

be concentrated on one area. A modified program was carried on until the completion of the "Dahlgren", a 29 foot motor boat especially equipped for oceanological work.

the production and distribution of pelagic life in the region of Frenchman's Bay in order to determine if possible to what extent the fertility of this area is due to strictly local conditions, or to what extent it may be influenced by the peculiar hydrographic conditions at the mouth of the Bay of Fundy.

It is possible that local sources of food supply are not sufficient to maintain the rich animal and plant communities of the bays along the Maine coast, and instead of contributing to the fertility of offshore waters they may really be consumers, depending to a certain extent for their support upon the food stuffs transported by the westerly drift about the margin of the Gulf. If such a condition is found to exist, any alteration of the vital areas to the eastward, such as the proposed damming of Passamaquoddy Bay, might exert more than a purely local influence.

Investigations in areas of considerable river outwash, such as Penobscot or Casco Bays, would not yield results applicable to the coast line as a whole. Frenchman's Bay with its negligible land drainage offered a more favorable location in which to begin.

In major marine biological problems there are so many unknown factors to contend with that all possible physical, chemical, and biological aspects must be considered. Only through a correlation of the many known controlling factors can one hope to understand production and distribution of life in the sea.

Following are the individual summaries on the different subjects considered:

#### 4. PHYSICAL OCEANOGRAPHY

By H. R. SEIWELL, *Buffalo Museum of Science*

Observations on temperature and salinity of Frenchman's Bay and adjacent waters were conducted throughout the three months period June to September. Detailed observations were conducted at two stations, one in the mouth and the other near the center of Frenchman's Bay. Hourly series of temperatures and salinities extending over periods of eight to fourteen hours were made at these two stations and attempts were made to characterize the water masses and study their tidal movements. Four eight hour hydrographic stations were established throughout the length of Penobscot Bay. Temperatures and water samples for various major and minor constituents were obtained.

The temperature observations of last summer together with those of

this year will be used to compute the summer heat budget of Frenchman's Bay and facilitate comparisons with Bay of Fundy on the north and other bodies of water lying to the south where similar observations have been made. A comparison of summer heat budgets will also be made from temperature sections obtained in some of the larger inland lakes of Mt. Desert Island, which are presumed to be exposed to the same intensity of solar radiation as Frenchman's Bay.

The determinations of salinities and densities of all water samples collected were obtained by measurement of the chlorine content using Mohr's titrimetric method, and by the direct measurement of density using a glass plummet or sinker. All reductions were made from Knudsen's Hydrographical Tables.

The direct determination of chlorine was carried out in the usual manner. Fifteen cubic centimeters of the sea water sample were titrated with silver nitrate solution which had been standardized against Copenhagen standard sea water. Yellow potassium chromate was used as an indicator which reacting with the silver nitrate after all the halogens are precipitated produces the red precipitate of silver chromate. All chlorine titrations were made by Gladys Seiwel.

The direct measurements of density were made with a sealed cylindrical glass plummet which displaced about forty-one grams of distilled water. The plummet was hung from one arm of a chemical balance (sensitive to 0.1 mmg.) and after being weighed was suspended in a glass cylinder containing a sample of sea water. The temperature of the sample was read from a calibrated thermometer graduated to tenths of a degree. Two determinations were made on each sample for agreement.

A third type of density apparatus based on an application of Hare's method was experimented with. Using this method the known and unknown samples of sea water were caused to rise in the arms of a U tube, four feet long, by reducing the pressure in the upper part of the tube. Theoretically the lengths of the columns of liquid in the two tubes are inversely proportional to the densities of the liquids. Hence, if the density of one is known that of the other follows.

A comparison of the densities of sea water ranging from nearly fresh to more than 32 grams total salt per mille as determined by the silver nitrate and plummet methods will be worked out in detail. When these comparisons are completed they will throw light on the reliability of the assumption of the constant proportion of salts in sea water in the region of Mt. Desert Island, Maine. The duplicate density determinations were

carried out in conjunction with work on the salt ratio by Dr. N. W. Rakestraw.

Alkalinity and oxygen estimations were made by the Author's assistant, Gladys Seiwell. Samples for analyses were taken along with the regular hydrographic hourly series of observations.

Studies on the ammonia content of Frenchman's and Penobscot Bays were made by adding Nessler's reagent to sea water previously treated with salt seignette and sodium hydroxide. The yellow brown color developed was compared against standardized ammonia color standards.

Continuous records of air temperatures and pressures were kept by recording thermographs and barograph. A water thermograph attached to a floating dock gave a continuous record of surface water temperatures during the first two months of the season.

## 5. REPORT ON THE CHEMICAL WORK OF THE OCEANOGRAPHIC PROGRAM

By NORRIS W. RAKESTRAW, *Brown University*

The chemical work which has been carried on in connection with the oceanographic program of the Laboratory may be divided into several parts. During the summer of 1929 emphasis was placed upon the analysis of the water from various localities for its phosphate and nitrate content. These so-called "nutrient salts" have been shown to be intimately concerned, in the open ocean, with the growth of diatoms, and therefore indirectly with all other forms of life. Water collected at various depths from the several stations established in Frenchman's Bay and the vicinity was analyzed for these and certain other constituents in the hope of finding a similar relation in shore waters and in the effort to determine the contribution which the outflow of water from the land makes to these food factors in the sea.

The analytical results showed large variations in the concentrations of phosphate and nitrate, not only at different places but at different times at the same station. Concentrations were also somewhat higher than those found in the open ocean. Evidently conditions are very different, and in view of these findings it seems hopeless to demonstrate any relation between the growth or abundance of diatoms or other forms of life and the concentrations of such chemical constituents.

Nitrite nitrogen was also determined in most of the samples and was found to be present in significant amounts in the sub-surface samples but very seldom on the surface. Determinations of silicate and dissolved oxygen yielded no new information of importance.

Work carried on between the summers of 1929 and 1930 at Brown