with only one hydrogen bond reorientates readily when the bond breaks.

The description of excess mobility presented here implies a number of assumptions, of which the following are the most important:

1) The model of water applied [3] is assumed adequate for the purpose, though it is only a rough idealization of the real conditions. Hence x, the ratio of the number of established hydrogen bonds to the number of possible bonds, is known.

2) It is assumed that the H_3O^+ ions and the OH^- ions in dilute solutions have the same structural environment as the water molecules.

3) A random distribution of the hydrogen bonds between the molecules will be assumed. The ratio w of one-bonded molecules to the total number of molecules is then given by the following equation:

$$w = 4x(1-x)^3 \qquad (2)$$

Any coupling between the breaking of the bonds is disregarded in deducing this equation.

4) The assumption that the factor $f(T)$ in equation (1) is proportional to the number of molecules with one hydrogen bond is only valid within a limited temperature interval. For instance differences in mean chain lengths for transfers taking place over chains of hydrogen bridges are not taken into account. Coupling between the breaking of bonds is again disregarded.

5) Eqn. (1) is not quite exact, but assumed to be adequate.

In view of these assumptions and approximations the results obtained should be regarded as of only a semiquantitative nature. However, by plotting $\log u + \log T - \log x(1-x)^3$ against $1/T$, using the values of u given for the H_3O^+ ion by Gierer and Wirtz [1] or by Bjerrum [5] and the values of x given by Grjotheim and Krogh-Moe [4], a straight line is obtained for temperatures up to 200° C. The slope of the line corresponds to an activation energy of 1.7 kcal/mole. This value compares favourably with the values 1.3—2.6 kcal/mole obtained by Grjotheim and Krogh-Moe for the breaking of a bond in water. It should be noted that this value for the hydrogen bond includes only the part of the total interaction responsible for the tetrahedral configuration of the water molecules.

The activation energy for the OH^- ion conductivity is shown to be 0.6 kcal/mole higher than that for the H_3O^+ ion [1]. This means that an OH^- ion cannot have quite the same surroundings on average as the H_3O^+ ion. The energy of the hydrogen bond appears to be slightly different in these two cases. Rather than a single energy, however, we have in these systems an energy distribution. A single hydrogen bond energy seems to be a fairly good approximation, however.

The previous considerations enable us to understand why the extra mobility increases with pressure in a certain temperature range. In this temperature range the breaking of a hydrogen bond results in a decrease in volume [4]. Therefore increased pressure means a smaller number of bonds in the liquid. This leads to a larger number of water molecules with only one bond, as may be seen by introducing into eqn. (2) the appropriate values of x. Consequently an increase in extra mobility with pressure is expected. If the factor $f(T)$ of structural influence in eqn. (1) were proportional to the number of established hydrogen bonds, the pressure dependence of extra mobility could not be explained.

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The Vitamin Content of Pollen after Storing

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In a previous paper [1] the results of an investigation concerning the content of some B-vitamins in pollen from different plants were given. The samples examined were obtained from *Zea mays*, *Alnus glutinosa*, *A. incana* and *Pinus montana*. The following vitamins were determined: riboflavin, nicotinic acid, pantothenic acid, pyridoxine, biotin and inositol. The determinations were carried out during October

Table 1.

		Zea mays		*Alnus glutinosa*		*Alnus incana*		*Pinus montana*	
		µg/g	%	µg/g	%	µg/g	%	µg/g	%
Riboflavin	1954	6.2		11.2		12.1		5.6	
	1955	6.6	106	11.4	102	8.9	74	3.5	63
Nicotinic acid	1954	71.8		82.7		82.3		79.8	
	1955	65.7	92	73.1	88	79.0	96	64.9	81
Pantothenic acid	1954	12.7		4.2		5.0		7.8	
	1955	9.9	78	0.6	14	1.9	38	5.6	72
Pyridoxine	1954	5.5		5.7		6.8		3.1	
	1955	5.7	104	5.4	95	6.0	88	3.0	97
Biotin	1954	0.55		0.65		0.69		0.62	
	1955	0.50	91	0.67	103	0.65	94	0.70	113
Inositol mg/g	1954	30		3.0		3.5		9.0	
	1955	30	100	2.8	93	3.5	100	8.0	89

and November 1954, shortly after the pollen samples had been collected. The samples were stored in a cool and dry place immediately after collection.

Now, after one year, the pollen samples have been re-examined to determine, whether the vitamin content had changed. Throughout the year the samples were stored in containers in a cool, dry place. The vitamins determined were the same as in the previous investigation. For the methods employed the reader is referred to the paper mentioned [1].

It is evident from the results presented in Table 1 that the stability of the vitamins in the different pollen samples varies greatly. The pantothenic acid content shows a substantial decrease in all the samples, especially in the pollen taken from the two *Alnus* species. For instance in the sample from *A. glutinosa* only 14 % of the pantothenic acid found in 1954 remains. The biotin and inositol content is practically unaltered in all the samples, the variation being within the limits of the accuracy of the analytical methods. The contents of riboflavin, pyridoxine and nicotinic acid remain the same in some samples and show a decrease in others. With the exception of pantothenic acid, the vitamin content of the pollen from *Zea mays* shows hardly any change. On the other hand, in the pollen from *Alnus incana* a marked decrease is seen not only in the pantothenic acid content but also in the amounts of riboflavin and pyridoxine.

The marked decrease found in the pantothenic acid content may prove to be due to a binding of this vitamin and not to its destruction. For the determination of the pantothenic acid no enzymatic liberation was used.

The previous examination [1] of the pollen samples showed that the two samples from *Zea mays* that were collected in 1953 and 1954 contained different amounts of nicotinic acid. It was assumed that this difference might have been due to the storage of the sample collected in 1953, but the results reported here make this explanation unlikely. Therefore the difference found in 1954 must be due to a variation between different samples.

This repeated investigation shows that the stability of vitamins in pollen (in so far as the six vitamins investigated are concerned) depends on the kind of pollen used. The greatest stability is found in pollen from *Zea mays* in which the contents of five of the vitamins remain practically unchanged. The least stable vitamins are found in pollen from *Alnus incana*.

Pantothenic acid seems to be the most unstable vitamin.

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