Physical constant.	Hydrogen peroxide.	Water.
Freezing point	—1.70°	0°
Density of liquid at 0°	1.4633	0.99987
Mean coefficient of expansion —10° to +20°	0.00107	0.00000
Density of solid	1.644	0.9167
Specific heat of liquid	0.579	1.0
Latent heat of fusion	74 calories	80 calories
Specific heat of solid	0.470	0.472
Surface tension 0°	78.7 dynes	75.5 dynes
Association (Ramsay and Young) at 0°	3.48	3.58
Viscosity 0°	0.01828	0.01778
Refractive index (D) 22°	1.4139	1.3330
Molecular refractive power (D)	5.90	3.715

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[CONTRIBUTION FROM THE CHEMISTRY DEPARTMENT OF McGILL UNIVERSITY.]

THE PROPERTIES OF PURE HYDROGEN PEROXIDE. II.

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This second paper deals solely with the freezing-point curve of solutions of hydrogen peroxide and water. These solutions were prepared by concentrating 3% hydrogen peroxide and purifying the resultant concentrated solution by means of a distillation. As the only volatile impurity contained by the original solution consisted of a trace of hydrochloric acid, the final product may be looked upon as having been pure except for a trace of this acid which found its way into the distillate. In this way an 86% solution was obtained.

In order to obtain the freezing points of hydrogen peroxide-water mixtures a weighed amount of this 86% peroxide solution was placed in a test-tube. A platinum thermometer, reading to 0.1°, was immersed in it. The temperature was lowered by means of a suitable freezing mixture until crystals formed. All but a few of these were allowed to melt and then the temperature was slightly lowered until crystallization again set in, the liquid in the meantime being vigorously stirred. The solution was then allowed to warm up slowly, the freezing point being taken as the temperature at which the last crystals melted under vigorous stirring. The solution was analyzed; an adequate amount of water, sufficient to dilute the solution a few per cent. was added, and then the whole procedure repeated. In this way the freezing points at various concentrations were determined.

The solutions between the concentrations 40% and 60% hydrogen peroxide had a tendency to supercool into a thick viscous mass, but when allowed to stand at a temperature of —90°[1] crystallization started after some time.

[1] Carbon dioxide-ether under a vacuum was used as freezing mixture in this case.

Hydrogen peroxide. %.	Freezing point of solution. ° C.	Hydrogen peroxide. %.	Freezing point of solution. ° C.
86.0	—14.0	49.8	—51.7
80.45	—22.7	47.0	—50.8
74.0	—32.5	46.21	—51.8
69.2	—39.0	42.02	—46.25
67.4	—41.5	37.80	—38.0
65.4	—45.5	36.47	—35.7
63.05	—50.0	31.96	—28.5
61.14	—52.5	27.72	—23.4
58.8	—54.5	22.50	—17.0
56.2	—54.3	15.91	—11.1
55.06	—53.6	9.96	— 6.1
53.7	—52.5	4.9	— 3.4

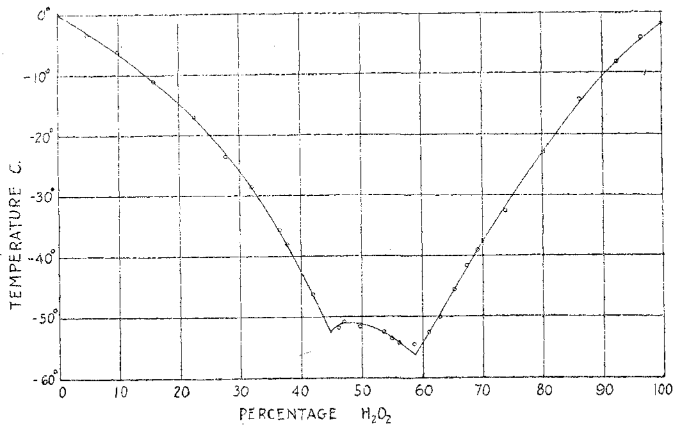

Fig. 1.

The graph (Fig. 1) of these results gives a good idea of the variation of the freezing point with concentration. It is seen that a molecular compound $2H_2O$-H_2O_2 is formed corresponding to a composition 48.6% of hydrogen peroxide.

Wolffenstein[1] had cooled down concentrated solutions of hydrogen peroxide and analyzed the crystals formed. He came to the conclusion that 2 compounds existed, represented by the formulas—$H_2O_2.H_2O$ and $H_2O_2.2H_2O$. The freezing point curve gives no evidence for the existence of the former, and it is probable that the belief in its existence was due to the difficulty of separating the solution completely from the hydrogen peroxide crystals at low temperatures. This phenomenon was considered in the first paper on hydrogen peroxide.

Summing up: the freezing point curve of hydrogen peroxide-water has been determined, and one molecular compound, namely, $H_2O_2.2H_2O$, with a melting point of —51°, has been shown to exist.

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[1] Wolffenstein, *Ber.*, 27, 3307 (1894).