point. Determination 16 shows that tap water distilled from a residue from distilling sea water is only slightly heavier than ordinary tap water. Experiments 21 and 22 indicate that if tap water as purified contains an impurity it distributes itself equally between the phases when the water is frozen, which seems very unlikely. Experiments 19 and 20 indicate that if sea water as purified contains an impurity which increases its density it tends to stay with the ice rather than the liquid. I consider that these experiments prove that the difference in specific gravity is due to a difference in isotopic composition.

Summary

Pure water obtained from sea water has been found to have a specific gravity of 1.0000023 at 0 ± 0.0000002° compared with pure water obtained from Cambridge tap water at 0°.

A convenient method of measuring small differences of specific gravity has been described.

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NOTE

The Magneto-Optic Nicol Rotation Method for the Quantitative Analysis of Copper

BY EDNA R. BISHOP, IRENE G. OTTO AND LOUIS BAISDEN

An investigation has now been made of the use of the magneto-optic nicol rotation method[1] for the determination of copper.

Regular curves in which the angle of rotation of the analyzing nicol varied with the concentration of copper chloride and with the observer were obtained. These curves could not be superimposed on the previously reported curves for calcium[1] with the concentration expressed in grams of cation, grams of compound or molecules of compound per cc., although they were nearest together when the concentration was expressed in grams of cation per cc.

In the presence of excess NH_4OH, minima appropriate to $Cu(NH_3)_4Cl_2$ were found at scale readings of 30.20(2), 30.30(1) and 30.42(3). These scale readings represent the three isotopes of copper and their order of abundance, as shown by the magnitude of the angle at which minima could be read, is indicated by the numbers in parentheses and is the same as those of simple copper compounds.[2] The $Cu(NH_3)_4Cl_2$ solutions that were employed had a concentration of 1.457×10^{-5}, 1.457×10^{-8}, and 1.457×10^{-11} g. of Cu/cc. The angle of rotation for $CuCl_2$ and $Cu(NH_3)_4Cl_2$ was determined for each of these solutions. In every case the $CuCl_2$ minima became visible at the same nicol setting in the presence as in the absence of NH_4OH. The minima of $Cu(NH_3)_4Cl_2$, however, were seen at a larger angle than those of $CuCl_2$ when both were present in the same solution. When expressed in grams of cation, $Cu(NH_3)_4^{++}$, the points fit on the $CuCl_2$ curve.

Na^+, K^+, NH_4^+, H^+, Fe^{+++}, Ca^{++}, $SO_4^=$, $PO_4^{\equiv}$ and NO_3^- were added to a $CuCl_2$ solution but did not affect the angle at which the $CuCl_2$ minima could be seen. In the presence of excess of these four anions, the $CuCl_2$, $CuSO_4$, $Cu_3(PO_4)_2$ and $Cu(NO_3)_2$ minima all became visible at the same nicol setting.

The magneto-optic nicol rotation method should, therefore, be useful for the quantitative analysis of copper, especially at low concentrations or in complex mixtures since no preliminary separations are necessary. The range of concentrations at which this method can be employed is approximately 5×10^{-12} to 1×10^{-4} g. of Cu/cc. A calibration curve of nicol rotation *vs.* concentration must be made by the observer who is to make the analyses.

ALABAMA EXPERIMENT STATION
AUBURN, ALABAMA

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(1) Bishop, Dollins and Otto, THIS JOURNAL, **55**, 4365 (1933).
(2) Bishop, *Phys. Rev.*, **40**, 16 (1932).