OCEANOGRAPHY

Scientists Go to Sea

More and more scientists are taking to the sea in the summer. They do not take pleasure cruises, even though they travel in trim boats, but are on floating laboratories.

By RICHARD MAGAT
Science Service Correspondent

➤ NOT EVERY SLEEK YACHT and cabin cruiser seen afloat this summer was bent on pleasure. Some were "floating laboratories," carrying scientists exploring a range of subjects from marine biology to beach erosion.

The eminent 19th century British mathematician Lord Rayleigh said, "The basic law of the seaway is the apparent lack of any law."

The sea voyager still knows far less about what he will encounter than a bus or train rider, as the recent collision of the Andrea Doria and the Stockholm tragically showed.

Yet modern oceanographers, mathematicians, naval architects and others are steadily modifying Rayleigh's aphorism with remarkable strides by formulating general rules about the complex and apparently unpredictable behavior of the three-fourths of the earth's surface that flow about the continents.

Much of their work is analytical and mathematical, and an oceanographer can make a significant discovery about the sea's behavior while sitting at a desk miles away from any coastline. Also, high-speed digital and analogue computers and other electronic devices are some of the oceanographer's most valuable new tools.

Many Institutions Are Active

A vast amount of field study remains, nevertheless, as witnessed by the increased tempo of activity by scientists at sea this summer.

The Woods Hole, Mass., Oceanographic Institution in June commissioned a new research vessel, the Crawford. A converted 125-foot Coast Guard Cutter, the ship is being used to explore Caribbean waters east of San Juan, Puerto Rico, birthplace of many hurricanes that plague the East Coast of the United States.

More recently, New York University put into service a 65-foot auxiliary schooner, Action. Working this year in Long Island Sound, the vessel's initial tasks are to study the role played by tiny ocean waves less than two inches high in reflecting radar beams from aircraft flying over water, and the effect of sea surface conditions on the tough problem of accurate long-range weather forecasting.

Smaller research ships are also in service.

The American Museum of Natural History and N.Y.U. geologists are using a 33-foot motor launch in a new three-year study of the bottom of Long Island Sound. This venture is more geology than oceanography, for its purpose is to find clues to the formation of petroleum in sediment composed of plants, tiny microscopic invertebrates and man-made wastes.

Research vessels from Columbia's Lamont Geological Observatory continued their deep-sea studies with the aid of new devices for sampling the ocean floor.

The Scripps Institution of Oceanography and Johns Hopkins University are other leading centers where sea research is conducted.

There are land-locked experimental facilities for sea studies as well. New ship designs are tested in model form at the David Taylor Model Basin in Carderock, Md., and a similar installation at the Stevens Institute of Technology, Hoboken, N. J.

At these locations, models are towed through an especially instrumental tank filled with water. Calculations of ship stability and behavior under various speeds and hydrographic conditions may be made.

A special wind tunnel at New York University's engineering research division will be converted this fall to an experimental water tank for the study of capillary waves. In the past, the tunnel has been used to study models of industrial plants in an effort to prevent or control air pollution problems.

In its temporary new role, it will simulate the tiny capillary waves that are of current interest because they seem to affect radar from aircraft.

Capillary waves are so called because they arise, not from winds as most ocean waves, but from the type of capillarity associated with surface tension phenomena. Because their slopes are greater, they seem to influence radar beams more than the large gravity waves. Capillary wave data obtained from the Action will be tied in with findings in the tunnel.

The role of oceanography is growing also because of the increased "mining" of the sea and the ocean bottom. Not only do hundreds of oil well structures dot coastal waters, but industry is looking to the sea for magnesium, bromine, sulfur and metallic ore-bearing sands.

SCIENTIFIC TORPEDO—This small torpedo-like device, held by Capt. Harry E. Rogers, is harmless. It is a bathythermograph, thrown overboard to measure the temperature of the sea at different depths. Capt. Rogers is skipper of the newly commissioned New York University oceanographic vessel, Action. In the background is Dr. Gerhard Neumann, professor of oceanography at New York University. Like other scientists throughout the nation, they are taking to the sea to learn its secrets.

One of the most significant trends is the increased attention to oceanographic events in an effort to improve weather forecasting, especially the long-range, or 30-day and longer, variety.

For the last few years, for example, under Office of Naval Research and Weather Bureau sponsorship, meteorolgists and oceanographers have been seeking to find precisely how the circulation of the earth's atmosphere—the large wind systems sometimes called air tides—responds to ocean currents and water temperature changes.

One outgrowth of such studies was a broad theory of ocean current circulation by New York University's Dr. Gerhard Neumann. It takes into account such diverse factors as the curvature and rotation of the earth, vertical variations of ocean density, and the depth of the bottom of circulating ocean masses.

Predict Ocean Waves

Dr. Neumann and a co-worker, Dr. Willard J. Pierson Jr., are also responsible for a major attack on the "mystery of the sea." They have formulated and put into practice theories for predicting the spectrum of ocean waves.

Their results, in the form of a forecasting manual, were published by the Navy and issued to all its ships. Despite its length—350 pages—authorities call it an unusually practical device for predicting ocean wave behavior. It is essential, for example, for a naval commander getting ready to be refueled from another ship in a relatively calm sea, to know that in the next 15 minutes he can expect a 20-foot high slamming wave.

Similarly, an aircraft carrier calling its planes in for landing wants to know as accurately as possible the state of the sea in the very short future. The Neumann-Pierson theory permits naval officers, even those with relatively light technical training, to do this with high statistical accuracy.

What Drs. Neumann and Pierson did was to break up—in matematical terms—the various components of an ocean wave, just the way a beam of light is broken into various colors by a prism can be described mathematically. With this foundation, they brought statistical mathematics to bear on the problem of forecasting wave height and frequency, on the basis of various wave properties and meterological conditions.

Not only is this significant in naval operations, but also in harbor, seaplane and ship design, and shore protection.

The last problem is another fertile field for the oceanographer's talents. Some estimates say the coast line of the United States is receding at an average rate of one foot a year. The erosion problem along the Jersey Coast was particularly critical a few years go. At one point, a jetty erected for test purposes trapped 70,000 cubic yards of sand that ordinarily would have been washed off the coast.

Shore Protection Problem

Beach erosion specialists and government authorities need the oceanographers' guidance in order to get the most from their shore protection expenditures.

Electronics is also helping in the technical battle against beach erosion. Research engineers have developed, under contract with the U. S. Beach Erosion Board, an electronic ocean wave analyzer. This does in five minutes the laborious mathematical computations that previously required two weeks by hand. Smaller and considerably less expensive than a computer, the analyzer "feeds" on magnetic tape records of ocean waves. The records are obtained from signals sent out by pressure gage-transducer systems submerged offshore.

The envelope of air around the earth is, like the ocean, a fluid. Both ocean and air experience solar and lunar tides. Like the Gulf Stream and the Humboldt Current cut through the ocean, planetary currents of air swirl about the globe. These similarities, plus the constant interaction of the two media, demand close co-operation between meterologists and oceanographers.

Aid Hurricane Research

Hurricane research is one instance of this interaction. The Woods Hole ship, Crawford, is expected to provide valuable supplementary hurricane data to the increased aerial reconnaissance planned by the Weather Bureau and the armed services for the 1956 hurricane season. Edwin Fisher, who directs a hurricane research project at N.Y.U., said hurricane forecasting might be improved with better records of sea surface temperatures in the hurricane spawning grounds.

To date, most of the records available come from merchant shipping in the period preceding the hurricane season. When hurricanes threaten, naturally, ships avoid these areas. Researchers are poring over existing records in an effort to establish the direct relationship between pre-hurricane sea temperatures and the incidence and path of the violent storms.

In addition, they hope that experience with the Action will lead to improved in-

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struments and techniques for more accurate measurement because the Action, in contrast to larger, deep-sea research vessels, permits oceanographers to "put their noses right down to the sea surface."

For most of the year, the oceanographer can hardly be distinguished from his colleagues in other branches of science. Come warm weather, the call to the sea grows louder, not only because voyages add invaluable knowledge, but because there is in many of the scientists a deeply-rooted love of the sea.

Dr. Neumann, for example, was a sailor before he became a scientist, going to sea at the age of 17 in his native Germany. The ship on which he took his first cadet training cruise, a three-masted bark, was caught in a North Atlantic storm and sank. All hands were rescued and Dr. Neumann went on to more fortunate cruises, including two around Cape Horn.

Later he attended the Hamburg Merchant Marine Academy and became a navigation officer for the Hamburg-American Line. Only after a decade of practical seamanship did he enter the University of Berlin and earn the degree of Doctor of Natural Science.

Dr. Neumann's seafaring instincts stayed with him and were undoubtedly responsible for a prodigious task he undertook a few years ago, work that eventually led to his wave spectrum theory.

Previous wave observations had consisted only of random samples. A complete theory required, first of all, a body of systematic and continuous data, taken by a trained observer. So in 1950 and 1951, sailing on a freighter, Dr. Neumann singlehandedly made 27,000 individual ocean wave observations in the Atlantic. This required that he stand on the flying bridge, stopwatch in hand, timing and measuring the waves.

Future oceanographic research, Dr. Neumann hopes for his students' sakes, will not involve first-hand labor to this degree. Busy activity in this field of science and in all other branches of geophysics science is expected to come to a climax during the International Geophysical Year.

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