The water thus produced, 0.06 g., was freed from carbon dioxide and carefully distilled. If all of the deutacetic acid had remained in the form CH_3COOH^2 and if no ordinary hydrogen had been picked up in the long series of manipulations the specific gravity at 25° should be 1.106. If the H^2 had been randomly distributed between carboxyl and methyl groups the specific gravity should be 1.026. The specific gravity found was 1.096. Considering the difficulty of a density determination with so small a sample, and the many opportunities for contamination with ordinary water, this result indicates that there had been no interchange with the hydrogen of the methyl group.

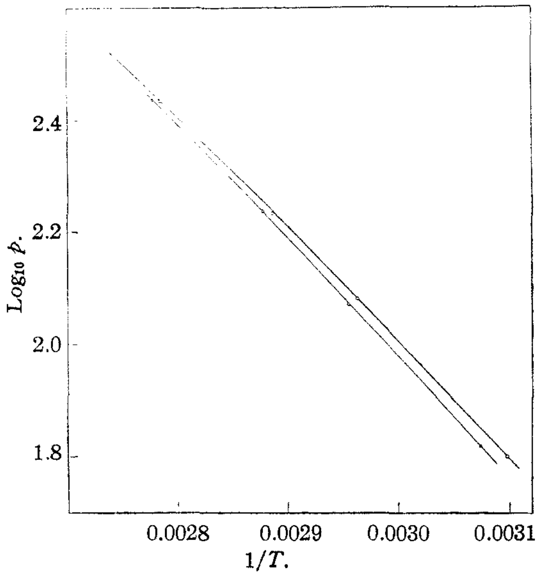

Fig. 1.—○, H^2Ac; □, H^1Ac.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA
GILBERT N. LEWIS
PHILIP W. SCHUTZ

RECEIVED JANUARY 23, 1934

THE VAPOR PRESSURE OF LIQUID AND SOLID DEUTOCHLORIC ACID

Sir:

Some time ago we attempted to measure the vapor pressure of pure deutochloric acid, H^2Cl. The values obtained were almost identical with those found for ordinary hydrochloric acid except that there was no pronounced break in the curve at the freezing point. The work was not altogether satisfactory owing to uncertainty regarding the purity of the H^2Cl and to some difficulty in maintaining and measuring the temperatures. It seemed worth while to repeat the experiments using the utmost care in these particulars.

After trying many chlorides it was found that the best H^2Cl was obtained by allowing pure H^2_2O to react with anhydrous magnesium chloride at 600°, the system being so designed that, after removing H^2Cl, the excess water could be returned to react further with the magnesium chloride. From the vessel containing magnesium chloride the H^2Cl was finally distilled at −130° into the measuring apparatus, to remove water and any other impurities of relatively low volatility. The thermostat consisted of a Dewar tube filled with pentane which was kept at a desired temperature by external cooling and stirred by a stream of cold air. The thermocouple was calibrated by determining in the same apparatus the vapor pressure of ordinary HCl for which we have the extremely accurate and concordant data of Henning and Stock and Giauque and Wiebe [*Z. Physik*, **4**, 226 (1921); THIS JOURNAL, **50,** 101 (1928)]. Our results are given in the table. The triple point of H^2Cl was determined visually as 158.2°K.

TABLE

T,°K.	p, mm.	
152.6	54.5	Solid
154.7	67.5	Solid
157.1	84.5	Solid
157.6	88.0	Solid
159.5	104.0	Liquid
168.2	205.5	Liquid
175.0	329.0	Liquid
181.0	486.5	Liquid
188.3	757.5	Liquid
195.9	1131.5	Liquid
200.9	1474.5	Liquid

Comparing the vapor pressure of H^2Cl, p_2, with that of H^1Cl, p_1, we find that the data for the two liquids agree accurately with the equation

$$\log_{10}\frac{p_1}{p_2} = \frac{15.4}{T} - 0.075 \qquad (1)$$

while those for the two solids are in rougher agreement with the equation

$$\log_{10}\frac{p_1}{p_2} = -\frac{57.7}{T} + 0.387 \qquad (2)$$

It is interesting that the ratio of the two vapor pressures reaches a maximum of 1.05 at the triple point, below which they approach each other as the temperature is lowered. Assuming that the molal volumes for gas, liquid and solid are approximately the same for H^1Cl and H^2Cl

under similar conditions, we may calculate accurately from Equations (1) and (2) the difference in their heats of vaporization; that of liquid H^2Cl being greater than that of H^1Cl by 70 ± 1 calories per mole, while in the case of the solids, there is a difference of 265 ± 20 in the other direction. Thus, from the work of Giauque and Wiebe, the heat of vaporization of liquid, the heat of vaporization of solid, and the heat of fusion, are, respectively, for H^1Cl at its triple point, 4081, 4557 and 476 calories per mole. Our corresponding values for H^2Cl are 4151, 4292, and 141. Our low value for the heat of fusion is very striking and accounts for our earlier failure to detect a break in the vapor pressure curve at the freezing point.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA
GILBERT N. LEWIS
RONALD T. MACDONALD
PHILIP W. SCHUTZ

RECEIVED JANUARY 23, 1934

MONOMOLECULAR FILMS OF FATTY ACIDS ON GLASS

Sir:

Langmuir showed in 1919 that a monomolecular oil film could be deposited on a solid surface by dipping the solid beneath a water surface covered with a monomolecular film, and withdrawing the solid slowly. After the water peeled away from the solid surface, or evaporated, the oil film was left on the solid, the molecules in the film retaining the orientation which they had on water.

This method has been developed further for depositing fatty acids on glass. The nicest experimental procedure is that in which water peels completely off the glass as the glass is withdrawn from the water-bath. This occurs when molecules of the fatty acid, which are spread on the water surface, leave the water and attach themselves to the edges of the glass slide as soon as one end of the slide emerges from the bath. Water then peels away from this coated area, and, as the water retreats, the oil film coats new areas until all the water is displaced.

Films which attach themselves to glass in the manner just described, called glass-adhering films, are formed only under special conditions. Fatty acids form these films, provided the film on the water surface is under surface pressure, and provided the glass is wet with alkaline water ($^1/_{1000}$ N NaOH). Stearic acid gives excellent results, used at a surface pressure of 20 dynes per cm. on an alkaline water-bath. Some fatty acid films, however, collapse when compressed on alkaline water, though they will withstand pressure on acid water. One can spread substances of this type on acid water, rinse the slide in alkaline water, touch only the tip of the slide to the oil film, and the film spreads instantly over the wet slide to form a glass-adhering film.

Stearic acid may be deposited in successive layers, the layers of odd number being oriented with the CH_3-groups away from the glass, the layers of even number with these groups toward the glass. The former occur when glass is raised through an oil film spread on water, the latter when glass coated with a glass-adhering layer is lowered slowly through a similar film. As the glass is lowered, the film on the water surface attaches itself tightly to the slide, but, since water makes a contact angle of approximately 90° with a coated slide, the film is turned upside down as the slide carries it down into the water. The phenomenon is striking when the motion of the film is observed by means of scattered talc particles.

Films deposited on glass with the molecules oriented so that only CH_3-groups are exposed at the upper surface, form a surface which oil and benzene will not wet. A drop of pure mineral oil, or tetradecane, or benzene, placed on a layer that is 1, or 3, or 5, . . . molecules deep, rolls about on the surface leaving no trace of its path, although stearic acid is soluble in these liquids. Water rolls about on a layer 3, or 5, . . . molecules deep. Films oriented in the opposite direction, with all COOH-groups on the outer surface, are completely wet by clean water.

RESEARCH LABORATORY
GENERAL ELECTRIC CO.
SCHENECTADY, N. Y.
KATHARINE B. BLODGETT

RECEIVED JANUARY 24, 1934