Natural History 1985
6; 42-49

In November 1911, the schooner James T. Maxwell, Jr., *was abandoned fifty-eight miles east of Cape Charles, Virginia. A Coast Guard ship tracked down the hazardous derelict and towed it to port.*
Brown Brothers Photo, Collection of W.J. Lewis Parker

Derelicts and Drifters

Old abandoned sailing ships and new satellite-tracked buoys tell us where some ocean currents came from and where they're going

by Philip L. Richardson

As a child growing up in a small coastal town in northern California, I used to daydream about sunken wooden ships. I pictured them drifting endlessly through the water, each at a different depth. The ocean was layered, I thought, with these trapped, abandoned vessels. Years later, when I had become a physical oceanographer and moved to the Atlantic Coast, I learned that abandoned wooden sailing ships had indeed drifted in the ocean—but on its surface and not forever. In the late 1800s, sightings of these derelicts provided the first information on the paths of surface currents, particularly of the Gulf Stream, in the North Atlantic. For eight years I had been studying the Gulf Stream, using freely drifting buoys tracked by satellite, and I thought I was the first to assemble a sizable body of information on current trajectories in the North Atlantic. I was wrong. The earlier information, which had been forgotten in the last eighty to one hundred years, was also extensive and quite accurate.

The nineteenth-century derelicts that provided information on surface currents were wooden-hulled ships; those that stayed afloat the longest—for more than the average thirty days—were often schooners carrying cargoes of lumber. From the point of view of a ship's captain, any drifting derelict was a formidable hazard. A collision with such an object at night or in a fog could damage or sink a ship. Toward the end of the last century, the Atlantic Ocean was strewn with numerous abandoned schooners and barks in various stages of disintegration.

In December 1883, the U.S. Navy Hydrographic Office, a branch of the Bureau of Navigation of the Navy Department, began to publish monthly pilot charts for the North Atlantic that showed the positions of the abandoned ships—identified by name—and of other drifting debris. The charts were issued free to navigators in return for their reports of recent navigational and weather information. The pilot charts were successful because a large number of observers contributed information to them each month and because they were distributed rapidly to ships' captains.

In the late 1800s, more than 1,600 derelicts were sighted, and reports were collected from nearly 3,000 voluntary observers—mariners who crossed the North Atlantic and who patrolled its waters. These sightings provided information on the bifurcation of the Gulf Stream near the Grand Banks of Newfoundland and evidence of the variability of ocean currents. They also documented a tragic loss of life. Toward the end of the nineteenth century, 12,000 lives and 2,200 vessels were lost worldwide at sea each year. Every severe ocean storm left new derelicts in its path and added new names to the long list of vessels that left port but were never heard from again.

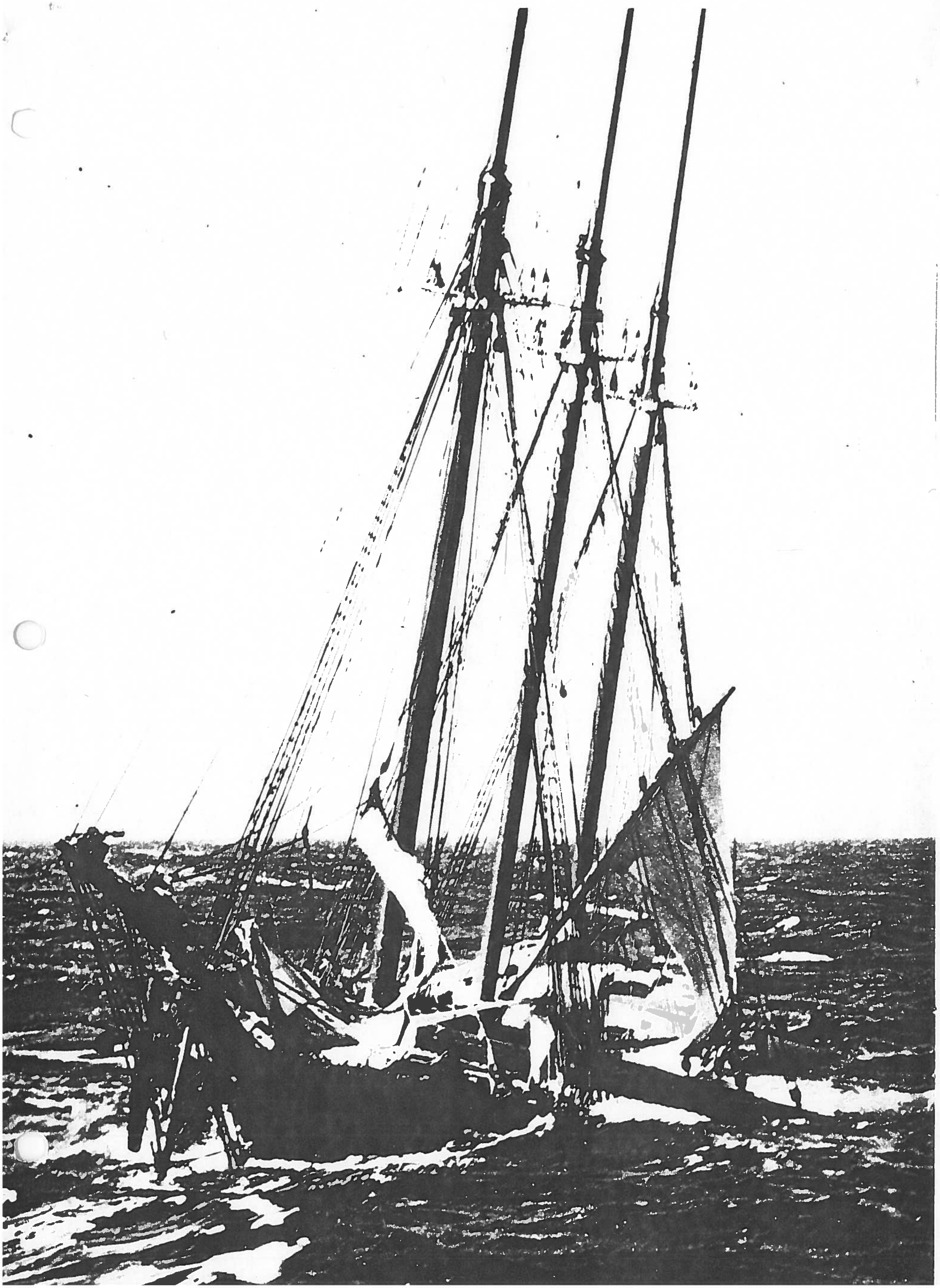
Most of the reported derelicts were found in the Gulf Stream off the U.S. coast. Because of the hazard they represented to other ships, they were sought actively, initially by U.S. naval vessels, later by revenue cutters—armed government ships used primarily to prevent smuggling. When sighted, the derelicts were towed into port or set on fire while still at sea. During 1887–93, forty-one derelicts were towed ashore and another seventy-six were set on fire. One was destroyed by torpedoes and ramming. Others continued to drift until they broke apart or became so waterlogged and encrusted with barnacles that they sank on their own.

This is a typical pilot chart report, written in July 1889:

Notable Derelicts in the North Atlantic

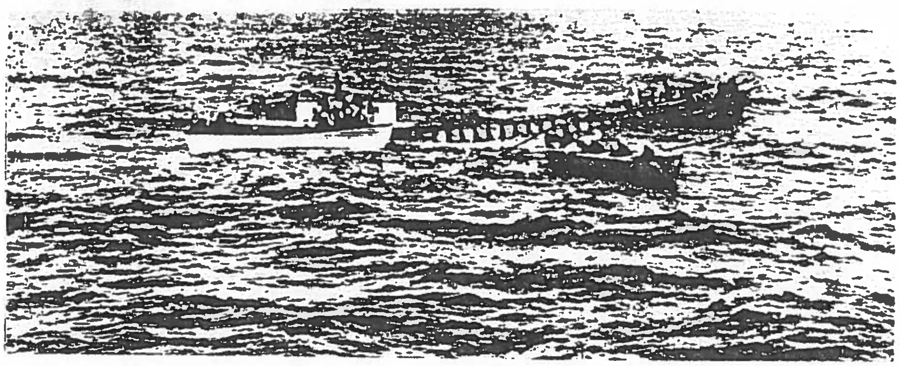
Of the many wrecks afloat this month in the North Atlantic Ocean, none has as interesting a history as the Italian bark "Vincenzo Perrotta." Abandoned September 18, 1887, this vessel has been represented graphically on every edition of the Pilot Chart published since that time. Her wonderful drift began in about latitude 36°N, longitude 54°W [south of Newfoundland, east of Cape Hatteras]; and on April 4, 1889, when last reported, she was about 60 miles north of Watling's island, in the Bahamas. She has thus made good a distance of about 1,400 miles in a general SW. by W. direction, in 1 year, 6 months, and 16 days. She has been reported 27 times in all, and when last seen had mizzenmast and about 10 feet of mainmast standing, foremast gone, end of jibboom broken off and port anchor on bow.

In addition to the derelicts, other debris was reported drifting in the North Atlantic. In December 1887, a large raft of logs broke apart while being towed from Nova Scotia to New York by the steamship *Miranda*. The raft, which weighed 11,000 tons and drew twenty feet of water, consisted of 27,000 tree trunks bound with chains into the shape of a cigar. The logs were spruce pilings meant for the construction of docks and the foundations of large buildings. On December 18, the towing steamship *Miranda* encountered a severe storm. Her fifteen-inch towing hawser parted and the log raft went adrift in the track of commercial navigation. Although a search was made for the raft within a week of her disappearance, only remnant logs were found scattered over a wide area, about 140 miles southeast of Cape Cod. No ship was reported



Sailors leave a derelict ship after completing preparations to blow it up. If not burned, towed, or otherwise removed, such vessels often drifted for months, presenting a danger to passing ships. Derelict ships became a rarity as iron and steel replaced wood as a shipbuilding material.

The Metropolitan Magazine (September 1911), The New York Public Library

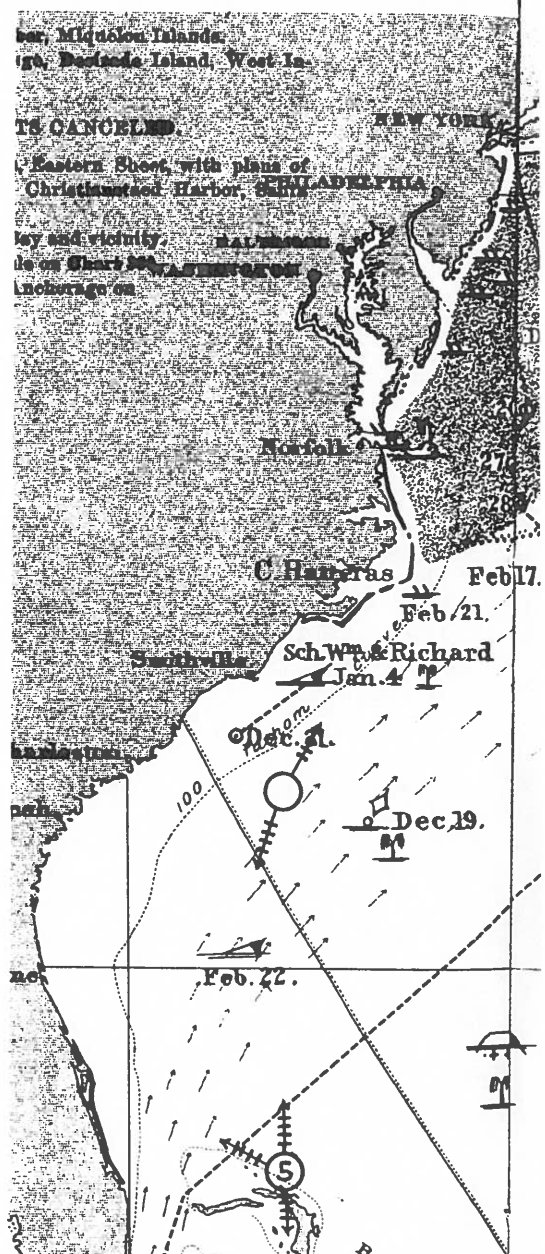


lost because of the incident, but the German bark *Bremen* was in the area for five days and had her sheathing torn and her rudder damaged. This log raft was one of only two of its kind that appeared on the east coast; an earlier one had arrived safely in New York from Nova Scotia. Schooner owners and captains, whose livelihood was threatened by the use of such rafts, were delighted that they proved impractical.

Many derelicts remained afloat for more than half a year and were reported often enough to provide evidence of long and interesting ocean trajectories. Six drifted longer than a year—the schooner *Fannie E. Wolston* drifted for 1,100 days; the schooner *Wyer G. Sargent*, 615 days; the bark *Telemach*, 551 days; the bark *Vincenzo Perrotta*, 536 days; the schooner *Ethel M. Davis*, 370 days; and the schooner *James B. Drury*, 367 days. These abandoned ships traversed from 1,700 to 9,000 miles.

Although the paths of these long-lived derelicts differed markedly in detail, patterns of drift can be detected. Several ships moved eastward in the Gulf Stream until they reached 50° W (south of the Grand Banks of Newfoundland), where their paths diverged. Some continued eastward and crossed the Atlantic in an average of ten months, others drifted southward. Two made tight turns and drifted westward just south of the Gulf Stream. The *Wolston*, which drifted for three years, first floated south to 25° N, then westward in the North Equatorial Current to the Bahamas, and finally northeastward into the Gulf Stream again, crossing its earlier path. Two derelicts drifted erratically but in a generally southwestward direction through the Sargasso Sea and grounded on the Bahama Islands. Most derelicts looped as they drifted. The *Sargent* and the *Wolston* made large, 300-mile loops (southeast of the Grand Banks) within a period of ten months. Several other derelicts made frequent, smaller-scale loops.

Derelicts that first appeared near the coast between Long Island and Cape Hatteras usually drifted southwestward, following the inshore current until they reached Hatteras. There they entered the Gulf Stream and drifted eastward. In general, derelicts entered the Gulf Stream north of 30° N (Cape Hatteras) and moved eastward in the stream. In an area south of the Grand Banks, near 40° N, 50° W, the derelicts appear to have followed either of two divergent paths. Recent measurements have confirmed that the Gulf Stream splits into two bands near the Grand Banks. The first band extends northeastward into the eastward flowing North Atlantic Current, passing north of the Azores. The second extends southeastward and then joins the westward flowing North Equatorial Current. The general circulation indicated by the collected trajectories of the abandoned ships is a large, clockwise pattern split into two branches, one to the north and the other southwest of

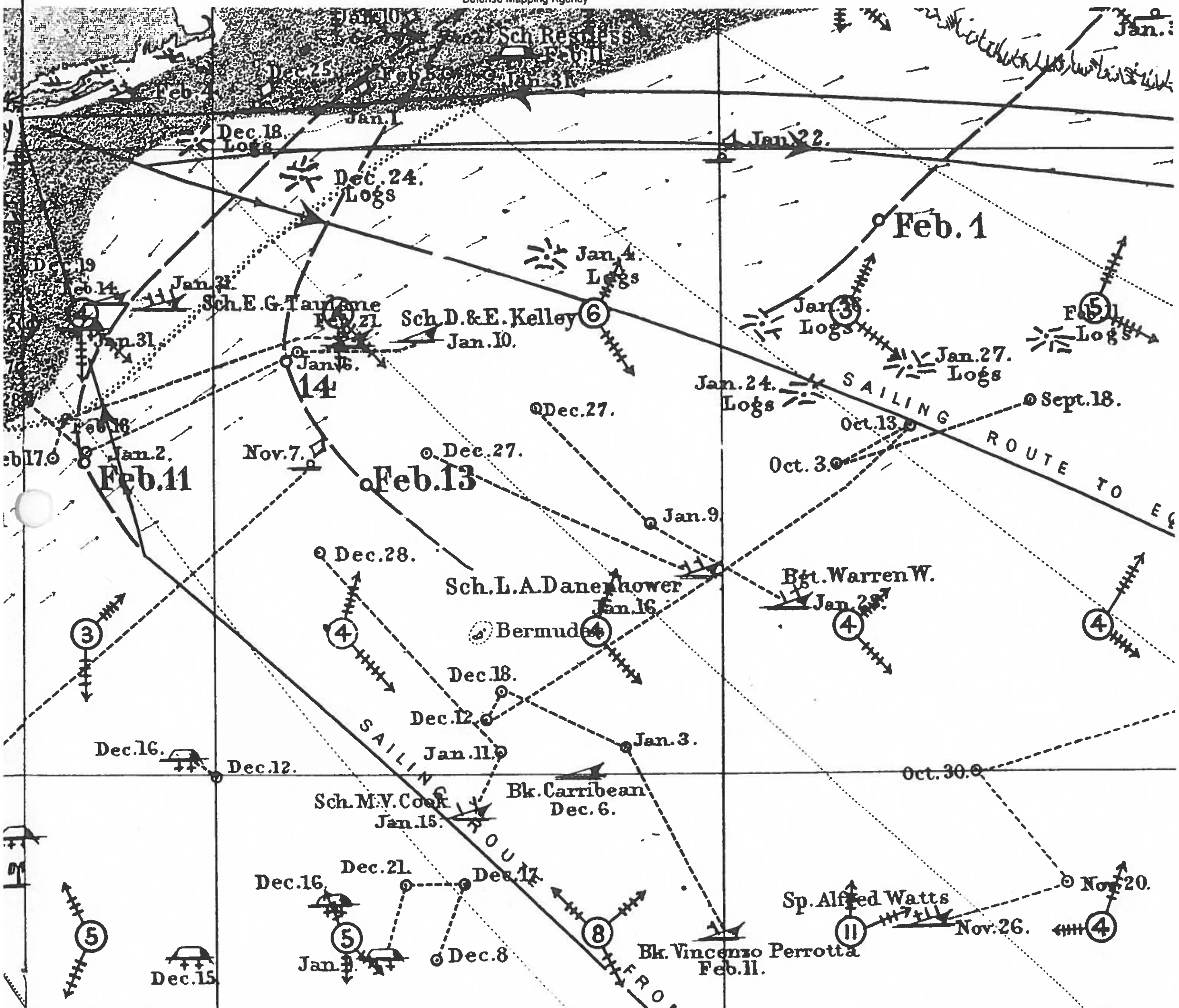


the Azores. Six derelict vessels moved southward between the Azores and Spain and Portugal.

The large-scale, long-term ocean circulation pattern is characterized by considerable current variability. The derelicts did not usually follow the general pattern smoothly; instead they drifted in convoluted trajectories that often crossed each other. The convoluted paths give an early

A detail of the U.S. Navy's pilot chart of the North Atlantic for March 1888 gives the locations and dates at which derelict ships were sighted. Schematic drawings indicate the conditions of the ships, for example, stern down, bottom up, or mast standing. The paths followed by some identified derelicts are shown by broken lines. Other symbols locate drifting buoys, steamship routes, fog belts, and other vital navigation information.

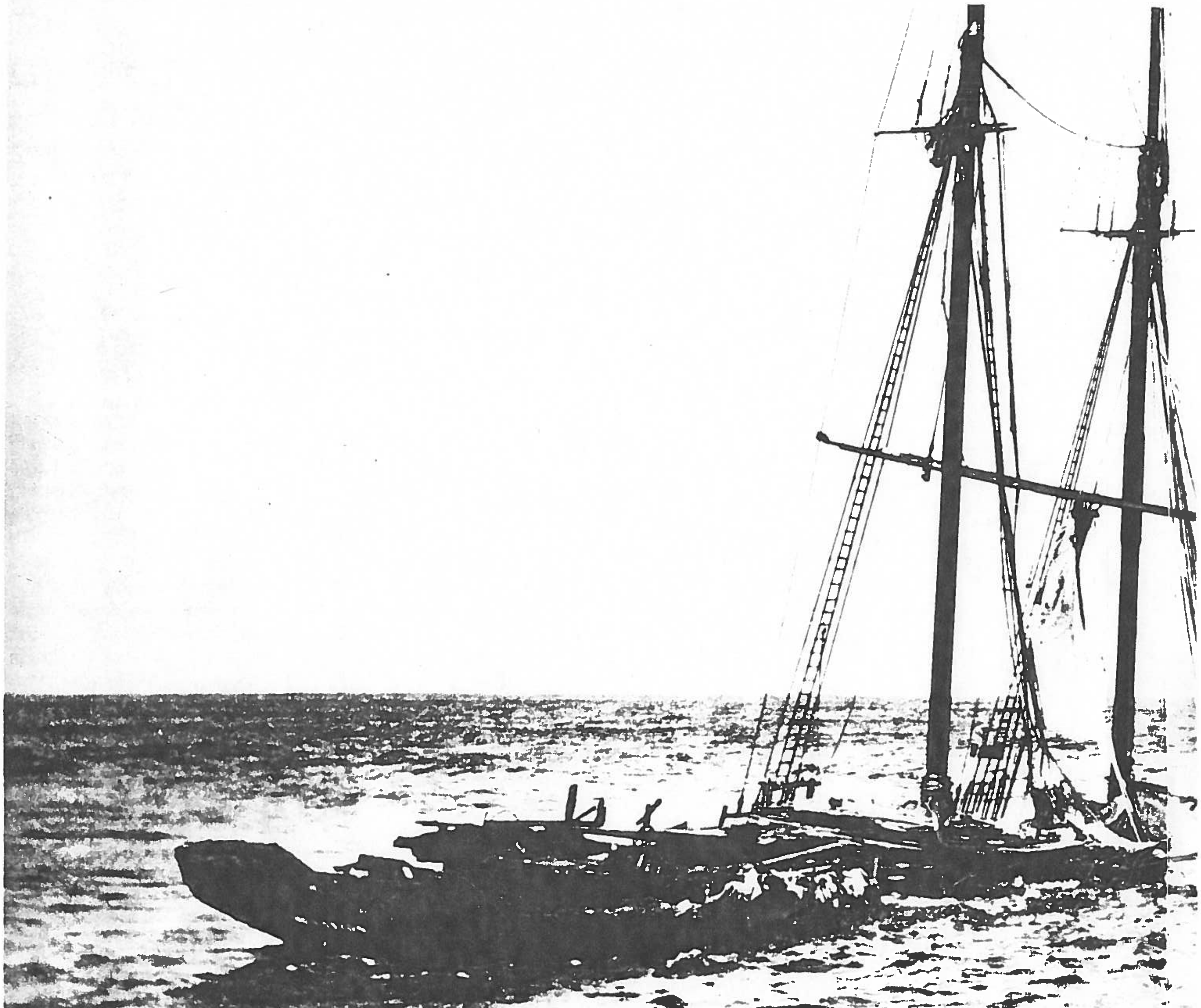
Defense Mapping Agency



measure of medium-size eddies and of longer-period current fluctuations. We now know that the ocean is populated by energetic eddies that are usually much stronger than the mean currents (the average velocity of the currents). The importance of these eddies to the general circulation has been discovered recently, and they have been studied intensively. Because of these eddies, the mean circulation becomes recognizable only by averaging a great number of observations in space and time. In the Gulf Stream, the North Atlantic Current, and the North Equatorial Current, one clearly sees the general drift in spite of the eddies. In the Sargasso Sea, the trajectories are dominated by the motion of medium-size eddies. The eddies in the Gulf Stream region are important in driving the average flow and determining the character of the general circulation. They also drive a deep eastward flow under the Gulf Stream and a westward recirculation on both its sides.

One should be cautious, however, about ascribing all the motion indicated by the derelicts' trajectories to water movement. Derelict ships varied in size, weight, and the state of damage. Some were totally dismasted and filled to the gunwales with

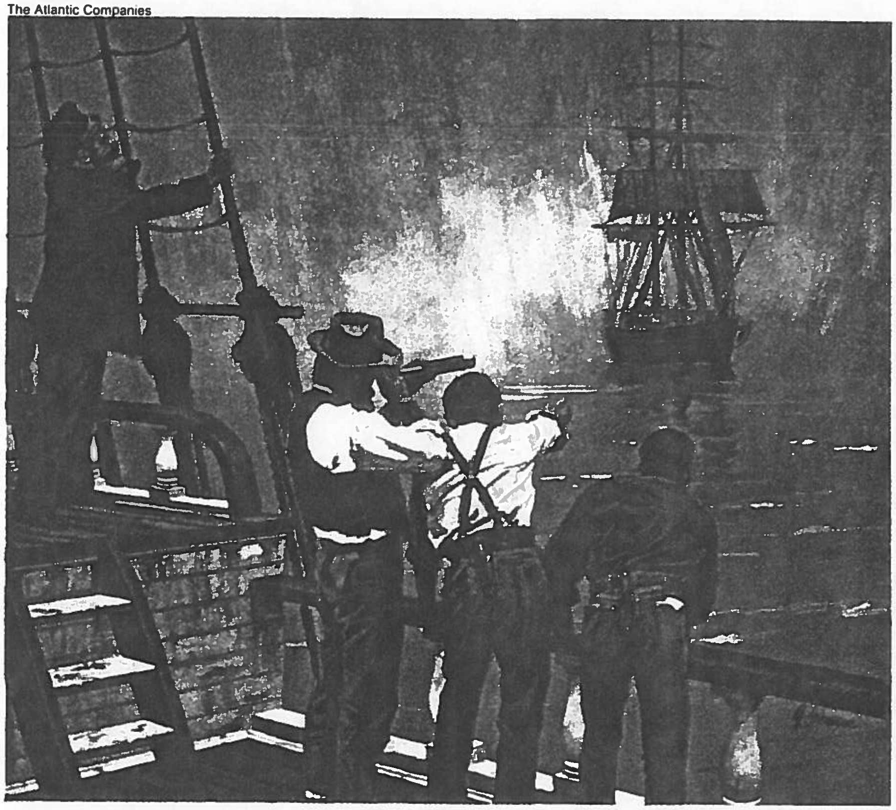
Built in 1874, the schooner Alice Murphy *was caught in a violent storm in 1915, off the North Carolina coast. The captain and six crew members, who had lashed themselves to the mizzenmast, were rescued, but the waterlogged vessel went adrift in the Gulf Stream. This photograph may have been taken from a tug owned by a New York salvage firm that investigated the derelict. The burned-out wreck of the* Alice Murphy *was later sighted six hundred miles east of New York, where it had been carried by surface currents.*
Collection of W.J. Lewis Parker



water. These, along with the 30 percent of the sightings of vessels that were turned bottom up, probably provided a good indication of the speed and trajectory of near-surface water. But derelicts with their masts standing and those riding high in the water were no doubt also influenced by wind blowing directly on the masts and the exposed hull.

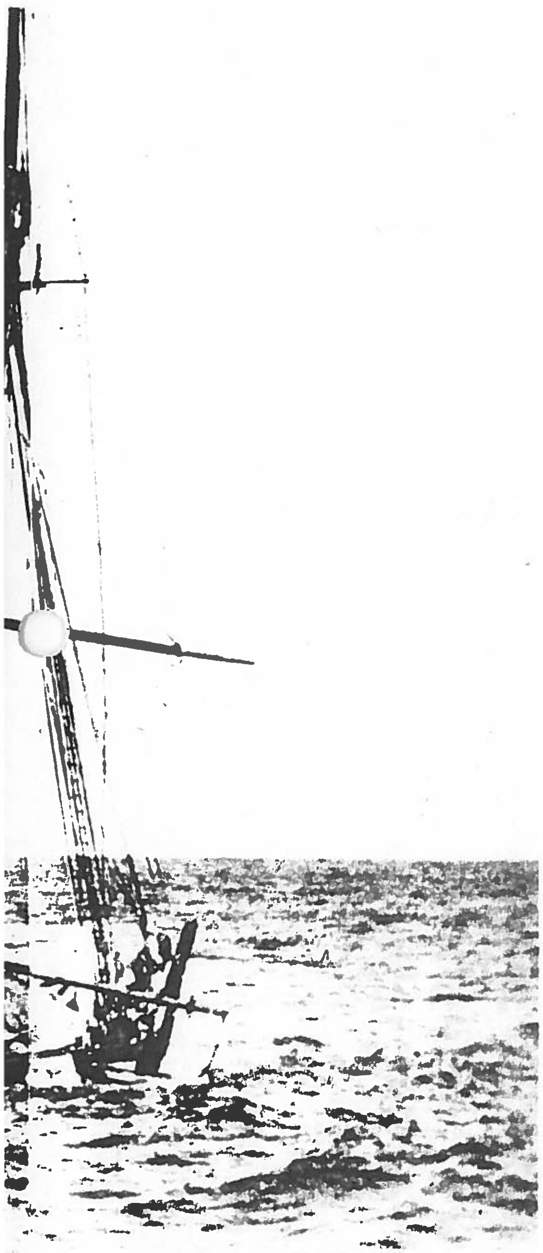
Additional problems in the effort to interpret the trajectories accurately are position errors of the reporting ships, misidentification of derelicts, and infrequent sightings. The average number of days between sightings was about twenty—this is small enough to indicate some aspects of medium-scale eddies, but it is not small enough to resolve individual loops around the strong eddies, as do today's buoys. Nevertheless, the collection of the trajectories represents a realistic view of the general surface ocean circulation and the variability of currents.

In the nineteenth century, other information concerning surface currents came from ships under way. A ship's course and speed can be estimated in two ways: from its apparent progress through the water, and from its change in position on the earth's surface, as measured by ce-



In a 1965 painting by Gordon Johnson, the crew of the Dei Gratia *sights the* Mary Celeste, *found drifting off the coast of Portugal on December 4, 1872. Apparently the captain and crew had hurriedly taken to a lifeboat several days before; they were never seen again.*

The Atlantic Companies



lestial navigation. The difference, expressed in terms of set (direction) and drift (speed), is attributed to surface currents. Measurements of set and drift were first made in the late eighteenth century, after the introduction of chronometers had sufficiently improved the ability to determine positions at sea. As large amounts of data were accumulated, however, the huge numbers of observations became difficult to handle quantitatively. Therefore, most early summary charts of ship drift observations, such as those shown on the U.S. pilot charts, were schematic and qualitative. Only in recent years, with the advent of high-speed computers, have quantitative and statistical analyses of ship drifts been published.

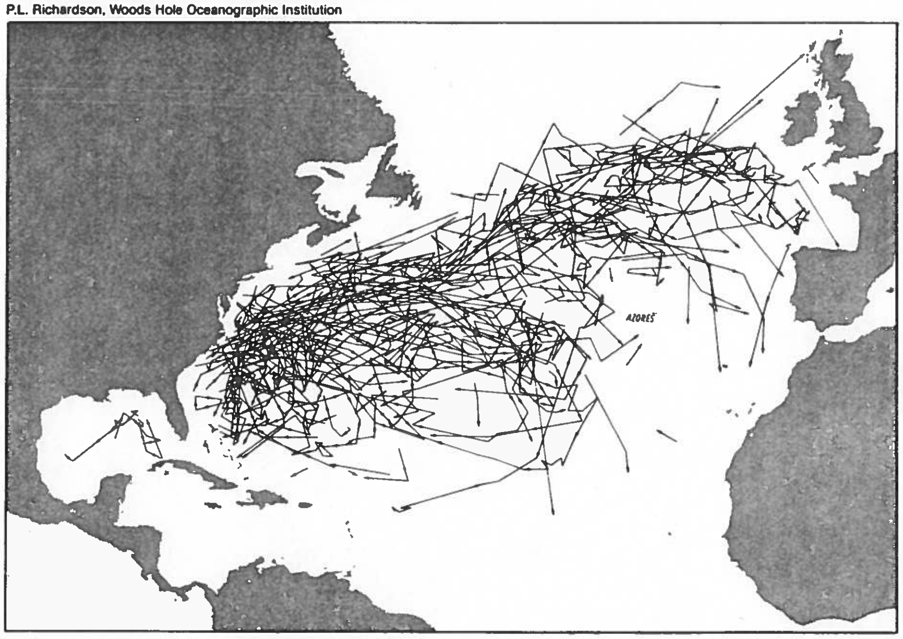
Because of the strong ocean variability, ship drift velocities taken individually or in averaged form do not provide a good measure of where the water actually goes. This key bit of information was provided by the drifting derelicts, which followed the water and provided long-term trajectories of water parcels. In this way the derelict trajectories complemented the measurement of ship drift velocity.

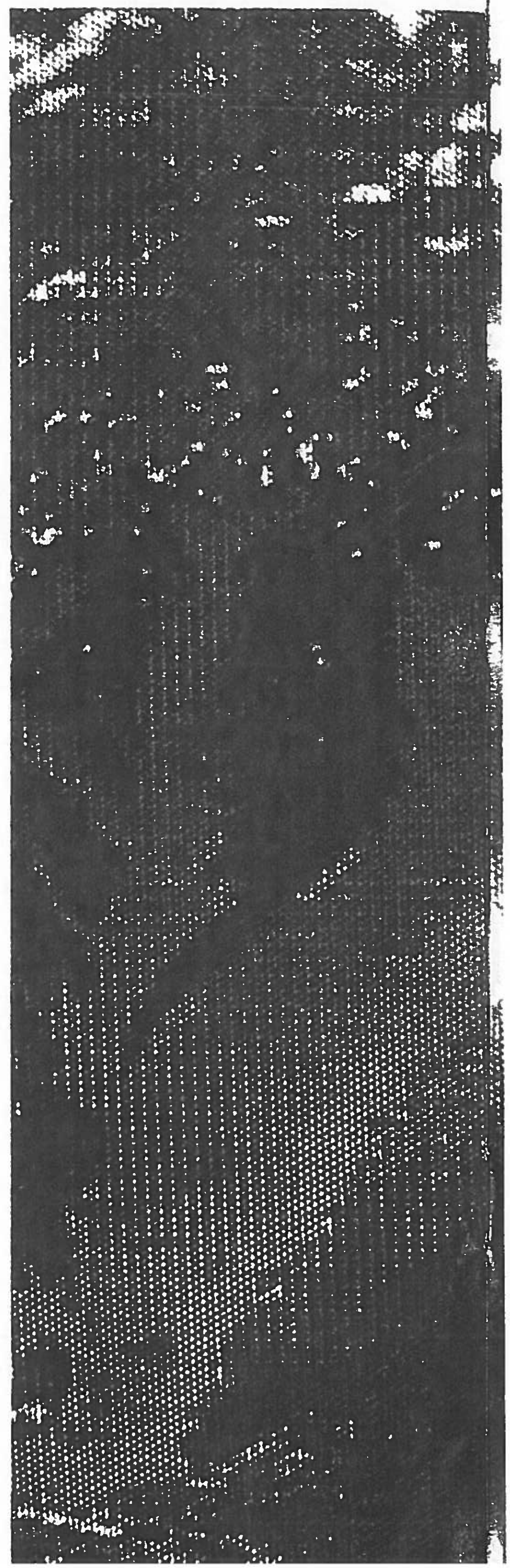
At the end of the nineteenth century, the number of drifting derelicts diminished rapidly. Relatively few derelict trajectories are found in the pilot charts after 1900. There were two major reasons for this decline. The first was the gradual replacement of wooden sailing ships with steam-powered vessels of iron or steel, a change that began in Britain. The second was the successful search for, and destruction of, derelicts by revenue cutters and naval vessels. By 1880, British steam tonnage superseded sailing tonnage, which was falling, and clipper ships could no longer compete with steamships as a means of fast transport. By 1900, the steamship had practically ousted the full-rigged sailing ship from every important trade route on the seas. The triumph of the steamship was a result of the introduction of iron hulls and steel hulls, the development of the screw propeller, and finally the triple expansion engine—a more efficient steam engine—which came rapidly into use after 1880. These developments resulted in stronger ships with more predictable speeds. The newer ships were abandoned less often, and those that were abandoned usually sank.

In America, the transition from sail to steam was more gradual than in Britain. Not until 1894 did American steam tonnage surpass sail in the coastal trade. Coastal sail tonnage continued to grow un-

The superimposed trajectories of drifting derelict ships and a few drifting buoys, as given by monthly pilot charts published between 1883 and 1902, reveal the large-scale pattern of North Atlantic surface currents. The surface water circulates in a clockwise direction, dividing into two smaller currents that move north and south of the Azores. Because of variations over time of the ocean currents, the paths of individual derelict ships often differed from one another or from the general pattern.

P.L. Richardson, Woods Hole Oceanographic Institution



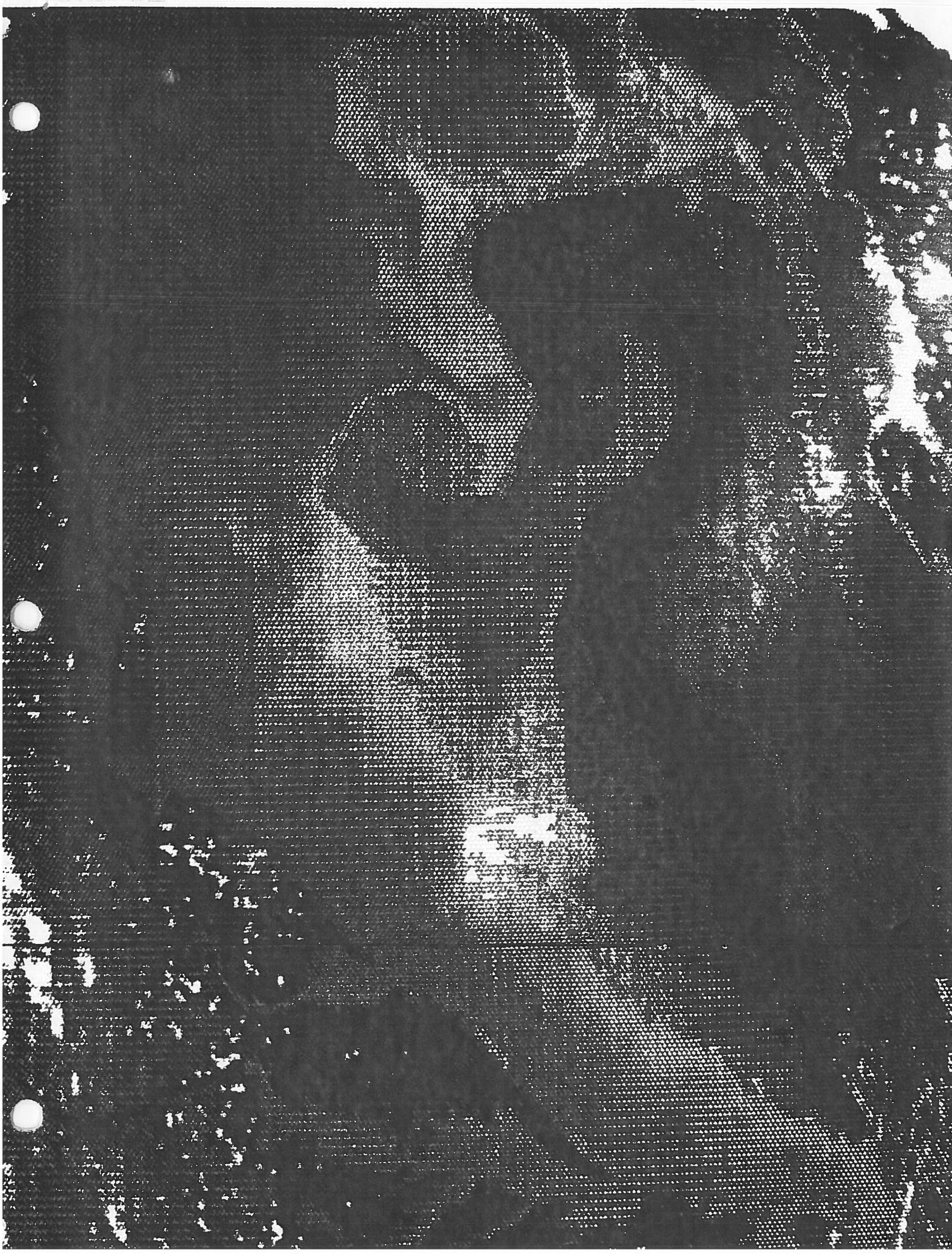


til 1907, when it reached its absolute peak, representing 39 percent of the total coastal tonnage. By far the major part of this fleet of coastal sailing vessels was made up of wooden ships. A study of the casualty pages of the New Marine Register shows that a great many of these vessels continued to be abandoned waterlogged after 1900. But because of a more vigorous, systematic program of derelict destruction by revenue cutters and also by naval vessels, fewer wooden ships appeared as derelicts on pilot charts published after 1900.

The advent of wireless communication in the early twentieth century made locating a derelict at sea much easier. Positions of derelicts were sent by radio to the cutters so the derelicts could be found quickly and destroyed. Before this method of communication at sea, derelict hunting was at best a haphazard occupation. In 1907, a new revenue cutter, the *Seneca*, was built expressly for finding derelicts and destroying them or, if they were salvageable, towing them to port.

Today the large numbers of drifting buoys (sometimes called drifters) that measure ocean currents are tracked by satellite. The principal areas under study are the North and South Atlantic, the tropical Atlantic, and the tropical Pacific. The ocean's surface layer, directly forced by local winds, is only a thin skin over the mass of deeper water, which has a very different motion. In recent years, deep trajectories in the North Atlantic have been measured by high-tech drifters. These drifters, or floats, are constructed from aluminum tubes that are less compressible than seawater and are ballasted to sink to prechosen depths. Once there, they remain at those depths (like the wooden ships of my childhood reveries) as they drift. Because the ocean is relatively transparent to sound, the floats are tracked acoustically.

Known trajectories of nineteenth-century derelicts still outnumber those of today's buoys, but the newer measurements have the advantage of several fixes per day and a higher positional accuracy. From a collection of these contemporary measurements, we have been able to obtain a more quantitative picture of the general circulation and of the geography of ocean variability. Plots of the buoy trajectories show patterns very similar to those of the derelict trajectories. Although the derelict trajectories were made long ago by methods that now seem primitive, I believe they remain one of the best, if not the best, direct measures of the surface circulation of the North Atlantic. □



Born into a Mormon family in Utah, **Paul Alan Cox** (page 36) interrupted his undergraduate work at Brigham Young University to go on the traditional two-year Mormon mission. His mission took him to Samoa where he learned some Polynesian dialects and found, as Darwin had in the Galápagos, "that the mechanisms of nature seem exposed." As a graduate student in biology, Cox returned to Samoa to do work on tropical ecology. Since getting his Ph.D. at Harvard in botany, he has gone back to Samoa and to other locations in the South Pacific many times to study the local flora. "They are not very well known," he says. "Not many botanists work in the South Pacific. I have the advantage of speaking the languages. And the climate is wonderful." Cox's article in this issue is the second he has written for *Natural History* (see "Sex and the Single Flower," November 1983).

"I usually go on one cruise a year to do hydrographic sampling," says physical oceanographer **Philip L. Richardson** (page 42). "On the cruises we launch surface buoys, deep drifters, and current meter moorings." Richardson has been studying the general circulation of the Atlantic for more than a decade. The cruises have taken him along the Gulf Stream, the eastern Atlantic, and to the equatorial Atlantic. Currently an associate scientist at Woods Hole Oceanographic Institution, he earned a Ph.D. in physical oceanography from the University of Rhode Island in 1974. Richardson is also interested in the historical aspects of oceanography, and he likes to poke around in various libraries and archives to find old maps. In the course of these excursions, Richardson discovered Benjamin Franklin's original chart of the Gulf Stream.

Theodore H. Fleming (page 52) became interested in fruit-eating bats while working in Panama on the Smithsonian Institution's Mammals of Panama Project in the late sixties. His early work dealt with reproductive cycles and food habits, but over the years he has become increasingly curious about how individual bats sustain themselves. Fleming is currently writing a book that summarizes his past ten years of research at Santa Rosa National Park in Costa Rica. It focuses on the behavioral ecology of the short-tailed fruit bat in tropical dry forest and the bat's impact on ecological succession. The forty-three-year-old biology professor is temporarily working at Duke University while on leave from the University of Miami. He spends his spare hours tending to his garden and helping his wife raise two children.