and its culture to open the way to that kind of service which brings the joy of progress and the continuing rewards of real accomplishment.

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THE WORLD'S SUPPLY OF IODINE IN RELATION TO THE PREVENTION OF GOITRE[1]

OWING to the varying reports as to the concentration of iodine in sea water, I have made a number of determinations on water dipped from the Santa Monica, Cal., pier. Even after filtration, this water contained so much colloidal material as to interfere with the determinations. It was finally observed that thorough shaking with carbon tetrachloride and filtration removed this sufficiently to make analysis possible. The carbon tetrachloride was purified by the addition of a drop of bromine, action of sunlight and shaking with an excess of sodium thiosulfate solution. In determining this excess, some very dilute sodium carbonate solution was poured into the carbon tetrachloride and tenth normal sodium thiosulfate run in, about half a cc. at a time, followed by shaking, until the color disappeared. This solution was separated off and more carbonate and about two cc. of thiosulfate added with thorough shaking, followed by separation of the water phase. The carbon tetrachloride was then dried and distilled, the first distillate being rejected.

It was found that evaporation of the sea water until sodium chloride began to crystallize out made it acid, due to precipitation of calcium carbonate and the hydrolysis of $MgCl_2$, magnesium being a weak base, but there was no loss of iodine. Furthermore, a dry salt could be made of the sea water, without appreciable loss of iodine. This was accomplished by evaporation until the calcium carbonate precipitated; precipitation of the remaining calcium and magnesium by the addition of 100 cc. of seven per cent. Na_2CO_3 solution for each liter of original volume; filtration; washing the precipitate on the filter and evaporation of the filtrates to dryness.

In the analysis of the iodine content of salt, it was dissolved in water and the same procedure followed as with brine. In analyzing water or brine, standard solutions of the same NaCl content but varying concentrations of iodate were made up and treated in the same way as the unknown. The quantity of reagents added varied with the samples, and no portions were thrown away until the yield of iodine was found to be complete. Each sample if not near neutrality, was neutralized, using test paper, and about 10 cc. of concentrated HCl per liter added. In case buffers were present, at least enough acid was added to react acid to brom-phenol-blue (or methyl-orange). An excess of arsenious acid was added to reduce the iodate to iodide, the equivalent of 1 to 10 cc. of tenth normal per liter, and allowed to stand 20 minutes or more. At this stage colloids, if present, were removed. One per cent. sodium nitrite solution was added to the extent of ten times the quantity of arsenious acid. The sample was then extracted with several portions of carbon tetrachloride, which were then collected in a separatory funnel. In cases of 0.04 milligram per 100 cc. of the sample, a pale pink color could be detected in the carbon tetrachloride. The smallest workable quantity, often 1 cc. of very dilute (less than 0.1 per cent.) sulfurous acid was shaken with the extract until complete extraction of the iodine was effected. The carbon tetrachloride was removed from the sulfurous acid solution and a drop of concentrated sulfuric acid added, followed by sufficient sodium nitrite solution to oxidize the sulfurous acid and completely oxidize the iodide to iodine. The iodine was extracted with a sufficient quantity of carbon tetrachloride to fill the colorimetric apparatus (which varied in nature with the size of the yield) and compared with the standards. There must be nearly the same quantity of iodine in the final standard taken for comparison as in the unknown, and the treatment must be identical, quantitatively, especially in regard to volume relations and thoroughness of shaking.

The quantity of iodine found in the sea water was 0.05 milligrams per liter, which is a confirmation of the findings of Winkler for

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[1] From the Southern Branch, University of California, and the University of Minnesota.

Adriatic sea water. Winkler probably had less decaying organic matter in his samples than were present in mine, as he makes no mention of difficulty on account of the presence of colloid material.

A sample of water which I dipped up from the Saltair pier, in the Great Salt Lake, Utah, contained only 40 per cent. more iodine than in sea water although the chlorine concentration was about 500 per cent. greater than in sea water. Since the Great Salt Lake is the residue left from the evaporation of Lake Bonneville, which was 1,000 feet deeper than the Great Salt Lake, and received practically all of the drainage of the Great Basin, covering Utah and parts of neighboring states, we have here a demonstration of the small quantities of iodine that are given up in the weathering of both igneous and sedimentary rocks.

Practically all of the iodine of the earth's surface is in the sea, which contains about sixty billion metric tons of iodine in the form of inorganic salts. This iodine probably entered the sea at the time chlorine accumulated in it. Iodides were probably the most soluble salts on the earth's surface, chlorides being next in solubility. If the earth was once hot on the surface, it is probable that hydriodic acid existed in the atmosphere and was washed into the sea with the first rain. Insoluble iodides of heavy metals are considered by Emmons to be secondary formations, due to the seepage of sea water through ores.

Judging by the prevalence of goitre, there is often a deficiency of iodine in our food and drink. At present, so little is known about the exact quantities of iodine taken into our stomachs that we can judge only by the number of cases of goitre. Omitting the details of local distribution of goitre, there is a wide goitre belt extending north along the Appalachian mountains to Vermont, thence west through the Great Lakes region to Montana and Washington and turning south it finally includes all of the Rocky Mountain and Pacific states. In fact, the goiterous belt includes the mountainous and glaciated regions. Since the run-off from mountainous and glaciated regions has carried away so much of the soluble material, it seems likely for this reason in addition to other evidence that the goitre belt is a low iodide belt.

Since the goiter belt includes large cities and millions of population, it seems unlikely at present that all of its inhabitants will receive iodide medication in pure form. Since the sea contains the bulk of the supply, the transfer of iodine from the sea to our food or drink should be increased. Perhaps the most attractive method is the inclusion of sea-foods in our diet, but this is limited. Dr. Turrentine of the Kelp-Potash Plant at Summerland, Cal., informs me that powdered kelp, when added in small amount to food can not be tasted and when added in larger amount imparts a pleasing taste to it. Since it is richer in iodine than ordinary sea-food and is relatively abundant, it should be an important source of iodine in our diet. Since sea water and salt-deposits contain iodine, salt might be made an important source of iodine in our dietary scheme. Blood and shell fish are about the only foods that do not require the addition of salt to make them palatable and fill our physiological needs, and hence the presence of iodine in salt would insure its universal consumption. Mr. O. S. Rask and myself failed to find iodine in any one of a number of samples of salt examined. Salt could easily be prepared from sea water as described above with the retention of the iodine compounds and at a cost not exceeding that of present-day table salt. Some of the magnesium carbonate precipitated from it could be added later if it be desired to make a shaker-salt, but from a nutritive standpoint, the addition of calcium phosphate for this purpose is highly desirable.

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INTERNATIONAL MEETING OF CHEMISTS AT UTRECHT

At Utrecht on June 21 to 23, there was held the first gathering at which chemists from Germany and Austria have met with chemists from England, America and other countries for the presentation and discussion of scientific papers. The following persons were present: America: L. M. Dennis, D. A. MacInnes, W. A. Noyes.