely, about 0·1 mm.) to make noticeable the diffusion from the body of the pyknometer into the surrounding water.

The method of carrying out the experiments was as follows:

At the beginning the difference $(\Delta P)_1$ in equilibrium hydrostatic pressure for the solution and ordinary water was measured. Diffusion from the pyknometer was allowed to occur, in a separate vessel at constant temperature and for a given length of time t, and the measurement of the difference in the equilibrium hydrostatic pressure was repeated, giving $(\Delta P)_2$.

From Fick's law, the following equation can be easily obtained:

$$\lg\frac{(\Delta P)_1}{(\Delta P)_2}/Dt = K,$$

where K is a constant.

Constant K was obtained from observations of the diffusion of potassium chloride solution, employing data of the International Critical Tables for the diffusion constant. All experiments were duplicated, results agreeing within 5 per cent.

The following values of D were obtained for the diffusion of heavy water from ~ 3 mol. per cent solution into ordinary water.

$$D = 1{\cdot}1 \times 10^{-5} \text{ cm.}^2 \text{ sec.}^{-1} \text{ at } 0{\cdot}0° \text{ C.}$$
$$D = 2{\cdot}5 \times 10^{-5} \text{ cm.}^2 \text{ sec.}^{-1} \text{ at } 28{\cdot}0° \text{ C.}$$

Hence the constants are of the usual order of magnitude, contrary to the result of Orr and Thomson.

My thanks are due to Prof. M. Polanyi for the use of the micropyknometer apparatus and for much valuable discussion.

M. TEMKIN.

Physical Chemistry Department,
University, Manchester.

[1] NATURE, **134**, 776; 1934.
[2] *Z. phys. Chem.*, A, **166**, 254; 1933.

Identity of Natural Vitamin D from Different Species of Animals

BILLS, Massengale and Imboden[1] have found that one rat unit of blue-fin tunny liver oil in chicks has only 15 per cent of the antirachitic effect of one rat unit of cod liver oil, whence they conclude that the two forms of vitamin D are different. However, Dols[2] demonstrated that the antirachitic effect of these two forms of vitamin D in chicks is the same, the necessary dose being about 80 international D units a day for each chicken. Before the results of Dols were known to us, we had running a great number of tests to investigate whether there is any difference between the vitamin D of different species of animals. (The fact that there is another form of natural vitamin D found in green plants and accompanying the free fatty acids[3] is not discussed here.)

From the different fats under investigation the unsaponifiable fraction was first isolated, the vitamin A eliminated and the vitamin D to some degree concentrated by a method reported by us[4]. We have examined the liver fat as well as the body fat of the following species: coalfish (sei, *Gadus virens*), cod (torsk, *Gadus morrhua*), cusk (brosme, *Brosmius brosme*), dogfish (ha, *Squalus acanthias*), dorn (piggrokke, *Raja clavata*), Greenland shark (håkjerring, *Somniosus microcephalus*), haddock (kolje, *Gadus æglefinus*), halibut (kveite, *Hippoglossus hippoglossus*), herring (sild, *Clupea harengus*), mackerel (makrel, *Scomber scombrus*), pollack (lyr, *Gadus pollachius*), redfish (uer, *Sebastes marinus*), salmon (laks, *Salmo salar*), shark (håbrand, *Lamna cornubica*), sprat (brisling, *Clupea sprattus*), tunny (makrelstorje, *Thunnus thynnus*), wrasse or 'Old Wife' (berggylte, *Labrus berggylta*), blue whale (blåhval, *Bolœna musculus*); we also had specimens of vitamin D from the liver and body fat of a cow and of a human female. We found no difference between the antirachitic effect in chicks of all these fats, the daily dose required being in all cases 70–80 international D (rat) units per chicken.

We were thus able to confirm Dols's results but not the results of Bills *et al.* with tunny liver fat None of the preparations investigated by us showed a maximum of absorption in the ultra-violet spectrum at 260–270 mμ nor any rotation of the plane of polarisation in alcoholic solution, and the degree of

© 1935 Nature Publishing Group