probably no science has done so much as chemistry in revealing the hidden possibilities of the wastes and by-products in manufactures.

This science has been the most fruitful agent in the conversion of the refuse of manufacturing operations into products of industrial value. . . . Chemistry is the intelligence department of industry.

Yet we are often uninformed concerning the character and amount of the by-products going to waste in our immediate neighborhoods, a careful study of which might lead not only to financial reward for the manufacturer as well as for ourselves, but might also prevent much of the present pollution of our streams and of the air we breathe.

It is not only very desirable, but will soon become really necessary for manufacturers to avail themselves more freely of the assistance of the experts in universities, technical schools and scientific institutes.

THE FUTURE OF RESEARCH IN CANADA

With a strong and prosperous nation to the south, expert in manufacturing operations and constantly endeavoring seriously to gain markets for its surplus production, Canada has developed less rapidly from an industrial viewpoint than if she occupied a more isolated position geographically. European and American products have long been familiar to the Canadian people, and the manufacturers of the Dominion have had an arduous struggle in establishing their wares. But this time is past. Since 1910, all over Canada, new factories have been erected, new products are being manufactured, and new plans for the future are being considered.

With her diversified and abundant mineral resources, her extensive forests and her great power sources, Canada has indeed wonderful industrial prospects. Noteworthily helpful work in the opening-up of various fields has been done by your Department of Mines, whose distinguished division Directors, Dr. Eugene Haanel, of the Mines Branch, and Dr. R. W. Brock, of the Geological Survey, have been pioneers in your industrial development; but as your mineral, wood and water-power wealth become more and more apparent, just so much more will the need for and value of industrial research become apparent to your manufacturers. As in other countries, chemistry will be the pathfinder.

Canada is but at the adolescent period in her industrial life. Your patriotism need not therefore be shocked by apparently

> Nourishing a youth sublime
> With the fairy tales of science.

Many of the natural secrets of your vast country have been gained, laboriously wrought for, but rich rewards await your coming generations who inherit the knowledge gained by an awakened conscience of research.

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OCEANOGRAPHIC CRUISE OF THE U. S. BUREAU OF FISHERIES SCHOONER "GRAMPUS," JULY AND AUGUST, 1914

DURING the past summer the fisheries schooner *Grampus* has continued the oceanographic work of 1912 and 1913,[1] in my charge, with Mr. W. W. Welsh as assistant. The general problem laid out for the *Grampus* cruises of the past three years has been the study of currents, salinities, temperatures and plankton of the coastal waters off our eastern seaboard. In 1912 the work was confined to the Gulf of Maine; in 1913 it extended over the whole

[1] H. B. Bigelow, "Oceanographic Cruises of the U. S. Fisheries Schooner *Grampus*, 1912–13," SCIENCE, N. S., Vol. 38, No. 982, pp. 599–601, October 24, 1913; "Explorations in the Gulf of Maine, July and August, 1912, by the U. S. Fisheries Schooner *Grampus*. Oceanography and Notes on the Plankton," *Bull. M. C. Z.*, Vol. 58, pp. 31–147, 9 pls., 1914.

breadth of the continental shelf between Cape Cod and Chesapeake Bay, with a repetition of the Gulf of Maine stations; and for 1914 we planned to continue our survey eastward from Cape Cod, as far as Cape Breton and Cabot Straits, to connect with the observations taken by the U. S. revenue cutter *Seneca* during the preceding spring. Special attention was to be devoted to George's Bank, important oceanographically because of its position as a rim between the cold water of the Gulf of Maine and the Gulf Stream; to the effect of St. Lawrence water on the physical characters of the coast water in general, and on the Gulf Stream; and to the possible influence of the Labrador Current on our coasts. Experience has shown that the coastal water, bounded as it is by the coast on one hand and the Gulf Stream on the other, is best studied by successive sections normal to the coast; and our stations were located with this end in view. We were able to carry out this program as far as Halifax. But the European war forced us to relinquish the stations further east; and the time thus released was devoted to repeating our Gulf of Maine stations, and to running a section from Marthas Vineyard to the Gulf Stream for comparison with the preceding year.

The general program of work for each station consisted of serial temperatures and water samples, at sufficiently small vertical intervals to afford satisfactory salinity and temperature sections (3 to 7 according to the depth); a vertical haul with the Hensen quantitative net, especially instructive for copepods, less so for larger and more active organisms; surface hauls with the fine (No. 20) and coarse (No. 5) silk nets; and hauls at intermediate depths with one or more of the large nets, according to depth. When two were used they were attached simultaneously to the wire rope, the Helgoland net usually at the lower, the "Michael Sars" net at the higher level. In addition, the surface temperature was taken hourly throughout the cruise; and the color of the sea frequently recorded by the Forel scale. Current measurements occupy so much time that we obtained only one complete record of an entire tide from the ship at anchor.

Since 1912 considerable additions have been made to the outfit of the ship; and this year we were provided with six stopcock water-bottles, an Ekman reversing water-bottle, three Ekman current-meters, a Lucas sounding-machine, and twelve reversing deep-sea thermometers of the latest type, especially valuable because by their use the probable error of the temperature readings was reduced from .15° to .03° F. Another refinement of apparatus was the attachment of the thermometer frames to the stopcock water-bottles, allowing the two sets of instruments to be used simultaneously in series, thus shortening the time for each set. We also carried a very complete set of horizontal and quantitative plankton nets, besides the usual trawls, fishing gear and harpoons; in short, we can at least congratulate ourselves on a thoroughly modern oceanographic outfit.

Our first section, across the Gulf of Maine and the western end of George's Bank, to the Continental Slope, occupied us from July 19 to July 21. Being then well within the sweep of the Gulf Stream, as shown by the temperature and plankton, we skirted the outer edge of the Bank to about longitude 66° 10′ W., whence we drew a second section across the Bank, to the deep basin of the Gulf. It would have been of interest to have extended the work to the abyssal depths further off shore; but our gear limited our observations to the upper 500 meters.

We next drew a section across the deep gully known as the "Eastern Channel," between George's and Brown's Banks, of great oceanographic interest because it is the only connection between the basin of the Gulf below the 100-fathom contour, and the deeps of the Atlantic; occupying stations successively in the gully, on Brown's Bank, in the channel north of the latter, and on the coastal bank off Cape Sable. On July 25 the *Grampus* anchored in Shelburne, Nova Scotia.

Two days later we made a current station a few miles off that port, anchoring the vessel in 30 fathoms of water, and taking measure-

ments of the surface current hourly for twelve hours (thus covering an entire tide, ebb and flood), and a few bottom current readings. The calm weather of that and the two preceding days gave an ideal opportunity for this work; hence the strong dominant set to the southwest which our instruments revealed is probably of considerable importance as an index of the long-shore flow of St. Lawrence water. From this point we ran a section across the coastal shelf, via Roseway Bank and the deep but circumscribed basin between it and La Have Bank, to the continental shelf, where we towed and took oceanographic observations to 500 meters.

Our program now called for a section crossing the shelf obliquely, to Halifax, and the first half of this line was successful. But an easterly storm drove us off our course, to shelter in La Have River, where we were held prisoners, first by northeast winds, then by fog, and finally by a violent southwest gale for four days. On reaching Halifax, August 2, we learned of the European war; and shortly received orders to return to United States waters.

On August 6 we sailed from Halifax, planning to make first a section across the Continental shelf normal to the coast as far as Emerald Bank; and then to run to the Gulf of Maine, making stations en route. The section was successful, and we were lucky enough to vary the monotony of the plankton hauls by the capture of a large swordfish, and of a sunfish (*Mola mola* Linn.). But thick fog set in on August 8 and drove us once more to Shelburne for shelter. Until the eleventh we lay at anchor, waiting for a change of weather; then lost patience and put to sea again. Our next field was the Gulf of Maine, where we located our stations at the same positions as those of 1912 and 1913, first in the northeast corner, then off Mt. Desert rock, and along shore to Gloucester, where we arrived on August 15. A week was spent in port; and on the 22d the *Grampus* sailed again, running east to the center of the gulf, and then to Cape Cod. Passing through Vineyard Sound we took our departure from No-Mans-Land on August 25 for a section across the Continental shelf, with stations at the 20-, 35- and 80-fathom contours, and one over the 1,000-fathom curve. We had supplied ourselves in Gloucester with bait and a long-trawl, and made two sets for tile fish (*Lopholotilus chamæleonticeps*) on the twenty-sixth. In 80 fathoms we caught only two; but in 105 fathoms an hour's set yielded 19, the aggregate weight being about 350 pounds. We occupied three stations during the run back to Gloucester, where we arrived August 28.

During the cruise complete oceanographic data were taken at 52 stations, ranging in depth from 15 to 250 fathoms; 126 tows were made with the horizontal nets: the quantitative net was used at 26 stations. The distance sailed was about 2,000 miles.

Statements as to the scientific results must await the completion of titrations of the water samples and the general examination of the plankton samples: the general report on the cruise, like that on the cruises of 1912[2] and of 1913 will be prepared in the Museum of Comparative Zoology.

HENRY B. BIGELOW

INTERNATIONAL OCEANOGRAPHIC EXPEDITION

AT the present time arrangements are being completed to despatch the International Oceanographic Expedition under the command of J. Foster Stackhouse, F.R.G.S., for a seven years' voyage to chart the seas, and to determine as far as possible the exact position of the large number of rocks and reefs which have been reported during the last century.

Not since the days of the *Challenger* has so great an enterprise been undertaken, and it is highly desirable that no time be lost in making the fullest inquiries into these hidden dangers to navigation.

Over 3,500 dangers have been reported in the Pacific Ocean alone, and some of these no doubt account for the fact that during the last

[2] *Loc. cit.*