Michael McCartney: Columbus O'Donnell Iselin

The following is from Roger Revelle accompanying a letter to Worthington in 1976 requesting "fact checking". Worhtington's annotations have been incorporated.

In the twenty-fifth anniversary report of the Harvard class of 1926 Columbus Iselin wrote: "I have been lucky in my work, having taken up an obscure subject just before it began to receive recognition and support. ...the Navy is now supporting research and development at oceanographic laboratories on a generous scale. We have plenty of fancy gadgets to play with and these are most useful in working out some of the basic scientific problems of the sea."

To one who knew him, this statement tells much about Columbus and about his concepts of the science he did so much to develop. The "obscure subject" he took up as a beginning graduate student at Harvard has now become Big Science, with a total budget for oceanographic work in the United States at least a thousand times larger than when he began.

Columbus never thought of himself as a professional scientist. He was and remained an amateur of a nineteenth century kind. He loved the sea, in all its complexity, unpredictability and wild grandeur, and he loved to study the ocean. Yet he believed throughout his life that oceanography was a primitive science, which demanded from its practitioners devotion, hard work, and a seeing eye, but not, necessarily a background of professional, scientific training. His closest colleagues in his own research were inspired amateurs who began work at the Woods Hole Oceanographic Institution as technicians or deckhands.

In his research, he confined himself mainly to one majestic problem - the nature of the Gulf Stream - but his work was mostly descriptive. He had little interest or belief in hydrodynamic theories; the "fancy gadgets" that appeared after World War II were, for him, ingenious devices for making new kinds of descriptive measurements.

Columbus O'Donnell Iselin II was born on September 25, 1904, in his family's summer home in New Rochelle, New York. His great-great-grandfather, Isaac Iselin, came to America in 1801, at the age of 18, from Basel, Switzerland, where Iselins had been merchants, public officials, and military and professional men since the 14th century. Isaac and his descendants became private bankers and philanthropists in New York City.

The family custom of naming the first born son, Columbus, began with the marriage of Isaac's son to the daughter of General Columbus O'Donnell of Baltimore. Another child of that marriage, Oliver Iselin, successfully defended the America's Cup on four different racing yachts during the years from 1893 to 1903. This nautical great-uncle profoundly influenced young Columbus, who is reported to have built his first boat (called the Sponge, because it leaked) at age 11.

As was appropriate for the scion of a New York banking family, Columbus attended one of the "Saint Grotlesex" preparatory schools - St. Mark's in Southboro, Massachusetts. He entered Harvard in 1922. Believing that his destiny lay in banking, he planned to major in mathematics. His choice of a major, he claimed in later years, left him with much spare time, some of which he spent reading in the Widener Library.

This led him to Henry B. Bigelow, on of Harvard's great marine biologists, and all thoughts of banking were soon left behind. In an unpublished memorial, written in 1968, he said: "It was not easy to find (Dr. Bigelow), but finally I located him in a cluttered room on the top floor of the Museum of Comparative Zoology. He was peering intently at a small fish much preserved in formalin ... I told him about my growing interest in marine science, and hardly looking up from his little fish, he told me that I was reading in the wrong library. For anything having to do with oceanography, the library at the Museum was much the better one. ... In effect, he became my second father, for my own father died when I was 23."

Bigelow, a generous, yet sophisticated man, was a shrewd judge of other men and their potentials. As later events showed, he soon saw in young Columbus the qualities of leadership, intelligence and dedication he needed for a great project that was maturing in his mind.

Six feet four inches in height, straight and slim, with a classic profile and the quick strength of a sailor, Columbus at Harvard seemed like a "young god" to George Homans, who was several years his junior. Quiet and reserved, (his life-long shyness made him seem aloof), with an original, penetrating mind but few social graces, he never sought leadership - it was simply assumed by others that he would lead. He rowed on the Freshman crew and on the second varsity, joined the Hasty Pudding Institute and the Procellian Club, and graduated without special academic distinction in 1926. He enrolled as a graduate student in oceanography under Bigelow, received a master's degree in 1928, and was appointed Assistant Curator of Oceanography in the Museum of Comparative Zoology.

Every summer during his college years, and afterwards until 1930, Columbus went on long cruises Down-East, or elsewhere in the Atlantic, usually on a different boat each year. He was always accompanied by his boyhood friend, Terry Keogh, a wildly eloquent Irishman who was a magnificent seaman but developed an overwhelming thirst at an early age. In later years Columbus possessed an endless stock of sea stories, most of which centered around Keogh's drunken exploits.

During his senior year at Harvard, Columbus had a 78-foot schooner, which Terry christened Chance, designed and built in Nova Scotia to his specifications. Under Bigelow's guidance, she was fitted out with a gasoline winch and oceanographic gear. For the next two summers, Columbus and a group of other Porcellians, plus Terry Keogh and George Clarke, a fellow graduate student who later became Professor of Zoology at Harvard, cruised down to Labrador and southeast to Bermuda, studying the Labrador Current and the Gulf Stream. The results of these studies were published in four scientific papers between 1927 and 1931, which attracted wide attention. The data agreed so well with computations using the geostrophic equation (see below) that the ships of the International Ice Patrol soon adopted the geostrophic computations to predict the movement of icebergs.

A new 98-foot schooner, christened Atlantis by the romantic Keogh, was delivered in 1928. She was built in Lunenberg, Nova Scotia, in a shipyard that Columbus had purchased and given to Terry to manage. They sailed this first Atlantis, which had no engine, across the Atlantic and back in 1929, making oceanographic observations en route.

Terry Keogh's cousin was Eleanor Emmet Lapsley, who was always called Nora. They were both collateral descendants of the Irish martyr - patriot, Robert Emmet. Nora, a tautly beautiful woman, as accomplished a horsewoman as Columbus was a sailor, had known Columbus when she was a little girl in New Rochelle. They met again in 1927, when she was nineteen years old and he was twenty-three, and were married in January, 1929. During the next two decades they had five children, two boys and three girls. (Of course, the elder son was named Columbus O'Donnell.)

In 1930, Bigelow's great project became a reality - the Woods Hole Oceanographic Institution was established with a three million dollar endowment from The Rockefeller Foundation. Bigelow became its first Director, and appointed Columbus as his General Assistant. Soon afterwards, Columbus and Nora bought a 225 acre property at Chappaquansett on the island of Martha's Vineyard, where they lived for most of the next thirty-seven years. They operated it as a working diary farm; like many sailors, Columbus became an enthusiastic and competent farmer. He commuted to Woods Hole each working day, in good weather and bad, in a 40 foot launch, aptly named Risk.

Like the neighboring Marine Biological Laboratory, the "Oceanographic" was at first a summer haven for university faculty members who wanted to do research. Columbus was almost the only full-time scientist. His first task was to supervise the design and construction of a high-seas research ship. This was the 142-foot auxiliary ketch Atlantis, built in 1930-1931, in Copenhagen. Columbus became her first captain, and Terry was bosun. On her maiden trans-Atlantic voyage from Plymouth to Boston, there were twenty-five men in the crew, several of whom later became well known scientists. In the words of one of them, Columbus "was never a Captain in the military sense; things just got done without orders being given. We were proud of our assignment, he of his; he shed an easy confidence, and if he had any misgivings about his responsibilities, as well he might at age 26, he never showed them (Merriman, 1971). He had sold his own Atlantis the year before, with the proviso that her name be changed.

During the next nine years, Atlantis carried out a series of voyages in the deep Atlantic whose principal objective was the systematic exploration of the Gulf Stream. Columbus became Physical Oceanographer at Woods Hole, with collateral duties as Assistant Professor of Oceanography at Harvard. In 1940 he was appointed Director of the Institution, after Dr. Bigelow retired. He remained Director until 1950, when he turned the task over to Admiral Edward H. Smith, but resumed it again for two years after Smith's retirement in 1956.

Columbus's style as leader of the "Oceanographic" was similar to his behavior as a sea captain. He never seemed to give orders but instead encouraged each member of the staff, from the highest to the lowest, to do what he could do best. He spent much time walking around the Institution, talking to individuals about their work and their ideas, and usually contributing a new viewpoint of concept. He selected all the staff members personally, and made most other decisions himself, never bothering with the usual academic paraphernalia of committees.

An often-told tale is typical; one night, just before a long cruise, the carpenter shop was locked, and one of the scientists who were was about to sail early the next morning chopped the door open with a fire axe to obtain a needed box of tools. The irate carpenter knew the culprit and he complained bitterly to Columbus, whose advice after a short silence was: "Well, I guess the thing for you to do is to take an axe and chop down his door."

As a sailor and as a scientific directory, Columbus's outstanding traits were courage and quiet confidence. He had no discernible egotism, and little sense of his own greatness. His sister-in-law has described one of the many dangerous times at sea on a small boat. "About 70 miles off Cape May, we found ourselves in a bad blow ... Large pieces of gilt ornamentation kept flying back through the wind and spume ... We spelled one another at the pumps, and I can see Columbus lying fast asleep on the deck of the cabin, in his boots and oilskins, while the bilge water washed back and forth over him ... I attribute the fact that none of us suffered from fear - hunger, cold, seasickness and exhaustion, yes, but never panic fear - entirely to Columbus. His attitude was that this situation was not in the least unusual - was in fact to be expected if one went to sea, and simply called for resolution, endurance and vigilance. There was no talk about it. It simply emanated from him and was exceedingly bracing." (Schmidt, 1971).

The quantitative description of the physical structure and circulation of the North Atlantic Ocean Gulf Stream that Columbus and his scientific disciples developed over a period of more than 20 years, beginning in the early nineteen-thirties, was his most direct contribution to scientific understanding of the oceans. Among his co-workers and successors in this work were Alfred Woodcook, Fritz Fuglister, an artist who began his career at Woods Hole as a draftsman, and Valentine Worthington and Dean Bumpus, who began as shipboard technicians. He inspired other young men with more scientific training to devise and use the "fancy gadgets" that were "useful in working out the basic scientific problems." They included Henry Stommel, Willem Malkus, Allan Robinson, William von Van Arx, Maurice Ewing Athelstan Spilhaus, Allyn Vine, William Richardson and many others.

Iselin's principal scientific contribution are contained in four classic papers published between 1936 and 1948. (Iselin, 1936, 1939, 1940; Iselin and Fuglister 1948) The first of these was based on a series of measurements, from the surface down to more than four thousand meters, of the temperature and salinity of the waters at different depths along (seasonally repeated) cross-sections in the Western North Atlantic.

From these measurements it was possible to compute the vertical distribution of water density along each cross section and the resulting "geostrophic currents" at right angles to the section, that is the components of horizontal velocity at different depths. These computations depend on the assumption that at a fixed level in the deep water no pressure gradient exists, and there is no motion. Iselin took this level to be 2000 meters. Subsequent work has shown that the level of no notion, if it exists at all, may be much deeper or shallower than 2000 meters, and some of the unsolved problems of the Gulf Stream are related to this fact. Nevertheless, the geostrophic method does give relative velocities with depth in the waters beneath the wind-driven surface layer, and probably gives a fairly close approximation to actual average velocities in the upper water layers during the period of observations.

Iselin and his co-workers showed that the Gulf Stream is not a "river of hot water in the sea" as Benjamin Franklin and other early observers had thought. Instead, it is a deep, narrow, ribbon-like boundary zone between a huge lens or plug of water at an average temperature of 18(C in the Sargasso Sea down to depths of about 600 meters, and much colder waters along the Continental Slope. Near the surface, the water in this boundary zone moves toward the northeast with very high velocities, up to 9 km per hour. The current keeps the warm Sargasso Sea water from overflowing the colder, denser slope water.

On the assumption that there was little motion below 2000 meters, Iselin was able to compute the volume of water carried by the geostrophic current between Cape Hatteras and the tail or the Grand Banks. This transport is enormous, of the order of eighty million cubic meters per second, about eighty times the combined flow of all the rivers on earth.

The Atlantis section along the Mid-Atlantic Ridge made by Iselin in 1931 showed several distinct, broad, eastward-flowing currents. he supposed that beyond the ail of the Grand Banks the Gulf Stream breaks up into a number of branches, which together make up what he called the North Atlantic Current.

In his 1940 paper, Iselin compared the water transports computed from seasonally repeated hydrographic sections with those deduced from tide gauge records of sea level. He showed that the computed transport is at a maximum during the spring and summer months and about twenty percent smaller during October and November. The causes of this variation are still not known. In his paper with Fritz Fuglister in 1948, the results obtained from some of the new instruments developed during the nineteen forties were analyzed. This work was continued by Fuglister and Worthington in the 1950's. They were able to determine the water characteristics in great detail and to measure actual current velocities. The results showed that the high velocity region is very narrow, not more than sixty kilometers wide. The data apparently also indicated that the narrow, high velocity zone is not straight, but meanders and shed large eddies with horizontal dimensions of two hundred to three hundred Km. It is still not clear whether the current is continuous or discontinuous, consisting of multiple streams and eddies.

Below depths of one hundred meters over very large areas in the oceans there is a close relationship between temperature and salinity, such that when temperature and salinity observations are plotted against each other the points all lie on a narrow band, cutting across lines of equal "potential" density (roughly the density the water would have at atmosphere pressure). One widely accepted explanation of this relationship was given by Iselin in 1939. He supposed that the layers of equal potential density are like the layers of an onion, very extensive laterally by this vertically, extending from the surface in Northern latitudes to considerable depths in mid-latitudes. Where the layers intersect the surface, the waters gain their characteristic temperature and salinity from interactions with the atmosphere. This notion is undoubtedly at least partly true, but it has the serious difficulty that no connection has been found between North Atlantic surface waters with temperatures of eleven degrees or below and those at depth. A more likely explanation of part of the temperature - salinity relationship is that lateral mixing along surfaces of equal density stirs and homogenizes waters which originally had considerable differences.

Iselin and the late Maurice Ewing combined in a useful collaboration, just before the United States entered World War II. Both the British and the American Navies had developed echo ranging equipment, using underwater sound as a device for detecting and locating submarines. In the warm waters of the Caribbean and Bahamas regions, this equipment was very effective at night and in the early morning, but in the afternoon the range at which submarine could be detected diminished to a few hundred yards. It was at first thought that the cause might be biological. Ewing with his understanding of the ray theory of underwater sound propagation, and Iselin with his knowledge of the ways in which water temperatures near the surface change under the heat of the sun, showed that this "afternoon effect" resulted form the downward bending of sound rays and the formation of a sound "shadow zone", because of the heating of the surface waters during the day time. They produced a report illustrating the effects of vertical variations of sound velocity due to temperature and salinity distribution with depth, which was of great importance for both submarines and anti-submarine vessels, as well as for the introduction of oceanography into the consciousness of the Navy.

Columbus Iselin was one of the creators of the modern multidisciplinary oceanographic institution, which takes the world ocean as sits object of study. Before his time, many small marine stations existed in Europe, North America, Japan, and elsewhere. Most of these were devoted to physiological and other studies of near-shore organisms, although in a few, some research was carried out on the chemistry, physics, and other aspects of the neighboring ocean waters. These institutions had a relatively large scientific population in the summer time, mostly of unpaid faculty members from different universities, and a skeleton staff which maintained the collections and facilities during the academic year. In the United States only the Scripps Institution of Oceanography was a year-round institution with a full-time staff, but its only ship was a converted purse-siene fishing boat.

Henry Bigelow's concept of the Woods Hole Oceanographic Institution was likewise of a small laboratory that would be active mainly in summer, but with two important differences; the summer staff would be paid, and the institution would possess a high seas vessel that could operate anywhere in the North Atlantic ocean. As one present staff member described it: "Before World War II the Oceanographic was a place where about ten professors could come in the summer and not lose money. Scripps was an institution without much of a ship; Woods Hole had a ship but wasn't much of an institution."

Before Columbus' time, most oceanographic work on the high seas had been conducted on long expeditions. Many of these were major national efforts, and all of them required several years of planning, preparation and fund raising. During the expedition itself, as many kinds of research as possible were undertaken - collections of plankton, bottom living organisms, vertebrates and invertebrates, sediments, nodules and rocks from the sea floor, and water sample for chemical analysis; measurements of water temperature and biological productivity; geophysical and geological studies; and everything else that could be thought of in advance and that had a fair chance of accomplishment with the scientific techniques available at the time. After the ship returned home, the data and collections were analyzed and studied over periods of many years by some of the scientists who had been on board, and by colleagues whom they recruited. The work ashore was essentially that of a museum, in which many scientist-years were required for each month spent at sea.

With the coming of Atlantis to Woods Hole, investigations could be conducted in the deep sea far from shore on a year-round basis, year after year. It was possible to think of the Institution itself as a continuing expedition.

The problem then arose of achieving a balance between the work ashore and the work at sea, so that the results could be analyzed and reported within a relatively short time after they had been obtained. This could be accomplished in three ways: 1) by simplifying the work at sea, concentrating on a few types of measurements and samples; 2) by enlarging the scientific staff of the institution so that many scientists could share in the ship-board research and in working up the results; and 3) by development of methods for speeding up the analyses. Columbus was able to use the first two ways.

Throughout the 1930's, the work on Atlantis was concentrated on repeated measurement of temperature, salinity and a few other chemical properties of the subsurface waters, although some biological and geological studies were undertaken in the summertime.

Even with the cumbersome computing methods of the time, the data could be worked up, plotted and interpreted about as rapidly as they were collected.

With the dramatic growth in the size of the Institution during World War II, many groups of full-time investigators were organized, each concerned with a set of related problems that involved both sea-going and on-shore research. These and similar groups were capable of using the ship facilities on a full time basis after the war, provided sufficient financial support could be maintained. Fortunately, the Navy had been convinced that much more needed to be learned about the oceans, if its new and rapidly changing technologies were to be effectively utilized. The Office of Naval Research and the Navy Bureau of Ships were able to support much basic and applied oceanographic research. Columbus was an eloquent and persuasive salesman for this work. He was, himself, completely convinced both of the importance of the Navy and of its need for greater understanding of the oceans, and he had a gift for making simple analogies. For example, he compared the nature of submarine warfare to frontier conditions in early America, when the Indians who were intimately familiar with every aspect of their natural surroundings were often able to hold out against troops who had more fire-power but less knowledge.

At the same time he wrote and spoke whenever he could on the importance for all mankind of the living and non-living resources of the sea, the role of the oceans in determining weather and climate, and their uses for waste disposal and many kinds of human recreation. His enthusiasm, imagination, and special way of writing and talking about oceanography and oceanographers had a great impact, not only on government officials but on the scientific mandarins, nearly all of them physicists, who controlled the course of American science in the 1950's.

The third means of making analyses and publishing the results in "real time" depended on the development of computers and self-recording instruments. These have made it possible not only to speed up the analyses but also to collect much more detailed and meaningful data, particularly when the computers can be installed on ship board. But these devices were mostly developed after Columbus's time.

Long before most other oceanographers, Columbus recognized the developing international problems that are now so evident in the stale-mated United Nations Conference on the Law of the Sea. At the first International Oceanographic Congress, held at the United Nations in 1959, he said: "The economic and social problems that will be encountered as we begin seriously to exploit marine resources seem to me formidable, much more formidable than the remaining unsolved scientific problems ... I am afraid the freedom of the seas is ... incompatible with their efficient and wise exploration ... some very wise agency needs to be developing the ground rules within which the vast marine resources can be developed in an efficient and safe manner for the benefit of all mankind."

The National Academy of Sciences gave Columbus its Agassiz medal in 1943, for his scientific work on the Gulf Stream. He was the youngest man ever to receive this highest of awards to oceanographers. IN 1948 he was give the Medal for Merit of the United States Government, with a citation signed by President Truman, an in 1966 the Woods Hole Oceanographic Institution gave him its own Henry Bryant Bigelow Medal. He was elected a member of the American Academy of Arts and Sciences in 1944, of the American Philosophical Society in 1950, and of the National Academy of Sciences in 1951.

Columbus Iselin was seriously ill during the last several years of his life. He died in West Tisbury Falmouth, Massachusetts on January 5th, 1971. His beloved Nora died less than two weeks later. Columbus's funeral on Martha's Vineyard was attuned by many of the sailors and workers of the Oceanographic Institution and the fisherman and farmers of the Vineyard. They stood in the back of the church, dressed in their working clothes, and sang in deep, sonorous loud voices:

"Eternal Father, strong to save, Whose arm hath bound the restless wave... O hear us when we cry to thee For those in peril on the sea."

The return ferry trip to Woods Hole after the funeral was something of a festive reunion of his old colleagues, just as Columbus would have wanted it to be.

Roger Revelle
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