

## THE COMPOSITION OF WOODS HOLE SEA WATER.

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There are no more fundamental quantitative data than those regarding the composition of the medium nurturing the organisms on which much of the study of biological laboratories is based. Analyses of the tank water in the Marine Biological Laboratory were therefore made using the methods briefly outlined below.

*Calcium and Magnesium.*—50 cc. samples of sea water were boiled with a little HCl to expel CO<sub>2</sub>, cooled and the calcium precipitated as oxalate, the oxalate subsequently ignited and weighed as CaO. Magnesium was precipitated in the filtrate with Na<sub>2</sub>HPO<sub>4</sub> in the presence of an excess NH<sub>4</sub>OH, ignited and weighed as the pyrophosphate.

*Potassium* was determined in 1 cc. samples of water by the method of Kramer and Tisdall (1). This method essentially consists in the precipitation of potassium with cobalti-nitrite reagent, and titration of the precipitate after special washing with KMnO<sub>4</sub>. The method has been found to be exceedingly accurate and therefore has many advantages over the old, classical and tedious, precipitation as the chloroplatinate or the perchlorate.

*Sodium* was estimated by a modified Kramer and Gittleman technique (2). We have found that modification of the original technique—which was designed for blood serum only and for this most useful—is necessary because both calcium and magnesium are precipitated practically quantitatively by the sodium reagent, and are titrated along with the sodium.

The modified method consists in preliminary precipitation of the calcium and magnesium with alkaline phosphate, centrifuging off the precipitate, concentrating the supernatant liquor to about 3 cc. on the water bath, cooling and adding 10 cc. of the alkaline potassium pyroantimonate reagent, then 3 cc. of redistilled (over KOH) ethyl alcohol drop by drop with vigorous shaking. This precipitation is carried out in 50 cc. conical bottom Pyrex centrifuge tubes; it is important that these be used. After one half hour standing the tubes are centrifuged and the procedure carried out as Kramer and Gittleman recommend.

<sup>1</sup> Contribution from the Research Division of Eli Lilly and Company, Marine Biological Laboratory, Woods Hole, Mass.



Removal of the calcium as carbonate is unsatisfactory because of the very marked tendency of  $\text{CaCO}_3$  to form supersaturated solutions. Gentle heating of the solution will, however, bring the carbonate down.

Oxalate precipitation seems quite satisfactory followed by phosphate for the magnesium precipitation, but here two steps are required and there is slight danger of carrying some oxalate along until the thiosulphate titration.

Using the above slight modification we have been able to get most accurate check analyses of known solutions of  $\text{NaCl}$  and  $\text{CaCl}_2$ . Kramer and Gittleman's method is a most useful and unique technique and seems to have a wide applicability for the direct determination of sodium.

As in the case of potassium we feel that the direct determination of sodium as compared with the determination by difference, as the combined sulphates, etc., has certain advantages.

*Chlorine* was estimated by the  $\text{AgNO}_3$ - $\text{KCrO}_4$  titration of Fr. Mohr.

*Sulphate* was precipitated as  $\text{BaSO}_4$ , ignited and weighed.

*Phosphate* was determined in 5 cc. samples of water by preliminary oxidation of organic matter with  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}_2$  as described in more detail by Page (3), followed by the Benedict-Theis (4) technique. This technique consists essentially in the colorimetric estimation of a stable blue color developed by molybdic acid, hydroquinine and sodium bisulphite in the presence of a large excess of  $\text{H}_2\text{SO}_4$ . The following table gives the average of 4 analyses taken during the month of August 1926 from the tank water of the laboratory.

TABLE I.  
ANALYSIS OF TANK WATER OF MARINE BIOLOGICAL LABORATORY.

Grams per 1000 cc. sea water at 20 degrees C.

Specific Gravity = 1.0180 (20 degrees C.).

		Millimoles.
Sodium.....	8.80	0.3826
Potassium.....	0.412	0.0105
Calcium.....	0.428	0.0107
Magnesium.....	1.3004	0.0534
Chlorine.....	18.350	0.5912
Sulphate.....	2.615	0.0272
Phosphate.....	0.002	—



## DISCUSSION.

These analyses are in rather close agreement with those of Wheeler (5) made at Beaufort, North Carolina. The sodium and specific gravity are slightly lower than most of Wheeler's and Ditmar's (6) analyses. Whether the lower sodium is due to an error in one or other of the methods we cannot say.

The phosphate showed the marked seasonal variations first carefully investigated by Atkins (7). At times we could find no determinable quantity present. Atkins has shown that these variations are largely dependent on the plankton growth especially the diatoms.

F. W. Clark (8) gives a summary of most determinations that have been made of the composition of the oceanic salts.

## SUMMARY.

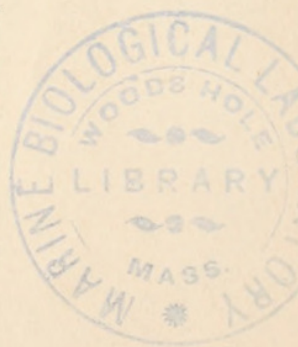
1. The relative quantities of the more important salts in the Woods Hole, Massachusetts, sea water have been determined.

2. The Kramer-Gittleman technique for the determination of sodium in serum has been modified for the analysis of sea water. It has been shown that Mg and Ca interfere seriously when present in quantity and must be removed before the Na determination.

It is a pleasure to acknowledge my indebtedness to Dr. W. A. Perlzweig for his many valuable suggestions.

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