Woods Hole in World War II

excerpts collected by Judith G. Stetson

Paul Galtsoff came to the U.S. from Russia at the time of the 1917 Revolution. He worked with the U.S. Fisheries focusing on shellfish studies and became an authority on the oysters of the world, including the Japanese oyster. He described the changes that World War II brought to the quiet village of Woods Hole where he worked with the U.S. Fisheries.

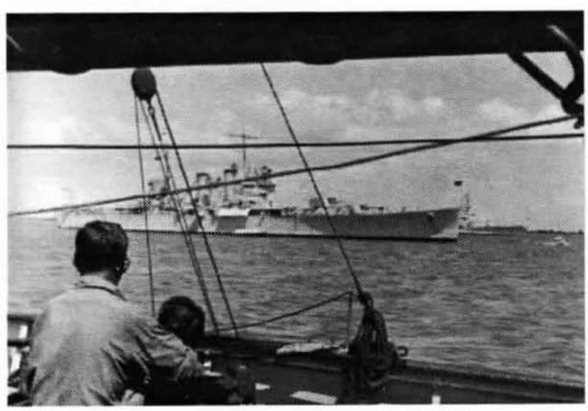
"During the war years Woods Hole presented an unfamiliar picture. The fisheries grounds and the adjacent buildings of the MBL were surrounded by a high fence, and became inaccessible to civilians. The gay crowd that used to assemble near the aquarium and around the seal pool was no longer there. Less than half of the MBL laboratory rooms were occupied. Bright-looking pleasure boats were gone, and very few fishing vessels were seen in the harbor. Even the New Bedford-Nantucket steamer lost its smart appearance under a coat of gray paint. At night everything was pitch dark and the streets were deserted."

The war came to Woods Hole village in the form of gun emplacements constructed on Juniper Point and on both shores of Naushon Island. But the military brass was slow to learn that the Woods Hole Oceanographic Institution could offer anything to the war effort.

Columbus O'D. Iselin wrote that on July 1, 1940, when Woods Hole Oceanographic Institution began its first contract with the Navy, there was practically no liaison between oceanographers and the Navy department or its facilities. The meaning of the words "ocean" and "atmosphere" seemed to be little more than "water" and "air."

On August 5, 1940, Iselin sent a memorandum to the National Defense Research Committee outlining eight specific projects that oceanographers could pursue for the Navy, including the study of marine fouling that was already under way. He pointed out that German oceanographers had been assisting the German government for years.

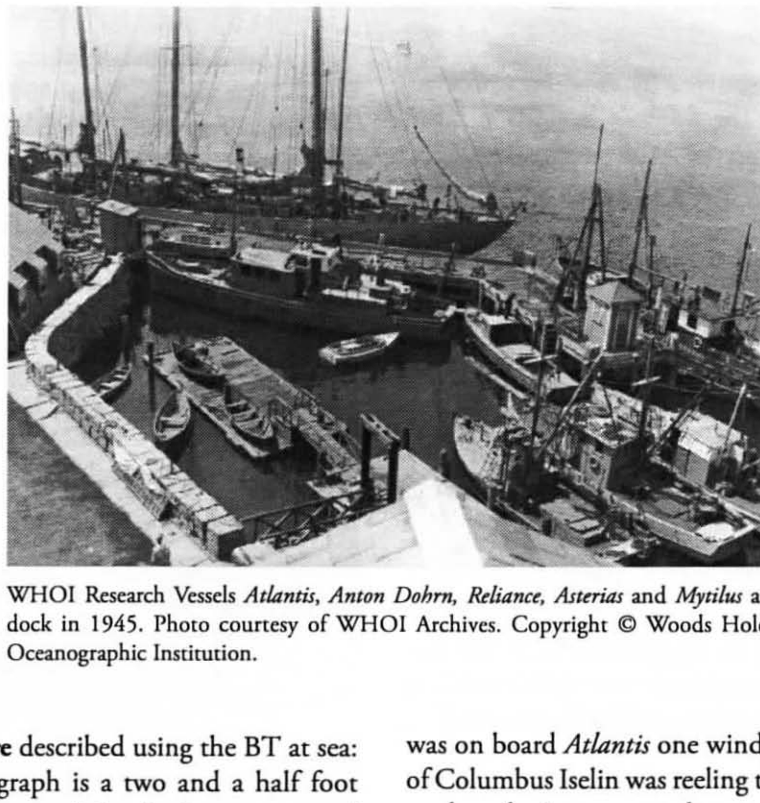
Lower ranking officers and practicing scientists had better communication. **William MacLeish** wrote, "During the thirties, the Navy had been experimenting with sound to detect enemy submarines. When the sonar began to miss or mislocate targets, a concerned lieutenant dropped by Woods Hole with some questions. Down to the Caribbean went [Columbus O'Donnell] Iselin and *Atlantis,* and up came the answer, the sonar beams were being affected by temperature differentials near the surface of the water, much as light beams are bent as they pass through a prism. A submarine could use temperature gradients



Warship seen from the *Atlantis* deck on a cruise around Cuba, 1938. Photo by Alfred H. Woodcock. Copyright © Woods Hole Oceanographic Institution.

to escape detection – if it could find them. And again, the Oceanographic had something to offer."

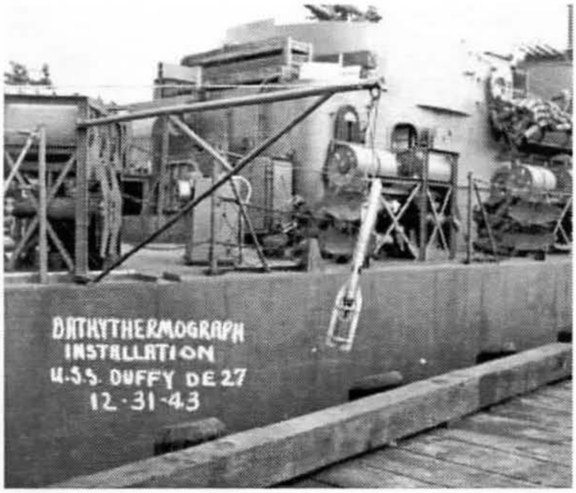
"An MIT meteorologist and Woods Hole summer sojourner named **Carl-Gustav Rossby** had designed a mechanism that could measure temperature continuously from the surface down to several hundred feet. Rossby asked a young colleague, **Athelstan Spilhaus,** to see what might be done to turn the mechanism into an instrument. Spilhaus...went to work. When he – and later **[Maurice] Ewing** and **[Allyn C.] Vine** – were finished, oceanography had a new and immensely valuable tool: the bathythermograph or BT. With the BT, and temperature charts made from thousands of BT casts, the Navy was able to improve vastly its chances of destroying Axis submarines and saving its own."



WHOI Research Vessels *Atlantis, Anton Dohrn, Reliance, Asterias* and *Mytilus* at dock in 1945. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

C. Dana Densmore described using the BT at sea: "The bathythermograph is a two and a half foot long brass torpedo containing both pressure and thermosensitive elements. Free-run off a small winch, like a fisherman's casting reel with a thousand feet of light wire, it delivers on a smoked glass slide a trace of temperature versus depth to around 200 meters. This operation was frequently cold, usually wet and on occasion dangerous. No one cared much about taking BTs, but they produced most useful data much sought after by the Navy. They are now superseded by the X (expendable) BT which drops a little bomb on the end of a hair-thin wire to record in the lab, and can be fired off instantly to a satellite for transmission."

Carlton E. Wing and his colleagues in the WHOI shop designed a winch to reel out and back the 1/8 inch wire of the BT. The WHOI machine shop manufactured it. **Tom Stetson** recalled that there was no automatic level to guide the wire back onto the winch, instead the operator used an oak stick to wind it safely and evenly back onto its reel. Even oak did not last long doing that work. Tom also said that the BT's 'smoked glass slide' was in fact smoked with skunk oil and was carefully handled by the edges. Tom was on board *Atlantis* one windy day when the son of Columbus Iselin was reeling the BT in. He forgot to slow the instrument down as it approached the stern through a strong following sea. The BT came flying out of the front of the wave. Like an ice skater accelerating into a whirl, the wire wound itself faster and faster, tighter and tighter around the boom of the winch. The wire finally broke and the BT shot off



Bathythermograph Installation on U.S.S. *Duffy*, 1943. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

into the air and sank with all its data. Unfortunately, this accident was not uncommon.

Thousands of BT casts were made to get raw data. Much more work was needed to make that data useful. **Frederick Fuglister** took some 60,000 bathythermograph records of shallow water temperature profiles obtained in the North Atlantic and patiently reduced them to monthly charts of temperature down to 200 meters depth.

Maurice Ewing and **Allyn Vine**, two of the wartime recruits at Woods Hole, recognized that knowledge of subsurface ocean temperatures would be equally valuable to submarines in avoiding sonar detection. They designed a bathythermograph for submarines, and this was widely installed.

Installation of the new BTs was no good without instruction. Enter **Dean Bumpus**.

Dean had been one of the few people working at WHOI in the spring of 1942 when **Nelson Marshall** brought his invertebrate zoology class over from Rhode Island for a tour of the institution. When the Navy's mass production order of BTs was filled, Dean left WHOI to serve on destroyers and submarines to teach the crews how subs could hide from sonar beneath the acoustic barriers that develop in stratified seawater. Dean later told Nelson Marshall that it had been much easier to interest the submariners than the Navy men aboard the destroyers in the new technique.

Roger Revelle reported that **Alfred Redfield** and Vine devised a completely different method for submarine use of vertical temperature gradients. They realized that a submerged submarine could control its buoyancy with sufficient accuracy to be able to "sit on a layer" (i.e., to remain in the middle of a vertical ocean temperature gradient without moving.) The submarine could shut down its motors and remain absolutely quiet for many hours, thus avoiding detec-

Maurice Ewing waiting for the seismograph, 1938. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

tion by listening as well as echo ranging. Together with their colleagues Dean Bumpus and **William Schevill**, they installed submarine bathythermographs and taught this technique with great success to the U.S. fleet submarines in the Pacific.

William Schevill and Allyn Vine also studied the effect of rudder and speed changes on trim and depth control in submarines to determine the best way to move a sub as rapidly, safely and quietly as possible from one depth to another.

Instructors could not be everywhere. Training manuals, although not dramatic, were an essential part of the war effort. In Washington the oceanographic unit of the Navy Hydrographic Office under **Mary Sears** (by that time a WAVES lieutenant) and the Sonar Design Division of the Bureau of Ships cooperated with Redfield and Vine in producing training manuals and Submarine Supplements to the Sailing Directions.

In 1942, the institution used a fleet of smaller craft for detailed studies and experiments in the local waters of Massachusetts Bay and Vineyard Sound. Every week the Woods Hole waterfront reverberated to the sound of underwater explosives as workers of the Underwater Explosive Laboratory detonated various test devices off Naushon Island. Nonamesset Island was used as a depot for storing TNT, and a casting shed was set up there to manufacture shaped charges.

Henry Stommel wrote that one of the most astonishing developments of the studies of underwater sound transmission was W. M. Ewing's discovery of the "sound channel," the level of minimum sound velocity that permits the sounds of small explosions to be heard across entire ocean basins.

Al Vine holding underwater camera, 1940. Photo by Alfred H. Woodcock Copyright © Woods Hole Oceanographic Institution.

Before the war was over, the Oceanographic had undertaken many wartime projects. Scientists who had studied current flows and sediment deposition off major U.S. estuaries advised the Navy to place its stationary hydrophones on the south side of eastern harbors and the north side of west coast harbors for best results in tracking enemy mine layers. **Henry C. Stetson**, head of the Geology Department at WHOI, constructed sediment charts for the continental shelf off the Atlantic and Gulf coasts of the U.S. which showed the acoustic effect of the bottom character in water less than 100 fathoms. He also studied the behavior of mines anchored in different types of sea bottom and scoured by different currents.

Studies were made to predict sea and surf conditions for forecasting conditions likely to be encountered during amphibious operations. **Jeffries Wyman** and **Alfred Woodcock** studied low-level meteorological phenomena pertinent to aircraft carrier operations and laying smoke screens. Oceanographic studies of deep ocean currents helped the Navy estimate the probable drift patterns of rafts carrying shipwreck survivors.

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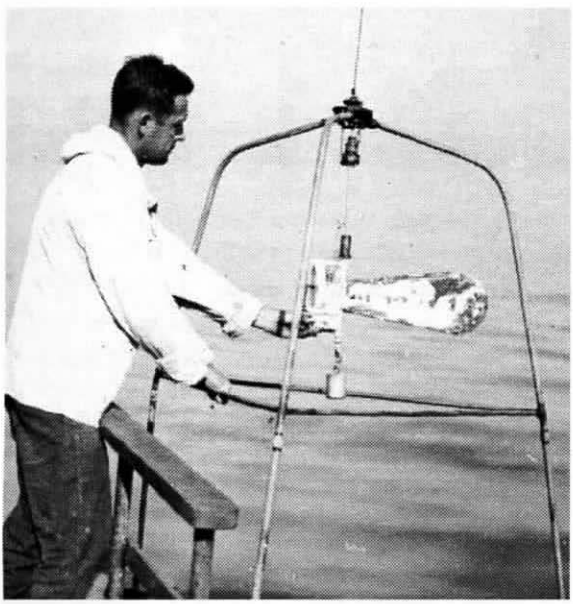

Roger Revelle with Ekman current meter, 1938. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

Alfred C. Redfield 1890 - 1983

Roger Revelle, a distinguished scientist in his own right, wrote a "Biographical Memoir" of his colleague Alfred C. Redfield that captured his intellectual curiosity and his scientific achievements as well as covering his life at the Woods Hole Oceanographic Institution. Here are two brief excerpts:

Redfield's life story from 1930 to 1970 was intimately intertwined with the first forty years of the Woods Hole Oceanographic Institution. The "Oceanographic" was founded in 1930 under the leadership of Frank Lillie, director of the Woods Hole Marine Biological Laboratory, with a $3 million endowment from the Rockefeller Foundation and with the marine biologist Henry Bryant Bigelow, a Harvard professor, as director. Following the tradition established by the Marine Biological Laboratory, the small staff gathered at Woods Hole only during the summertime.

With the onset of America's role in World War II in 1941-42, the Oceanographic underwent a sea change. Alfred Redfield was appointed associate director... Within a year the staff was multiplied thirtyfold. Research and development on underwater explosives and on many oceanographic problems of military importance was undertaken on a crash basis. Such a large number of people had never lived in Woods Hole during the winter. Most of the houses were not winterized, and it was very cold. I was the Navy's project officer for the Oceanographic, and I came up from Washington about once a month on a two-day trip. It was my impression that the old New England custom of bundling was widespread just so that people could keep warm.

Alfred Redfield, ca. 1955. Photo by Jan Hahn. Copyright © Woods Hole Oceanographic Institution.

Book launched by The Village Printer, Falmouth, Massachusetts.

Columbus O'Donnell Iselin 1904-1971 A Biographical Memoir by Henry M. Stommel, copyright 1994, National Academy of Sciences, Washington D.C. Courtesy Data Library and Archives, Woods Hole Oceanographic Institution.

In the Wake of a Great Yankee Oceanographer by Nelson Marshall, Professor Emeritus of Oceanography and Marine Affairs University of Rhode Island. Subtitle: "Recollections from the years following the foundations laid down by Henry Bryant Bigelow" TH Anchorage Publisher. 1999.

Alfred C. Redfield 1890 – 1983 A Biographical Memoir by Roger Revelle, pp. 320-322 copyright 1995 National Academies Press, Washington, D.C. Courtesy Data Library and Archives, Woods Hole Oceanographic Institution.

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Redfield's Fouling and Antifouling Studies

Throughout the war years, Dr. Alfred C. Redfield led a staff of about twenty persons in a study of antifouling paints and fouling organisms for the Bureau of Ships. How do paints prevent fouling? What are the physical and chemical properties of the toxins that make them effective? What are the best ingredients to use in the organic matrix of antifouling paint? What is the best rate of dissolution to prevent marine growth without requiring frequent repainting? What is the distribution and rate of growth of the fouling organisms?

Dr. Ketchum and Dr. Feury worked primarily on the physical chemistry of point systems while Dr. Hutchins and Dr. Deevey were concerned with the biological aspects of fouling. Dr. Redfield gave samples of experimental paints to friends with boats and asked them to use a different paint on each side of the hull and report on its effectiveness.

The Navy later estimated that these studies enabled it to save about 10% of its fuel budget. Dr. Redfield also realized that fouling organisms found on submerged or captured German submarines could yield valuable information about their home ports and their secret warm water fueling stations.

Dr. George L. Clarke

Dr. George L. Clarke was one of the scientists who worked at WHOI during the war years. In 1975, Elsa Keil Sichel interviewed him for the oral history archives of the Woods Hole Historical Collection. He had a dramatic story to tell. This version is excerpted from the WHOI archives:

One of the investigations that the Oceanographic was asked to undertake – and I was given the job of trying to undertake it – was to find ways of obscuring, or at least reducing, the wakes of vessels during the daytime. From an aircraft the white wake of a vessel is much more conspicuous than the gray vessel itself. At night the white wake catches the moonlight and reveals the position of the vessel. And often the wake is phosphorescent, bright because of the flashes of luminescent organisms, giving away the position of the vessel to another vessel, or to enemy aircraft.

Columbus Iselin's *R/V Risk* in Eel Pond. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

Now it turns out to be an extremely difficult thing to obscure the wake of a vessel because most military vessels go at a high rate of speed and produce a very large wake. We decided to make some pilot tests, using a smaller boat. And the boat that was available was the high-speed power boat named *Risk,* which belonged to Columbus Iselin, the Director of the Oceanographic Institution, but which he had turned over to the Institution for use in various war research projects. The idea which we wished to try out on a small pilot scale was to inject smoke from smoke bombs by power blowers at the side of the boat. We would inject the smoke underneath the water so that it would be sucked in under the stern of the boat and fill the bubbles of the wake with black smoke, thus hiding it.

We equipped *Risk* with two blowers and then waited for a supply of smoke bombs from the Army. They happened to arrive on a Saturday afternoon. My undergraduate assistant and I decided to take *Risk* out immediately into Vineyard Sound where there is plenty of room. First we would sketch the position of the bow wave and the stern wake of the ship so we would know where to install the power blowers. Just as we were starting, my wife came to the dock with two of my sons, aged about 7 and 9, and asked me to take the boys along for the ride. They climbed aboard and we cautiously worked our way out of the harbor through the channel until we got to the bell buoy off Nonamessett Island which for years marked the entrance of Woods Hole passage. I sent my assistant up on the bow of *Risk* with a clipboard and asked him to face the stern and make a diagram of the position of the bow wave and the wake when I turned the boat at full speed.

Unfortunately, I had completely forgotten that in its wisdom the Government had put down a second buoy just beyond the original bell buoy, a big flashing buoy. We rounded the bell buoy and I thought that we were in the clear, out in the open waters of Vineyard Sound. My assistant was standing up on the bow and I didn't see the flashing buoy.

I ran the engine up to full speed and looked over the stern to see how the wake was developing. Suddenly I heard my assistant give an exclamation, looked around and saw him throw himself flat on the deck just before we crashed into the flashing buoy. The *Risk* is so slim that if we had been six inches to one side or the other we would have struck a glancing blow and done little harm. But we hit the buoy exactly square. The crash threw me forward, bending the steering wheel, and threw my sons hard against the bulkhead. Fortunately my assistant was not thrown overboard.

Fortunately we had run into a buoy not a rock because even though the buoy was tremendously heavy, it did have a little give to it.

After we had recovered from our surprise, I asked my assistant to go down into the cabin to see if any serious damage had been done. A moment later he came back io report that the water was pouring in; it was a foot deep already. And then he said, "You know I can't swim, don't you?"

I was aghast. Here I was well away from shore with no help in sight, with an assistant who couldn't swim, two small boys, and the water rising fast. I decided the best thing to do was run for the beach on Nonamessett Island. So I turned the prow of the boat toward the island and ran for it full speed, striking the beach just before the boat sank, and fortunately before the sea water rose to the level of the engine. I set my assistant to pump the water out, then I lifted the boys out of the boat, waded ashore and set them on the beach while I ran for help.

I knew there was a house at the other end of Nonamessett Island occupied by one of the Forbes family. Nonamessett Island always looks small compared to Naushon on the chart, but I was surprised to find that when you're in a great hurry it turns out to be longer than you think. Running from one end to the other was quite exhausting but I arrived there and asked to use the telephone. Since it was Saturday afternoon, there was no one on duty at the Oceanographic Laboratory. Finally it occurred to me to telephone Columbus Iselin at his home on Martha's Vineyard. He suggested that I call Oscar Hilton in Woods Hole. Oscar offered to come immediately in his work boat, *Playmate*.

So then I ran back to the beach, found the boys sitting huddled together on a rock, and asked them, "What did you do while I was gone?" Peter, the older of the two, said, "We worried and worried, then we cried a while, and then we hoped it wasn't a cannibal island."

In about twenty minutes, *Playmate* with Oscar Hilton at the helm arrived. Oscar came on board, saw what the situation was, got an old mop from his store closet and stuck it up into the bow. Then he took a piece of canvas and tied it over the stem of *Risk* on the outside. He said, "Now I'll go ahead and have the drawbridge open and get my marine railway cradle all ready in the water, and I'll take the boys and your assistant in *Playmate*. And then you run full speed, don't dare stop, Just run full speed. The pressure of the water against the canvas will keep the water from coming in."

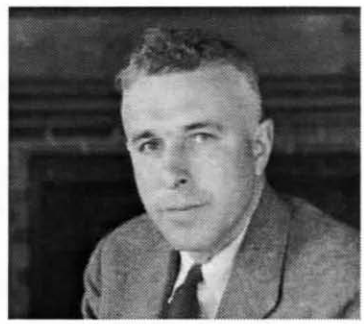
I hoped he was correct about this since the water in parts of Woods Hole Harbor is 70 feet deep. Off we went, full speed across the harbor and into the Eel Pond and right up onto the cradle of Oscar Hilton's boatyard.

I was terribly embarrassed by this accident. Oscar Hilton heard the story and was good enough to say, "Well, that's an accident that could happen to anyone." The worst of all was that there was the boat high and dry with its bow just a few feet from Main Street, so that everyone walking by for the next few days couldn't help seeing this great, gaping hole in the bow of *Risk*.

When Iselin arrived on Monday morning and looked at his power boat, he saw there was some dry rot in the planks of the stem which he said would have had to be replaced in any case. I'm glad to tell you that Oscar Hilton was such a skillful boat carpenter that he was able to splice and patch the planks in the stem to make the boat perfectly sound again.

Alfred H. Woodcock on deck of *R/V Atlantis*, 1938. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

Henry Stetson with bent coring tube, 1951. Photo by Jan Hahn. Copyright © Woods Hole Oceanographic Institution.



Columbus Iselin in his office, 1944. Photo courtesy of WHOI Archives. Copyright © Woods Hole Oceanographic Institution.

Jan Hahn in uniform (rear right) 1942. Jan Hahn Collection. Copyright © Woods Hole Oceanographic Institution.

Harold Edgerton (right) and George Clarke with deep sea camera, 1950. Photo by Jan Hahn. Copyright © Woods Hole Oceanographic Institution.