The Momsen Lung: Gone But Not Forgotten

ESCAPE TECHNIQUE

The Momsen Lung was a lifesaver to the Navy in more ways than one. It helped the sea service over a hump when the submarine was going through its early growing pains, after a period that came to be known—so far as subs were concerned—as the "Tragic Twenties."

The Momsen Lung did much to increase morale and help rebuild public confidence in the submarine. A quick look at those times will tell you why. A Navy doctor tells also what is now the approved technique that replaces use of the Momsen Lung.

THE TRAGIC HISTORY of submarine disasters of the 1920s pointed to need of a new kind of safety device. The United States, with its losses of USS *S-5*, *S-48*, *0-5*, *S-51* and *S-4*, was not alone in facing this problem.

In 1921, *K-5* of the British Royal Navy failed to return from a Fleet maneuver. The next year, *H-42* of the Royal Navy surfaced in front of a destroyer and was lost with all hands. In August of that year, the German *U-111* foundered. In 1923, the Japanese submarine *No. 70* sank because of premature opening of hatches. In 1924, *L-24* of the Royal Navy was rammed and sunk by a battleship, and another Japanese submarine was lost in a collision with a cruiser. 1925 saw three disasters: The Italian *Sebastiano Veniero* was sunk in collision; *S-51* rammed and sunk; and the Royal Navy's *M-1* also rammed and sunk. In 1928, Italy and France each lost a submarine and in 1929 two British subs rammed each other.

Each of these disasters meant the loss of many lives—usually of all hands aboard. In many instances, these men could have been saved had some type of escape mechanism been devised.

In response to this need, two developments made their appearance. One of these was the rescue chamber such as that used to rescue the crew of USS *Squalus* (see pages 59-63) attributed to LT A. R. McCann, USN, and the other was the submarine escape apparatus attributed to LT C. B. Momsen, USN. Today, the McCann rescue chamber is still in use aboard each ASR in the U. S. Navy.

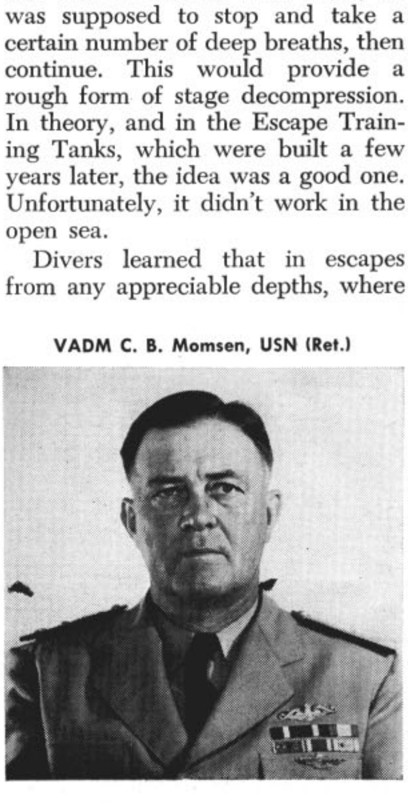
Use of the Momsen Lung was discontinued in 1958 in favor of the present buoyant ascent technique. Nevertheless, the submarine escape apparatus (Momsen Lung) played an extremely important role in helping to promote the development of the underseas Navy.

It was essentially a closed cycle rebreathing device. The volume bag was charged with oxygen and as the wearer inhaled, he drew the oxygen through a canister containing a soda lime and then exhaled into the volume bag. The Lung used a mouthpiece with a set of spring-loaded mica disc valves to maintain the flow in one direction in a cycle. To-and-fro breathing was prevented by the valve system. Thus, the gas breathed in was drawn through the soda lime which removed the carbon dioxide exhaled in the preceding breath. The user could breathe in and out of the bag until the oxygen content was reduced to levels too low to sustain mental and physical activity.

IN THE EARLY DAYS of thought on this subject, it was believed that the development of diver's bends would be a problem. At first, a man was taught to slide up the ascending line until he met a knot. Here, he was supposed to stop and take a certain number of deep breaths, then continue. This would provide a rough form of stage decompression. In theory, and in the Escape Training Tanks, which were built a few years later, the idea was a good one. Unfortunately, it didn't work in the open sea.

Divers learned that in escapes from any appreciable depths, where decompression might be important, there were apt to be currents that led out the buoy holding up the ascending line in a long catenary. This meant that the knots on the line did not tell the distance from the surface.

VADM C. B. Momsen, USN (Ret.)



Thus, as men learned more about the sea and how to use the Lung, instruction went through a process of evolution over the years. It was realized, for example, that the bends could be offset by shortening the time under pressure just as well as providing decompression stops on the way up. In time, the emphasis shifted to the principle of simply getting out of the lower depths as quickly as possible.

The Lung also went through several revisions. The long tubes, connecting the mouthpiece to the volume bag in the early models, disappeared. In the later models, the mouthpiece and neck containing the valves was fitted directly into the top of the bag. It was this style which, over the years, became most generally known as the "Momsen Lung."

A rebreathing bag attached to the Lung, and an oxygen supply aboard submarines, suggested additional uses. A dual threaded filling cap was fitted into the canister; it could be removed and additional filters used in its place. The proper filter, therefore, enabled this gear to serve as a smoke, chlorine, ammonia or carbon monoxide mask.

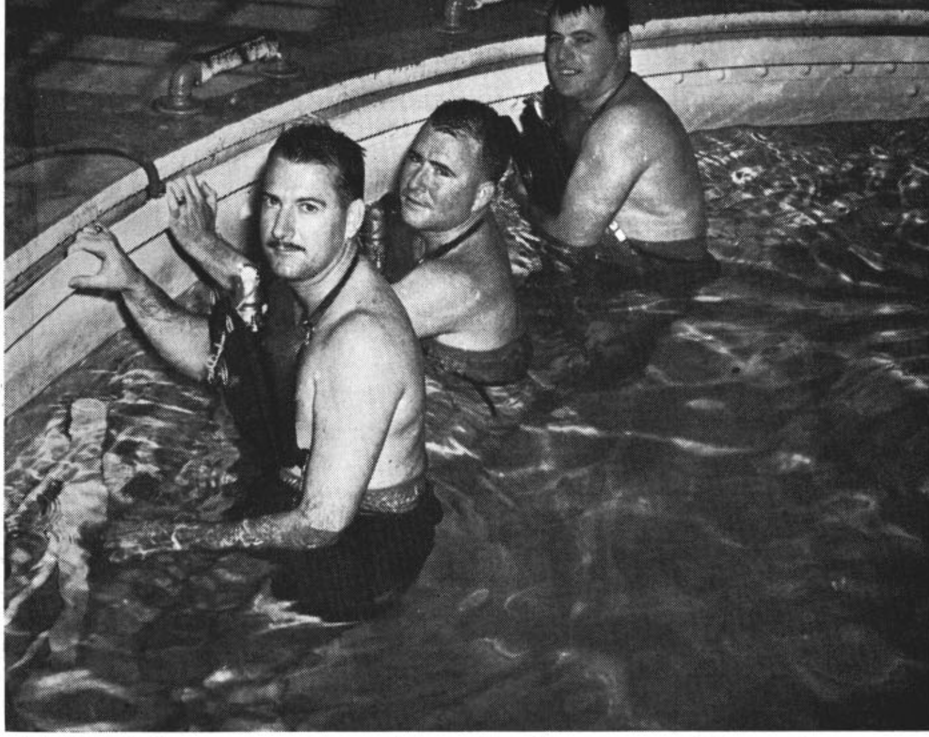
Although these accessories met with somewhat indifferent acceptance among submarines, the Lung itself was a tremendous success. Each man was convinced that he could, at least, save himself in the event of a disaster.

IN 1945, studies were started at the Escape Training Tank, New London, in a method of escape known as free ascent. Instructors had long since learned to work underwater while holding their breath. They had learned that a man buoyant at the surface was, if his chest was equally distended, buoyant at any depth. The flesh and bones of his body act as a fluid medium and are not compressed at any depth.

However, if a man took a large breath from an air pocket deep in the water, and began to float to the surface, he *must* exhale. If he were to hold his breath as he ascended, the air in his lungs would expand and possibly tear his lungs. If he exhaled too slowly, the effect could be much the same as if he held his breath. If he exhaled too rapidly, he might lose his buoyancy and sink like the proverbial rock.

This method had been demonstrated to submarines during World War II but, if there was any choice, it still was not the approved method of escape.

A committee report issued shortly after World War II disclosed that, in spite of all their training, many submariners had not used their escape apparatus at all. Even among those who tried to use it, many had used it improperly. As a result, it was found, as many men had made successful escapes (unintentionally, or by force of circumstances) without any apparatus as those who had made successful escapes with the Lung.



GOING UP—Momsen lung shown during submarine escape training session did much to increase morale, rebuild faith in subs after 'Tragic Twenties.'

THE QUESTION AROSE, of course: Why use the Lung? Inevitably, interest in free ascent increased, and it became a standard part of escape training at New London. Trainees often expressed a preference for free ascent. For some time, training included both the use of the Momsen Lung and the new technique. However, two fatalities within six months in 1952 brought the free ascent training to a halt.

At the same time, the theory of "buoyant ascent" gained more attention. It, too, was simple.

Wearing a Scuba and a standard life preserver, the first man goes out the escape hatch of a submarine to make sure the exit route is clear. When ready to make his escape, he inflates the life vest until it is comfortably full and checks the spring loaded relief valves to make sure they will vent excess pressure. Then he flushes his lungs with a few breaths of fresh air to extend his breathholding time. Then he holds his breath while making his exit out the hatch.

When in the clear, he exhales most—almost, but not quite all—of the air in his chest, and turns loose. He knows the life vest will bring him rapidly to the surface. The air remaining in his chest will expand and refill his lungs. He should continue to exhale during the ascent.

In many cases, he will pop up out of the water almost waist high. Then he relaxes in his life vest which holds him face up and head out of the water, until his shipmates join him. That's all there is to it.

The essential idea had been known for several years and demonstrations had been included as a stunt in "shows" at the Tanks for some time. At first, it was regarded as more dangerous than the free ascent method because the rate of ascent was more rapid.

Eventually, this was found not to be true. In addition, the method was not only simple to teach, but could be taught with relatively little risk. Its simplicity, plus the fact that it meant a good life preserver was at hand at the surface, soon created an enthusiastic group of supporters for this "new" method.

IN 1956, *buoyant-assisted ascent* became the approved method of individual escape from a submarine.

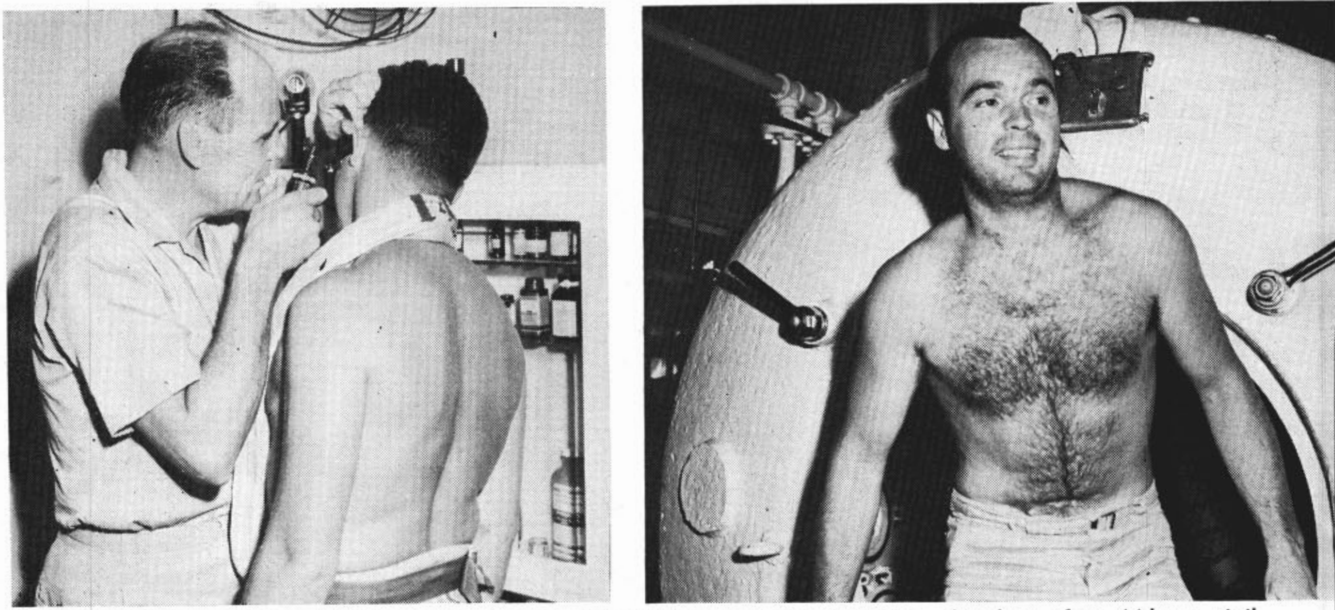
On 16, 17 and 18 Apr 1957, training escapes were made from USS *Tang* (SS 563) while it was bottomed in 142 feet of water.

With this event, 30 years of history came to a close. An invention which made it possible for the Submarine Service to continue, has gone to the scrap heap. Even there it must be mutilated so it will not fall into the hands of some unknowing enthusiast and be used as a piece of Scuba equipment. (If used as Scubas, Momsen Lungs are dangerous—this is the reason for the BuSandA instruction that directs their mutilation.)

At the time of the introduction of the Momsen Lung there was no really practical or widely used self-contained underwater breathing apparatus, and Scuba was still back in the alphabet. Today thousands go underwater where only a few went before. But for three decades of submariners there will always be a soft spot near their heart for Vice Admiral C. B. Momsen, USN (Ret.) and the Momsen Lung.

—CAPT Harry J. Alvis, MC, USN.

BUOYANT-ASSISTED ascent is now approved method of individual escape.


AT WORK—Diving corpsman checks trainee, and *right* HM leaves recompression chamber after 44-hour vigil.

Deep Sea Corpsmen

THE NAVY'S HOSPITAL CORPSMEN pop up in all sorts of places all over the world—from the battlefields where they serve with the Fleet Marines to the shadow of the Egyptian pyramids where they help search out the causes of little-known diseases.

One of the oddest of the corpsman's many odd jobs—and one of the most hazardous—is that of the Medical Deepsea Diving Technician, the Navy "Doc" who not only does the everyday job of tending the sick, injured and wounded, but who also functions as a deepsea diver. Thoroughly skilled in both specialties, he may be called upon to perform the duties of either any time of the day or night.

How does a man get into something like this? Well, here's the way James "Happy" Chandler, big six-foot, three-inch HMC, puts it:

"I was on independent duty during the war, serving in DEs. Because I was the only medical man on board it was interesting work.

"After that challenging and sometimes exciting work I was assigned to a shore station dispensary and then to a naval hospital. Compared to DE duty the shore station jobs seemed tame, and, I might add, somewhat boring, so I looked around for something that would really test my mettle.

"I hadn't known, nor even suspected that corpsmen worked as deepsea divers until one day when I was shooting the breeze with a boatswain's mate diver who told me about them. The more he talked, the more interested I became and, finally, after thinking it over, I decided this was just the thing for me. I put in a request to go to diving school, the Chief of Naval Personnel approved it, and I've never been sorry."

Since he became a diver the chief has made some 250 trips underwater, but he still says, "Never a day goes by that there isn't something new. I don't know of any job that could be more interesting."

To qualify as a "Diving Doc," a hospital corpsman is sent to the Naval School, Deepsea Divers, in Washington, D. C., for 28 weeks of rigorous training—26 weeks for the regular Diver First Class course, plus two more weeks to study diving diseases, gas analysis and such.

DIVING 'DOCS' work with divers and with submarine escape trainees.

After Chandler completed his training he drew a submarine rescue vessel assignment. He reported to USS *Kittiwake* (ASR 13) and got right on his job.

Although he did a normal amount of deepsea diving, his primary duty was to help in the treatment of the other divers on board. Every time they went over the side he stood by and, since he knew their work as well as his own, he was a good man to have around—especially when medical aid was necessary.

Chief Chandler now works at the Escape Training Tank on the Submarine Base at Pearl Harbor. Here, in a towering edifice, 134 feet high and filled with 210,000 gallons of water, submarine crews are trained in the latest underwater escape techniques, practicing the actual steps they would take to get out of a sunken sub alive.

At times the corpsmen at the tank also battle the grim reaper—usually when amateur aqualung enthusiasts are brought in with the bends, acquired from too deep a dive, too long a time underwater and too rapid a surfacing.

A victim of the bends must be taken into a decompression chamber and, by means of air pressure, brought to the depth (pressure) at which he finds relief from the symptom. This is a long and involved procedure in which there is no room for mistakes. A corpsman or doctor must stay with the victim the whole time he is in the chamber, which can mean a matter of several days. During that time pressure is released little by little as the victim is "brought up" from the deep.

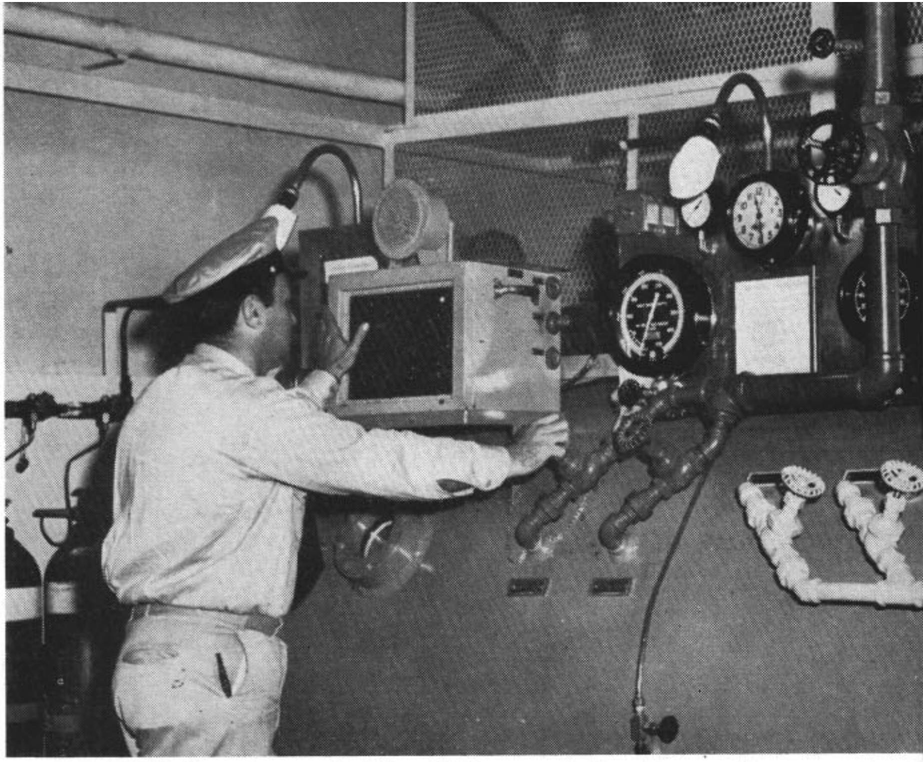
Chandler has spent many a night and day in the chamber, ministering to sick divers, testing pulse, respiration and such, and taking care of all the other details that need tending.

The treatment of air embolism also takes a long time for both victim and corpsman. To treat this disease the victim is put under pressure, and then brought up very slowly through decreasing pressures until he has reached "the top." During this ordeal the victim's condition must be given close attention, so a doctor or corpsman remains in the decompression tank with him.

One such case involving the "diving docs" at Pearl Harbor occurred early in 1957. Joseph L. Reynolds, a first class corpsman and diver, put in a 73-hour vigil with a Navyman who was suffering with the bends. The victim recovered and returned to duty. Some time later an Army sergeant was stricken while aqualunging with two companions at a remote beach almost at the other end of Oahu Island.

The incident illustrated the importance of proper indoctrination and the dangers involved. The sergeant's oxygen supply became depleted while he was submerged and he was forced to ascend too rapidly. Although he was rushed to the decompression chamber as quickly as possible, two hours elapsed between the time his distress was first noticed and the time he entered the chamber. Those two hours turned out to be irreplaceable. Reynolds, called from sick bay at noon, spent the next 46 hours in the chamber. Despite all that he and the two medical officers on the case could do, the sergeant died eight hours after he had entered the chamber. After the soldier's body was removed, Reynolds still had to remain in "the igloo" for 38 hours more. Because he had been under great pressure for a considerable length of time, he had to be taken through "table four," the longest and slowest ascent table in the book.

—Bryant Arbuckle, JO1, USN



DOUBLE DUTY—Experiences of diving HM's come in handy around recompression chamber and under sea. *Below:* J. Reynolds, HM1, readies for dive.

WHAT'S IT LIKE ON THE

As with so many other areas of human endeavor, exploration of the ocean bottom first began slowly, then grew at an ever increasing pace.

So far as we know, Magellan was one of the first to make the attempt. Somewhere in the far Pacific, he lowered his standard 200-fathom sounding line and, when it failed to touch bottom, came to the conclusion that he was over the deepest part of the ocean. His was not the last error to be made during the development of this science.

The next recorded attempt was made some 300 years later. In latitude 27° 26′ S., longitude 17° 29′ W., Sir James Clark Ross tied together every available line aboard *Erebus* and *Terror* and finally touched bottom at 2425 fathoms. This was, apparently, the first successful deep-sea sounding.

A sounding such as this was a major operation. The weather had to be nearly perfect, the ship had to stand as nearly motionless as possible, and the operation itself, involving as it did, miles of recalcitrant line, usually required a full day. Little wonder that skippers were reluctant to waste the time.

By 1854, when LT Matthew F. Maury, USN, collected all available records, only 180 deep-sea soundings had been made in the Atlantic and, by the time the modern echo sounder was introduced (in 1922, by the Hydrographic Office), a world-wide total of about 15,000 had been recorded. This averages out to roughly one sounding for every 6000 square miles of sea.

Today, hundreds of ships are equipped with sonic sounding instruments that trace a continuous profile of the ocean's bottom. This is a generalized summary of what they have found:

Once clear of the tidal areas, the oceans consist of three distinct areas: the *continental shelf;* the *continental slope;* and the *floor of the deep sea.*

The shelf has much in common with the land itself. Sunlight penetrates most of it to a varying degree; such vegetation as grows in the ocean may be found here; and much of the shelf consists of material washed into it from the land. The more familiar forms of fish may be found here. It is this relatively narrow portion of the sea that has been, up to now, of the greatest immediate importance to us. Parts of it may have been dry land at one geologic time or another.

At one time, the 100-fathom line was generally accepted as the line of demarcation between the continental shelf and the continental slope. At the present time, however, it is the fashion to mark the division wherever the relatively gentle slope of the shelf suddenly begins its plunge into the great depths. This abrupt dropping off averages, the world over, at about 72 fathoms, although there are some spots where the shelf ends at between 200 and 300 fathoms.

On the Pacific coast of the United States, the shelf is relatively narrow —not much more than 20 miles wide. On the Atlantic coast, the shelf is usually much wider. Somewhat north of Cape Hatteras it is as much as 150 miles wide; yet at the Cape

OCEAN BOTTOM?

itself and off certain parts of Florida, the plunge begins almost immediately.

Beyond the shelf, no matter how deep nor how far from land, the bottom drops off abruptly. Here, if man could enter it, would be a new and uncomfortable world. A frightening and awesome world. There is little light, no plant life; the pressure, cold and silence increase; the scenery is mud, rocks and clay, inhabited by large and small carnivores such as those encountered only in nightmares. The slopes are well below the familiar surface wave action, yet strong currents and tides move back and forth and, to some extent, up and down.

It is highly probable that these areas have never seen air and sunlight since the ocean's basins were first filled with water. It is not likely that they will again be revealed to view until the waters of the earth dry up for the last time.

In a way this is a pity, for the slopes are regarded by those who know as perhaps the most impressive physical manifestations on earth. They drop off abruptly from the continental shelves to the really deep ocean at as steep an incline as gravity will permit. Their average height is some 12,000 feet, although drops of 30,000 feet have been recorded.

ONE OF THE MOST spectacular features of the slopes are the tremendous submarine canyons which, with steep cliffs and winding valleys, cut into the shelves almost to the continents themselves. These canyons have been found everywhere, soundings have been made and, in all probability, are of world-wide occurrence. Geologically speaking, they are relatively young—no more than a million or so years old—but how they were formed, and why, no one knows.

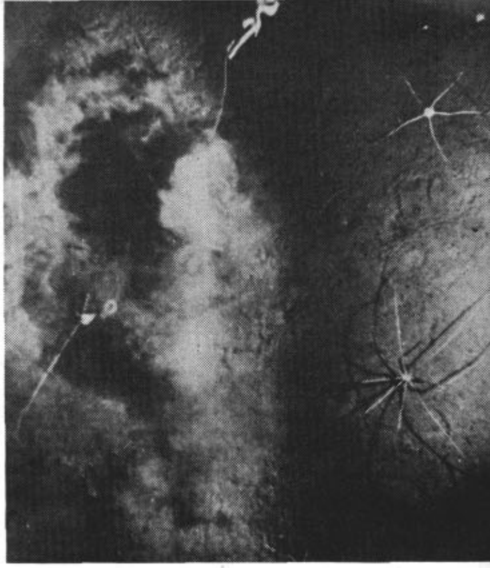
There are dozens of such canyons along the slopes and the most spectacular of our terrestial scenery, the Grand Canyon could, in some cases, be dropped into any one of these with hardly much more than a splash. They are usually found near the mouth of a continental river.

Geologists suggest the obvious clue (but any theory offered is promptly challenged by contradicting evidence) that the submarine canyons were cut by rivers at some time when their gorges were above sea level. It is agreed that the sea level dropped during the Ice Age, but only a few hundred feet at most. Some canyons are a mile or more in depth.

The most completely surveyed canyon in the Western North Atlantic is the Hudson Canyon. This extends from the 100-fathom curve, 90 miles southeast of New York harbor to a 2650-fathom plain some 300 miles offshore. This 200-mile long canyon is a chasm 1000 feet deep in places and has several sizable tributaries entering it. The canyon cuts through the continental slope and joins a depression in the continental shelf which marks the entrance of the Hudson River channel off New York harbor. In this instance, the Hudson Canyon system acts as a sluiceway down which sediment is carried by currents to the deep sea bottom which, at this spot, is an enormous plain of just plain mud. A near neighbor of the Hudson Canyon, the Mid-Ocean Canyon, starts near Greenland and extends some 2000 miles south. So far as is known, there are no major rivers in Greenland. Glaciers are thought to be the origin of this little number.

THE FLOOR of the deep ocean—the abyss—has not been subjected to the type of erosion responsible for our most spectacular scenery but this does not mean that no geologic action has taken place. The floor of the sea, like the continents, is a thin crust over the molten center of the earth and, like a pot of thick fudge, the entire crust is slowly—very slowly, with thousands and millions of years between each blop—bubbling and boiling.

That, at least, is one theory. This explains the wrinkles and folds where, at one spot, the interior cools imperceptibly and shrinks away from its covering. In another area, it falls away into the famous deep trenches and in still another, it pushes up conelike shapes of underseas mountains as volcanoes boil upward from the depths of the earth.

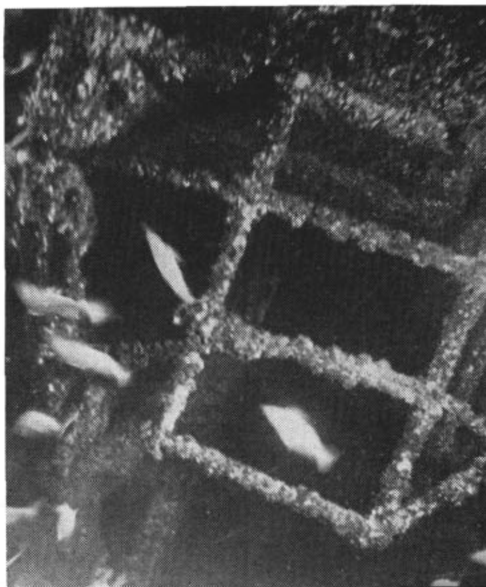


SEA STARS—Starfish and sea spiders were photographed on bottom of the Atlantic ocean 975 fathoms down.

The deepest depressions occur not in the center of the ocean's basins, as might be expected, but near the continents. The Mindanao Deep, east of the Philippines, is some six and one-half miles deep. The Tuscarora Trench, east of Japan, nearly as deep, is one of a series of long narrow trenches that border the outer rim of a chain of islands that include the Bonins, the Marianas, and the Palaus. The greatest deeps of the Atlantic lie near the West Indies, and also below Cape Horn. In the Indian Ocean, the curving island arcs of the East Indies have their accompanying deeps.

In addition to these trenches, or deeps, the existence of a continuous underseas crack some 45,000 miles long has been claimed by the Lamont Geological Laboratory within recent years. They say this rift aver-

DEPOSITS on floor include things dating from beginning of time. Shipwreck discovered off Cape Hatteras.



Mud Comes in Handy

So the bottom of the ocean is covered with mud! Who cares?

The Navy cares and, at times, is glad of it. The California Academy of Sciences, while engaged in an oceanographic survey sponsored by the Office of Naval Research, reported that not far off the coast of California the ocean bottom was covered with large areas of thick, gooey mud. Since the ocean's depth at that point was some 500 fathoms, this appeared to be further fascinating information—to be filed.

Then some unsung genius connected this sticky fact with the problem of disposing of large quantities of radioactive waste.

Now, the waste is loaded into steel drums, carried to muddy-bottom areas, and heaved overboard. The drums sink far into the mud long before they disintegrate and the mud absorbs the radiation. This avoids contaminating large volumes of sea water which would happen if the drums happened to be dropped on a sand or rock bottom.

The moral? Basic research is a fine thing whenever applied.

ages 20 miles wide and one and one-half miles deep. It coincides with a world-wide active earthquake zone along its entire length. Almost all of the earthquake shocks along the 45,000-mile line occur almost exactly within the limits of the rift.

The main line of the rift system is believed to extend through the North and South Atlantic Oceans, around the top of Africa into the Indian Ocean, and then branches through the Arabian Sea.

The other branch is supposed to pass between Antarctica and New Zealand, then branches again near Easter Island. Deepest point in the rift line is about four miles below the surface.

Until recent years, not much was known about the bottom of the Pacific. Most soundings had been taken near the coast and, as the ocean floor was relatively smooth in those areas, it was assumed that the floor was equally smooth all over.

Not so. Oceanographers of the Navy Electronics Laboratory tell us that only about 10 per cent of the bottom is smooth.

For a long time, geologists have wondered about the relationship between the great linear features of the earth's crust. On the continents, these have been so eroded that little more than "ruins" remain. Under the sea, however, where they have been protected from erosion, many more details have been revealed.

Between 1950 and 1953, four great parallel cracks or fracture zones were discovered by NEL on the floor of the northeastern Pacific. The northernmost, called the Mendocino Escarpment, extends westward from Cape Mendocino, Calif., for more than 1400 miles. One of its walls is 10,500 feet high. South of this is the Murray Fracture Zone, which can be traced from a point near the Pacific coast almost to the Hawaiian Islands. It hasn't yet been confirmed, but it is considered possible that this crack may run through the islands and continue into the undersea Mid-Pacific Mountains further west.

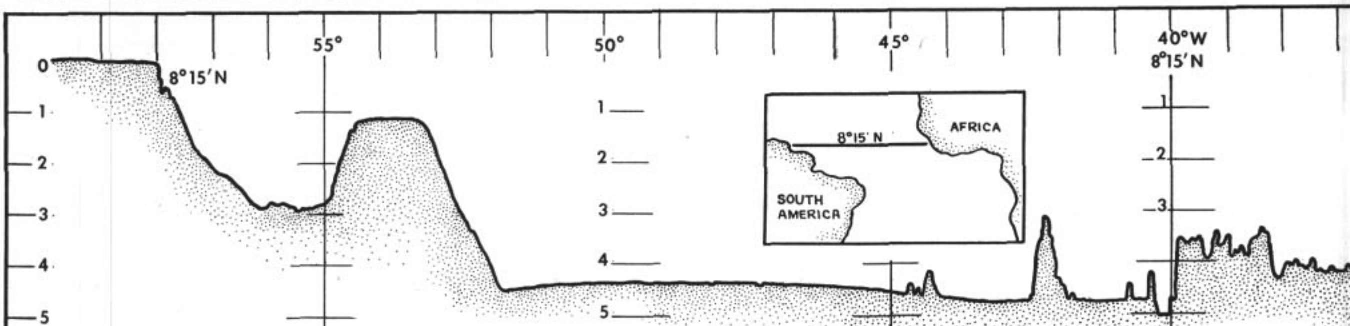
Off the coast of Mexico is a third great zone called the Clarion Fracture Zone. It cuts the ocean floor for at least 1700 miles and is thought to cross the continent along the lines of the volcanoes of southern Mexico. The last zone to be discovered and still under study, is the Clipperton Zone, which has been traced for more than 3300 miles. This lies farthest south of the four.

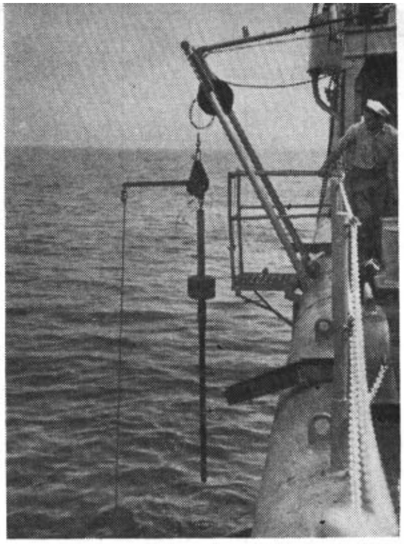
How are these breaks to be explained? It is believed (at the moment), that they and portions of California and possibly the Hawaiian Islands were created in one great upheaval of the earth's surface between some 150 and 50 million years ago—give or take a few million. Two possible reasons are given for the cracking. The first and most likely is the slow movement of great convection currents in the "plastic" material of the earth's mantle under the harder surface crust. The other —which is questionable—is the migration of the north pole from a position in India to its present position. Take your choice or, if you prefer, offer your own theory.

Explorers have, for a long time, realized that many of the islands of the oceans are simply the tops of mountains that rise from the floor of the sea. Most of the islands of the Central Atlantic, for example, are peaks of the Mid-Atlantic Ridge (see below, page 42). The Hawaiian Islands are peaks along the top of a great submarine ridge more than 1600 miles long. The Marshall Islands are coral caps on great volcanoes. Thousands of other mountains rise from the bottom of the Pacific but do not quite reach the surface. Dozens of other peaks were islands at one time but have sunk and now lie below the sea's surface.

While the transport USS *Cape Johnson* (AP 172) made its long voyages across the central and western Pacific during World War II, Dr. Harry Hess, formerly of Princeton University—her navigator and

SONIC SOUNDINGS have given new light on the contours of the vast region of earth covered by oceans.




RECENT STUDIES sponsored by Navy Hydrographic Office came up with a deal of new information on bottom.

later her commanding officer—studied the records of the ship's echo sounder. One day the soundings showed the presence of a large submarine mountain whose top was too flat and too big to have been the crater of a submerged volcano.

Later, he crossed 10 more of these strange "islands," and later discovered others in the records of the Hydrographic Office. Since that time more of these islands have been discovered and, in 1950, the Scripps ship, *Horizon,* discovered the Mid-Pacific Mountains, a submarine range extending from the vicinity of Necker Island of the Hawaiian group, to the vicinity of Wake Island.

Many of the peaks of this range, the highest of which towers more than 13,000 feet above the sea floor, have the peculiar flat tops first noted by Dr. Hess.

Material obtained by dredging and coring along the tops and upper sides of these seamounts have provided clues as to their origin. This material consisted of pebbles, cobbles and boulders of basalt, many of which appeared to have been rounded by the action of rivers or beach waves; and of limestone containing coral of about 100 million years ago. It was concluded that, during the time when dinosaurs still roamed the continents, this undersea range formed a chain of islands.

At this time, the sea eroded the projecting peaks of the chain to flat surfaces. Reef coral larva drifted to the islands, probably from the east, and lodged on and among the debris. In the warm tropical surface waters, enough of the corals grew and accumulated to form banks, but not enough to conceal the rocks and finer sediments and thus form atolls.

Probably, as a result of adjustments of the earth's crust, the great range sank, at first fast enough to kill the reef coral, then more slowly until the present depth was reached.

There it still remains—the oldest uneroded group of mountains known on earth—disturbed only by weak currents and the slow rain of tiny organisms from the waters above.

THE MID-PACIFIC MOUNTAINS may lay claim to being the oldest, but the Atlantic claims to have the biggest range of mountains. It winds from the Arctic to the Antarctic with peaks averaging 10,000 feet. One undersea giant, Pico, in the Azores, rises 27,000 feet.

Known as the Mid-Atlantic Ridge, this chain of submarine peaks and plateaus runs the length of the vast S-shaped trough of the Atlantic. Throughout much of its 10,000-mile length it gives the impression of an object formed by the interplay of great, opposing forces.

The range is about twice as wide as the Andes, and several times the width of the Appalachians. Near the equator a deep gash—the Romanche Trench—cuts across it.

The greater part of the Ridge is, of course, submerged. Its central backbone rises 5000 to 10,000 feet above the sea floor but there is another mile of water above most of its summits. Here and there peaks form the islands of the mid-Atlantic. The Rocks of St. Paul, near the equator are not much more than a quarter of a mile across, but their slopes drop off so rapidly that water more than half a mile deep lies only a few feet off shore.

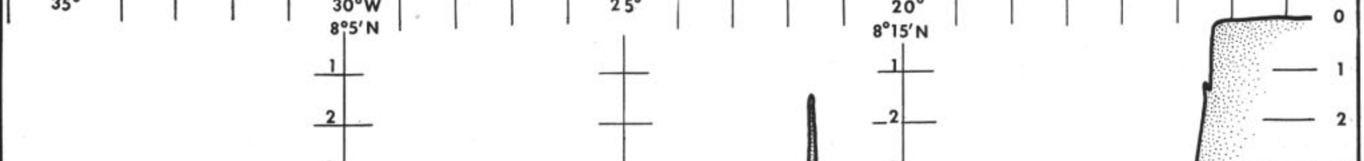
NOT ONLY DO THE OCEANS contain mountains, valleys and plateaus, but rivers also have been found.

One, an estimated 250 miles wide and 1000 feet deep has been mapped in the Pacific by the *Dolphin* expedition of Scripps. This river flows eastward along the equator for at least 3500 miles.

The current was discovered in 1952 by a member of the U. S. Fish and Wildlife Service in his studies of long-line fishing, a technique used in Japan. A series of fishing lines are attached to a rope several miles long which is supported near the surface by buoys. When Townsend Cromwell, the Wildlife Service man, put out his lines, he found that they did not move westward with the surface current as expected, but in exactly the opposite direction—and at high speed.

Measurements showed that, at one point, the core of the current lies about 300 feet below the ocean's surface, that the current is about 700 feet thick, and that it is about 250 miles wide. It is more rapid than the surface current, averaging almost three knots compared to the surface current's one knot. The amount of water transported in a given time was found to be about equal to that of the Gulf Stream

CHART OF BOTTOM topography of Atlantic Ocean between South America and Africa was made by Woods Hole.



CURRENTS and rivers and effects of waves such as this rippled bottom have been found at depths where it was previously thought the water was still.

as it emerges from the Straits of Florida. The core of the current gradually rises until, near the Galapagos Islands, it is only about 140 feet from the surface.

The *Dolphin* expedition also found *another* current beneath the Cromwell current. This one, relatively weak, flowed westward. Thus, in one area of the Pacific, within the first few thousand feet of the surface, we have three considerable currents lying like ribbons on top of one another and being pulled in different directions.

Are there more than three? Where does the water come from, and where does it go? We don't know. But we'll find out, some day.

In Rachel Carson's truly great book *The Sea Around Us,* she describes in one of her finest passages, "the long snowfall—the steady, unremitting, downward drift of materials from above, flake upon flake, layer upon layer—a drift that has continued for hundreds of millions of years, that will go on as long as there are seas and continents."

That, in short, is what lies on the bottom of the sea.

In addition to the silt of every river that empties into the ocean, there are other materials that make up the sediment. Volcanic dust, which may have been blown half way around the world, eventually finds its way to the ocean, floats for a while on the surface, then sinks. Dust from the desert is blown out to sea. Gravel, stones and small boulders, picked up by glaciers, fall to the bottom when the ice melts. Meteoric debris that enters the earth's atmosphere over the oceans finds its way to the bottom. A flake at this point; then, a minute, an hour or a year later, another flake there—each is added to the bottom of the sea. Added, but rarely subtracted.

Impressive as the total of this material may be, it is of minor importance compared to the billions upon billions of tiny shells and skeletons of the minute creatures which, for millions of years, have lived in the upper levels of the sea and then, upon death, have drifted downward.

How deep is this sediment? Until a few years, ago, no one could have spoken with any assurance. Now, educated guesses have been made. The rates of fall in different parts of the ocean presumably vary, but in any event, it is very slow. Cores, first 10 feet deep and later, 70 feet deep, have been taken from the bottom. It is assumed that each of these cores represents millions of years of geologic samples. Through a tricky technique of seismic refraction, by means of which sound waves travel horizontally through rock, sediment layers of 12,000 feet have been found in the Atlantic basin. No sediment layers thicker than 1000 feet have been found in either the Pacific Ocean or the Indian Ocean.

The Atlantic Ridge was mentioned earlier. Consider this: As the approach to the foothills from the American side of the ridge begins, the sediments deepen as though they were mammoth snow drifts—snowdrifts 1000 to 2000 feet deep against the slope. Farther up the Ridge, where occasionally the terrain flattens out into plateaus, the drifts increase at times to 3000 feet. The peaks are bare.

Near the continents, on the edges of the continental slopes, is just plain mud—blue, green, red, black or white—washed out to sea by the rivers. Farther out, the sediment is composed primarily of the shells of the tiny, one-celled creatures mentioned earlier—*globigerina.*

The sea floor over large areas in the temperate zone is covered with these shells. Over the ages the species have varied somewhat, so that it is possible through their shells, to estimate the age of the deposit. Like most one-celled creatures, an individual globigerina normally does not die but, by division, becomes two.

When this occurs, the old shell is discarded and each of the two tiny blobs grows new ones. The old shell falls to the bottom. Each shell is small, but in their numbers they have covered millions of square miles of ocean bottom, sometimes to a depth of thousands of feet, or even more.

The discarded husks of other living creatures also help form the bottom. *Radiolarians,* similar in appearance to snowflakes, form broad bands of ooze in the North Pacific. *Diatoms,* the microscopic plant life of the sea, are abundant only in cold waters. Because silica is resistant to solution in salt water, and because diatoms possess coverings, there is a broad belt of diatom ooze on the floor of the vast Antarctic Ocean.

Again, in the North Pacific, immense areas of the bottom are covered with a red, soft sediment. It occurs only at great depths and the only organic remains found so far are sharks' teeth and the ear bones of whales.

Where did the red come from? No one knows, but it has been proposed that the material may be windblown from the world's desert areas.

As you read this, more flakes of the "long snowfall" are drifting downward to the bottom of the oceans; acres of ooze are sliding down a sharp slope; slow currents are pushing their way silently through the black, cold water as they have done since time began.

This is the underseas world.

Treasure Below

NAVY DIVERS have gone below to do jobs including treasure hunting.

MOST SEEKERS OF BURIED treasure find little to reward them for their time and effort. But such was not the case in the Navy's search for silver in the Philippines' Caballo Bay, as well as Tokyo Bay, back in 1945.

The story of the treasure of Caballo Bay began in the early part of World War II.

When the Japanese advanced on Manila the government of the Philippine Commonwealth moved its money to Corregidor. USS *Trout* (SS 202) carried some of the money to safety. However, seven to eight-and-one-half million dollars worth of Philippine pesos still remained on the Rock. To prevent all that silver from falling into enemy hands, it was dumped into the Bay.

After the Japanese took Manila they attempted to salvage the treasure, using POWs and native divers. Altogether, more than one million dollars in coins were recovered before the Japanese discontinued the operation in November 1942.

In 1945 Manila was retaken by American troops. At first, salvage crews were too busy clearing up shipping facilities to pay much attention to the underwater treasure. However, when "bootleg" divers started seeking the money, the Navy was asked to help recover it. The Navy set to work in June 1945.

The silver rested in mud about 110 to 120 feet below the surface of the Bay. It had been in bags, packed in wooden boxes, but the boxes were now so flimsy that they had to be loaded into GI cans before they could be raised to the surface. The weakness of the boxes was partly due to natural damage from three years underwater and partly due to the deliberate efforts of the POW divers to weaken the boxes and scatter the coins.

When the money was brought up it was dumped on the deck, counted in the presence of an Army auditor and taken to an Army bank.

The Navy continued the job until about April 1946. By then some two-and-one-half million dollars worth of coins had been recovered. That, together with what the Japanese had brought up, made a total of around $3,500,000. The government of the Philippines recovered some more of the money in later salvage operations. However, a very considerable sum still remains on the bottom to tempt future treasure seekers.

The treasure in Tokyo Bay—more than six tons of silver ingots—was recovered in November 1945. It was valued at approximately $200,000.

In the latter part of August 1945, when the U. S. Third Fleet was entering the waters of East Japan, the Japanese had tried to remove the bullion from the Yokosuka Naval Base, where it had been stored. A typhoon and the Navy's arrival prevented any transfer.

The existence of the silver was not reported to the Navy when it took control of Tokyo Bay on 5 September, nor was it mentioned in the official report of 15 September on the list of assets of the Yokosuka Yard.

Meanwhile, salvage operations in the harbor were getting underway. Captured Japanese floating cranes were used to clear the shipyard, and it was a chief boatswain, in charge of one of these cranes, who turned up the first clue to the treasure.

He reported finding a bar of tin aboard the crane. The "tin" turned out to be almost pure silver.

Japanese yard workers (including the former operator of the crane) and officers and enlisted men who were known to have been in the area all denied any knowledge of the matter. However, the questioning resulted in a letter from the former Japanese deputy chief of staff to Commander Fleet Activities. The letter said there were 200 bars of silver just 40 yards offshore. It also explained why the silver had not been reported earlier.

On 23 August, the admiral wrote, the barge which was to have taken the silver from Yokosuka sank in a typhoon. Four days later it was refloated and brought back to the yard, where the barge—silver and all—was scuttled off Dock No. 3. The admiral had been unaware of the refloating and scuttling.

USS *Protector* (ARS 14) was assigned to the salvage job. She began operations on 2 November.

At 1200 on 3 November a wire cargo net, full of silver ingots, was found under 40 feet of water. The divers used probing bars and high-pressure water hoses to clear away the mud, and loaded between five and 10 bars at a time into canvas sacks which were then hauled aboard *Protector*.

Six days later, 182 ingots, each weighing 60 pounds, had been recovered. The search for the other 18 bars continued until 24 November, but without further success.

GOLD RUSH—Navymen shown evacuated Philippine gold before surrender. Some still remains at bottom of Caballo Bay in spite of attempts to find it.

OCEANS OF RESEARCH—Men have sailed sea's surface for years, but only recently they're finding out what's below.

Space Research — Under Water

"WATER, WATER everywhere . . ." The Navy has been sailing on it and in it for years, but still would like the answers to a lot of questions about the sea. For example . . .

How can fish, traveling in large or small schools, turn or stop, go up or down, as one unit? We have only a few hints.

Why do deep sea fish literally "explode" when brought to the surface, yet a great change in depth doesn't seem to bother others? How can a whale—a mammal—dive for hundreds of fathoms, then come charging to the surface at the exact spot from which he descended? We have some idea, but we're not too sure.

What caused the enormously deep chasms in the bottom of the ocean? We have a theory. We have several theories.

What caused the bottom of the sea to become so jagged and irregular? Again, our answer depends on theory.

Why, in the major ocean stream, does the current flow in one direction and, immediately below, flow in the other?

We don't know, even though we can justify the existence of ocean streams in theory.

The questions listed above could be extended for pages if we wanted to but we're learning at an increasingly rapid pace. Even when we don't have the complete answers, we know that many of our earlier theories about some of these problems were wrong. That's something.

A REVOLUTION is taking place and, whether or not you know it, you're taking part in it. In recent years we have, with a sense of shock, realized that although men have crawled over the face of the ocean for thousands of year, we know almost nothing about the sea below the surface. Until our present era, we took it for granted nothing much was there. Our present limited knowledge has only helped us to comprehend the great potentials ahead of us. The more we have learned, the more important the subject has become.

The ocean—what it is and what it does—is, of course, of peculiar interest to the Navy. It's the environment in which it operates. It takes only a minimum imagination to appreciate that, with the growing importance of the nuclear submarine, from here on in, we will operate not only *on* its surface but, for the first time, *in* it.

It is our thesis that the oceans, their behavior and their contents might be as important to all of us as that equally unexplored area, the space above us. It is a tribute to our present stage of knowledge, limited as it may be, that we are in a position to ask the questions mentioned above.

After all, on the face of it, once you've seen one piece of ocean you've seen it all. It is quite an accomplishment that we have learned that there *are* deep chasms, that the bottom of the sea *is* irregular, that there *are* definite currents below the surface of the ocean. In time to come we will discover the reasons for all these phenomena.

THE STUDY of the ocean is, of course, by no means new. Men have been writing and telling sea stories about it ever since Homer described the adventures of Ulysses. But it was an American naval officer, CDR Matthew Fontaine Maury, who in the 1840s and 1850s, first dignified the subject with a scientific approach. He charted the currents of the ocean and proved that these immense streams have stability and direction and that they have a profound influence on climate. In short, he taught the Navy how to navigate with the seas rather than against them.

It is only reasonable that the Navy should have a deep interest in oceanography. Consider, for example, this list of Navy activities which depend upon the subject for basic information: The Bureau of Ships, the Hydrographic Office, the Bureau of Ordnance, the Naval Research Laboratory, the Underwater Sound Laboratory, the Navy Electronics Laboratory, the Chief of Naval Operations, the Fleet Sonar School, the Amphibious Forces, the Bureau of Medicine and Surgery, the Bureau of Supplies and Accounts and the Bureau of Aeronautics.

This demand has grown, to a large extent, since the end of World War II. As the intricacy of naval operations and armament increases, the need for technical understanding of the sea keeps the same pace.

At the present time, the Navy's research program is under the direction of Gordon G. Lill, Head, Geophysics Branch, Office of Naval Research. Rather than set up its own laboratory (one already exists in the Oceanographic Division of the Hydrographic Office), the Navy underwrites the costs of projects in a number of existing civilian institutions. ONR does not closely specify the kind of investigations to be undertaken by these organizations. A free hand, it is felt, tends to foster healthy competition and leads to separate lines of attack by the competing groups.

THESE LABORATORIES — there are nine—are located on all three of our major coastlines. This enables them to study, for example, the deep temperature gradients of the Western Atlantic and the shallow ones of the Eastern Pacific; the shallow bays of the East Coast and the fjords of the Pacific Northwest.

Our Atlantic coast is typical of the western edges of most oceans. It has strong currents, a broad continental shelf, shallow "drowned river" estuaries, and a climate similar to that found on land.

The Woods Hole Oceanographic Institution is the major facility on the Atlantic coast. For the past 28 years it has carried out general oceanographic research as well as North Atlantic surveying. It has been active in research for the Navy, particularly in the field of underwater sound.

The Chesapeake Bay Institute, a fairly new branch of Johns Hopkins University, located near Annapolis, concentrates on shallow estuary problems such as harbor flushing and sedimentation. It is also concerned with the development of biological resources of the Chesapeake Bay. The Navy was somewhat startled to discover that the mud which affects the "setting" of oysters, also affects the setting of mines.

The Lamont Geological Laboratory of Columbia University specializes in marine geophysics and geology and in studies of the propagation of underwater sound.

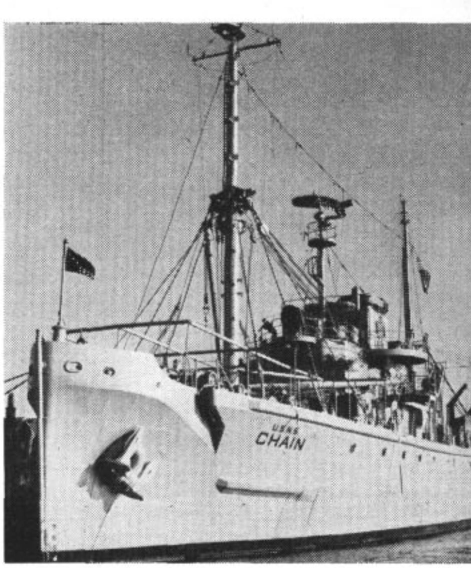
The Narragansett Marine Laboratory of the University of Rhode Island is mainly devoted to the problems of biological oceanography, and its findings concerning fish noises are of interest to the Navy.

Yale University and the University of Miami also maintain oceanographic laboratories.

THE GULF COAST area has sometimes been called the "American Mediterranean," not only because of its importance but also, like the European Med because it consists of a series of deep basins separated by relatively shallow sills. For some reason, it appears that the temperature of the water in these deep basins increases with the depth. That doesn't follow the rules. The area is of unique interest for two reasons: Its tremendous oil resources; and the enormous discharge of the Mississippi River. Also of interest are the frequent tropical storms.

Since 1950, Texas A and M University has organized a Department of oceanography and has begun a regular oceanographic survey of the Gulf. Some petroleum companies also carry out specialized research.

The Pacific Coast is characteristic of the eastern boundary of oceans the world over and is very similar to western Europe. Its special oceanic features include a slow southerly coastal current, steep shores with a narrow continental shelf, less oxygen than customary, and long-period waves.



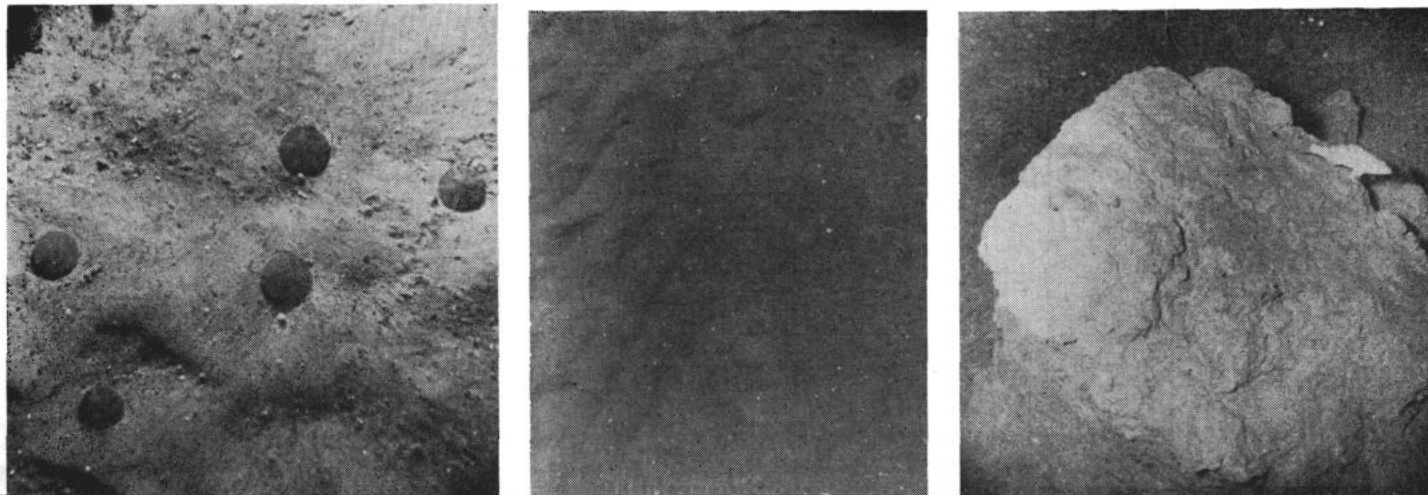
NEW JOB—Ocean research vessel, *USNS Chain* is doing deep-sea studies with scientists from Woods Hole lab.

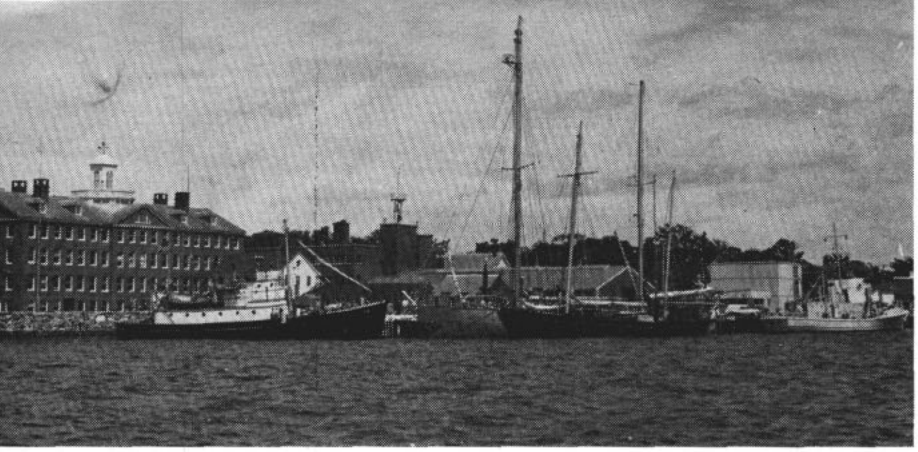
The Scripps Institution of Oceanography of the University of California, at LaJolla, is the chief oceanographic facility on the Pacific. During the war it was the chief center for training naval officers in techniques for forecasting sea, swell and surf. At the present time it carries on general oceanographic work in cooperation with the Marine Physical Laboratory and the Navy Electronics Laboratory.

The University of Washington at Seattle, Oregon State College at Corvallis and the College of Engineering of the University of California, at Berkeley, also maintain oceanographic laboratories.

Since 1947, ONR has taken over most of the support of oceanographic research for the Navy. Considerable research had been done by the Bureau of Ships during World War II and later, which has contributed a great deal to our knowledge of the oceans as applied to problems of submarine and mine detection.

BOTTOM—Sand dollars at 222 feet, animal tracks at 35 fathoms and boulder of alluvium rests in La Jolla Canyon.





HEADQUARTERS—Woods Hole Oceanographic Institution is major facility on Atlantic coast. Shown here is institution and its fleet of research ships.

THE OPERATION of research ships has been sponsored along with the research. As a general rule, about one quarter of all research funds during the past 10 years has gone for the operations of ships, including maintenance and fitting out.

What does an oceanographic research ship do? In very broad and general terms, it studies: The currents of the ocean, temperatures, the development of instruments and techniques, contours, sediments and structure of the bottom, heat flow, sound transmission and speed, noises, biological activities and specimens, radio activity, and water samples for different kinds of chemicals.

To accomplish this somewhat formidable job, the nine laboratories described above are provided with some 16 ships ranging in size from the 12-ton dragger operated by Rhode Island U. to the 760-ton ATA *Allegheny* operated by Columbia University. Scripps operates the largest "fleet" of five vessels, consisting of two 505-ton ATAs, a purse seiner, a Coast Guard patrol vessel, and a yacht. Woods Hole has three: *Atlantis*, a 298-ton ketch; *Bear*, a coastal freighter; and *Crawford*, a 280-ton cutter. The most modern ship of this group is the trawler, *Gerda*, which was built in 1949 and is now operated by the University of Miami.

IN ADDITION to these ships in operation, three additional ships are being added to the oceanographic fleet.

USNS *Josiah Willard Gibbs*, an oceanographic research ship (AGOR 1), will serve as the principal research ship of Columbia University. USNS *Chain*, (ARS 20) converted from the former Navy salvage ship of the same name, will be used by Woods Hole. Another salvage ship is scheduled for alteration this year and will be used by oceanographers on the West Coast.

Gibbs is a 310-footer with a displacement of 2800 tons and a maximum speed of 18 knots. With accommodations for a crew of 48, plus 28 scientists, she will be used to study the physics of the ocean itself, and of sound in the ocean.

The large size of *Gibbs* permits additional space for scientific purposes. There are several large laboratories aboard which can be equipped with scientific gear. In addition, the ship can handle heavier weights at greater depths and provide greater stability for delicate scientific measurements than any U. S. oceanographic research ship now in use. In addition to the two main propellers, the ship also has an auxiliary propeller which will enable it to maneuver precisely at speeds from zero to four knots.

A special feature will be the largest and heaviest deep sea winch ever used by this country for oceanographic research. It is capable of handling up to 40,000 feet of wire rope and lowering and raising as much as 20 tons of equipment.

Gibbs was named after Professor Josiah Willard Gibbs (1889-1903), who is generally conceded to be America's greatest physicist.

Chain, placed in operation last year, about one month before *Gibbs*, is 210 feet long, has a displacement of 1800 tons and a maximum speed of 14 knots. Capable of working in the North Atlantic in winter, *Chain* has accommodations for a crew of 40, and 28 scientists. She carries among her oceanographic equipment: A large thermistor winch; three hydrographic winches with 20,000 feet of wire each; one deep-sea winch with 30,000 feet of wire; three small winches; and four laboratories.

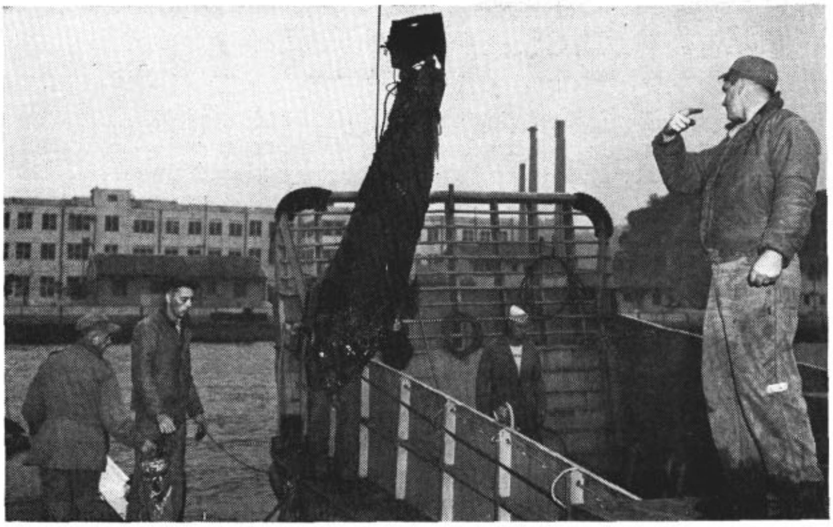
MSTS has the operational responsibilities for the ships.

All this is not to suggest that the Navy does no research itself. The Navy Electronics Lab and the Underwater Sound Lab each operates an EPCE; the Hydrographic Office operates *YF 854* and two 2700-ton former seaplane tenders, *San Pablo* and *Rehoboth*.

Itemized in this fashion, it might almost appear as though oceanography was one of the major sciences of this country. It is; and it isn't.

The number of individuals involved and money spent is relatively insignificant; the results, enormous. It has been estimated by ONR that there are no more than 500 recognized oceanographers in the United States; no more than 2000 world-wide. Yet, within a generation, the amount of useful information they have made available is far out of proportion to their numbers. The basic research these scientists have already accomplished will take years to evaluate properly.

HOWDY *STRANGER*—Oceanographic research ships like *Stranger* serving with Scripps Institution's fleet are continually studying mysteries of the sea.



BY THE TAIL—Bomb is pulled up and loaded on board EODT's landing craft.

TIME OUT—R. Parker, GMC, takes a breather after a hard day's work.

EOD Team on the Job

WORLD WAR II ENDED almost 14 years ago, but the U.S. Navy's Explosive Ordnance Disposal Team operating out of the Naval Ordnance Facility at Yokosuka, Japan, still faces vivid evidence of the conflict. The team's job is removing remnants of WW II ordnance that could still be deadly.

The team spotted some ordnance during a two-month search of Briggs Bay last September and began the job of removing 12 mammoth Japanese bombs about 100 yards from the base. The bombs weighed as much as 3300 pounds each.

Seabees from Amphibious Construction Battalion One operated the crane barge off which the EOD men were working. The EOD team, all second class divers, was made up of LTJG John P. Ellis, Richard Parker, GMC, John De Hahn, MNC, and John H. Briody, BM1.

Red buoys, each tied to a different bomb, marked the location of the projectiles which were submerged in about 35 feet of water. Although the largest bomb contained some 500 to 600 pounds of explosives, the EOD team figured there was little probability they would explode. But they were taking no chances.

Chief Parker got into a rubber diving suit, strapped on his aqualung, and jumped flippers-first into the bay. He located the bomb at the bottom of the bay and worked the cable he had carried with him toward the nose of the projectile. The sea bottom was muddy and it was like reading by Braille. With his bare hands he felt the rough barnacled surface of the bomb, and finally managed to wrap the steel cable several times around the casing. This done, he returned to the surface and was handed the end of another cable which he wound around the bomb.

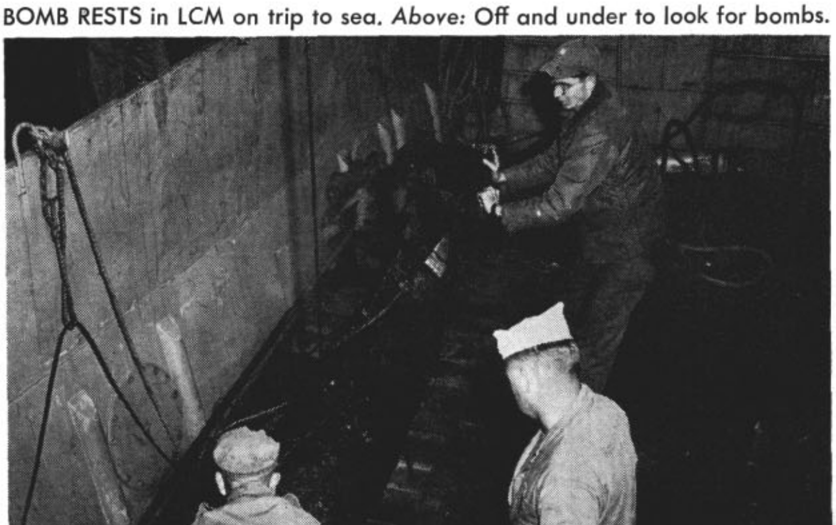
Seabees attached the crane hook through eyes at the ends of the cables. Slack went out of the cable and there was a strain as it inched upward. A few more inches and the crane was beginning to tilt and creak as the strain increased from the bomb which was sticking obstinately in the mud.

The list on the barge eased a little as the bomb slithered out of the mud. It wasn't long before it appeared, tail-first, out of the water. Fully exposed, it measured about 10 feet from its projectile-head to fins. Like the others, it was taken out to sea and dumped.

—Story by E. D. Ormsby, JO2, USN

—Photos by F. E. Henderson, AA, USN

BOMB RESTS in LCM on trip to sea. *Above:* Off and under to look for bombs.



The Not-So-Silent Sea

Davy Jones Has Noisy

DURING THE EARLY DAYS of World War II, USS *Permit* (SS 178) recorded in her log: "Picked up unusual noise . . . could see nothing through periscope on that bearing. Sounded like hammering on steel in a non-rhythmic fashion accompanied by porpoise noises. Headed for sound. At times could be heard through 360 degrees."

A week later, USS *Tarpon* (SS 175) reported: "Noises which sounded as if the deck grating over the boat storage had been lifted and dropped three times. Shortly thereafter, sound heard echo-ranging from two ships bearing in the direction of the Gulf (Albay, P. I.), but no propeller noise was heard. Nothing in sight through the periscope."

USS *Salmon* (SS 182) "heard screws dead ahead. Nothing in sight."

Other submarines told of encountering the gamut of sound ranging from: Mild beeping, clicking, creaking, harsh croaking, whistling, grunting, hammering, moaning and mewing, to the staccato tapping as of a stick rapidly and steadily drawn along a picket fence, of coal rolling down a metal chute, fat frying in a pan, the dragging of heavy chains. Only the limitations of the language prevented further description.

As might be expected, sonar operators were rapidly approaching the point where they huddled in dark corners chewing their fingernails and starting violently when anyone spoke to them—even kindly.

The first break in this symphonic madness came when it was noted that serious variations in noise levels in waters near Fort Monroe occurred during the dawn and dusk listening periods. A "strangely loud background noise" occurred in early spring when croakers were known to tune up.

With this as a clue, investigators from a number of aquariums and laboratories were able to reassure submariners that their sonarmen were not suffering from excessive ear fatigue. Marine animal sounds, they said, were not only widespread, but "a source of significantly high background."

THE MATTER was not merely academic. It was rumored that mines planted inside the Great Barrier Reef of Australia by enemy raiders had been exploded by sonic fishes. The noise made by a single toadfish was measured on the North Carolina coast and it was apparently loud enough to detonate the type of acoustic mine then being prepared by the Navy for use in the Pacific. A double-actuation mechanism had to be developed for protection against such biological interference. *The silent sea was no longer silent.*

(It might be mentioned here that, even with the limited resources then available, the U. S. Navy was still able to determine the causes of these sounds two important years before Japan came to the same conclusion. Not until late 1944 did a prominent ichthyologist from Tokyo Imperial University discover the biological source of the sounds which were causing as much trouble to the Japanese fleet as to us.

Even though U. S. scientists were learning more and more, information was not immediately available to explain the phenomena or to predict when and where these sounds might be met again. In 1942, so little was

NOW WE KNOW that sea creatures are noisy. They are a source of frustration to sonarmen as well as fishermen.

Neighbors

understood of the underwater noisemakers that a list of all known (world-wide) forms of marine life producing subsurface sound included only 14 families of fishes and 17 families of shellfish. Descriptions were mostly in broad terms such as "nasal whine," "loud grunt," or "hoarse croak." Magnitude and frequency had not been measured, and much was merely hearsay.

This wasn't enough. The Navy had to know the methods of sound production by different species, the character of the sounds, the regional and seasonal variations, and the conditions under which they were produced.

Detailed research had to wait until after the end of the war, but between 1949 and 1954, 62 species of temperate coastal fishes, 105 subtropical and tropical fishes, 20 shellfish and two species of mammals had been auditioned. This was not simply a matter of sitting down and listening to the little creatures speaking their pieces. Hydrophones (underwater sound detectors) and tape recorders monitored the reactions of specimens when fed, annoyed, frightened, crowded, drawn into competition and otherwise stimulated. A reference file was established which will eventually, it is hoped, include the characteristic sounds of all important marine species.

IT WAS LEARNED that although fish have no organ developed solely for the production of sound, nature has modified various organs to accomplish the same purpose. Quite often the air bladder or swim bladder becomes a sort of resonator or soundbox. Sometimes muscles are embedded in the air bladder and, by contraction, set up vibrations of walls and gaseous contents; sometimes slender muscles connecting the bladder to the vertebrae vibrate like violin strings. This helps to explain the muffled grunts of rock hinds, the sustained resonant rumbling of groupers, growling of trunkfish, drumming of croakers and the tomtom beating of sea catfish.

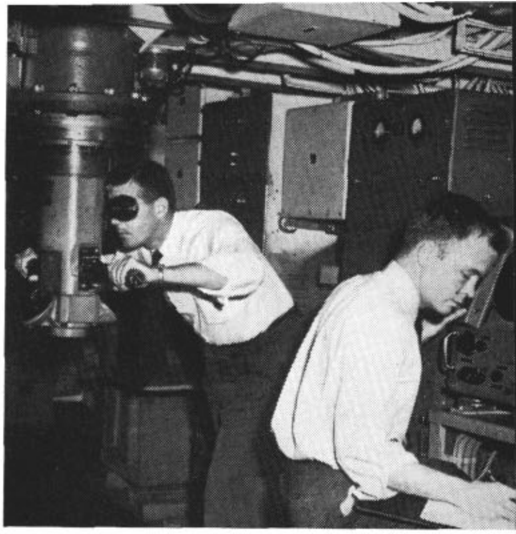
Others scrape bone against bone to produce sound. The sculpins of northern waters produce a dull droning, buzzing or long continued rumbling sound (something like a generator hum) with their pelvic bones; the king-size ocean sunfish grates its teeth. Puffers and burrfish manage long bursts of nasal croaking by rubbing together their upper and lower plates, and the sharp whining swish and chirp of filefish also come from the mouth—in this case by special transverse grooves in the uppers.

Each species, it has been found, has a characteristic range of sounds. These sounds are so characteristic with respect to range limitation, harmonic quality, duration and repetition rate that an experienced listener can soon learn to recognize the various sources—much like the expert birdwatcher can recognize a long list of birds from their calls.

The volume of sound appears to have a direct relation to the intensity of stimulation as well as to the size of the soundmaker — which seems only reasonable. Toadfish, for example, have been found to be somewhat louder in the open sea than when in laboratory tanks.

MOST SPECIES USE sound of one kind or another as a means of communication, as an expression of fight or fright, for defense or offense, as a response to changes in the environment, or as a means of orientation. A large portion of the noises heard, however, simply results from eating—a situation frequently known to exist in human society. Rays, for example, may be found by a loud crackling as their pavement-like teeth crush shells on the bottom, and hydrophones in shallow water populated by cunners may pick up constant clicking and chirping, which are chewing sounds.

Again, as in human society, the period of greatest noisemaking is frequently connected with social affairs and with the preservation of the species. Since spawning habits are known, the biologist can usually predict dates and locations of fish concentrations. Although the sound of an individual may be insignificant, the combined output of a school results in considerable volume. One drumfish croak, for example, may not reach more than 50 feet; however, a nighttime chorus of spawners has markedly raised the general background level of a large bay over the audible frequency range. The characteristic drumming, which sounds like a pneumatic drill working through concrete, may very well mask the sound of a slow-moving submarine.

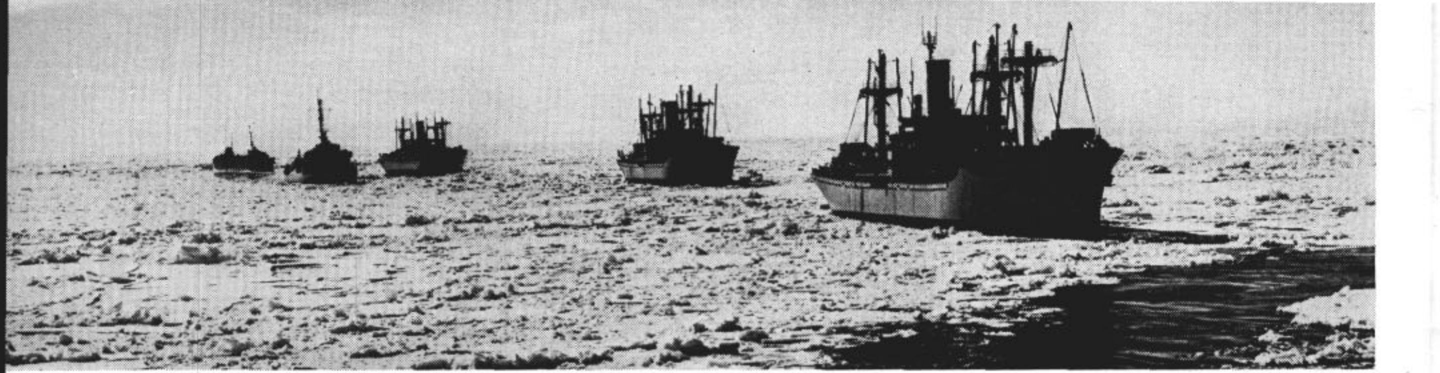

FACT-FINDING—Personnel of Navy's Underwater Sound Laboratory run an experiment from their floating lab.

Fortunately, croaker noises and that of many other fish, are restricted to a comparatively low and narrow frequency band. Experiments have shown that the sounds of most North Atlantic species can be almost eliminated by filters.

Shrimp noises frequently cause sonarmen to act the way they do. The shrimp have been found during certain seasons to reduce sonar ranges by as much as 40 per cent and seriously mask the sounds of torpedoes and cavitating subs.

Here again, the marine biologist offers practical advice: Shrimp and the equally noisy squilla can be expected in waters with coral, rock, stone or shell bottom almost anywhere around the world between 35 degrees North and 35 degrees South. But, he warns, if the noise you hear under these conditions comes from a depth greater than 30 fathoms, better tear out of there. It isn't shrimp.

However, one class of marine fauna simply does not lend itself to such neat classification. About the only useful information the biologist can offer concerning porpoises and whales is that they like submarines. Inquisitive and gregarious, they have at times followed their newfound friends for miles, sounding off with assorted false propeller noise, phantom echo-ranging pings and miscellaneous pings. This has frequently caused the sub and porpoise friendship to become unilateral.



PLANNING A VOYAGE?—Navy's Hydrographic Office has on issue more than 4400 standard nautical charts.

Pioneer: Navy Hydrographic Office

No discussion of oceanography will ever get far before it runs into rocks and shoals if it does not include mention of the U.S. Navy Hydrographic Office.

Founded in 1830 and given early impetus by Maury's wind and current charts first published in 1847, Hydro has led the world in its contributions of deep sea soundings and bathymetric charts ever since 1922. It was in this year that the Navy developed the first practical sonic sounding machine and two destroyers obtained a complete profile of the ocean's bottom along their track in a cruise across the Atlantic and through the Mediterranean.

Aerial photography was used for the first time by the Hydrographic Office that same year in conducting surveys of the coast of Cuba.

Throughout the years, Hydro has been engaged in various scientific fields. These include studies in meteorology, investigations in terrestrial magnetism, marine surveying, oceanography, cartography, photogrammetry, aerial photography, marine geography, engraving and printing. Some of these areas have become so highly specialized that new government organizations have been established for the exclusive study of these sciences.

Long-range over-water aviation, development of radar, loran, and other electronic devices for navigational purposes, new systems and methods of computing fixes from celestial observations, the oceanographic research demanded for modern antisubmarine and amphibious warfare—all have influenced the activities and functions of Hydro.

The mission of the Hydrographic Office is enough to make strong men tremble:

To collect, evaluate, compile, produce and distribute accurate and timely hydrographic, oceanographic, and aeronautical information, including nautical and aeronautical charts and publications calculated to afford the maximum possible navigational safety and facility to ships of the Navy, Coast Guard and Merchant Marine, and to naval aircraft operating over areas of strategic interest to the Navy.

And: To produce special charts and related publications for use of the Navy and its operating forces, for training and operational purposes, including those for amphibious, air and undersea warfare.

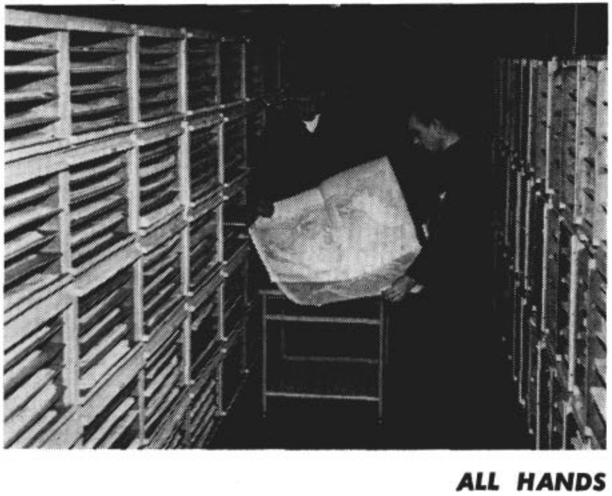
And: To produce special hydrographic, oceanographic and aeronautical charts and related data in cooperation with the Army and Air Force to meet the needs of joint operations, and further to meet the requirements of the Joint Chiefs of Staff in support of war plans.

And: To serve as the Navy Department repository of record of technical source material relating to hydrographic, oceanographic, cartographic, magnetic, geodetic and gravity matters; and, further, to serve as the principal agency of the Navy Department to administer, regulate, and manage the exchange of such material with the Army Map Service, the Aeronautical Chart and Information Center, the Geodetic Survey, and other departments.

If that wasn't enough to make any branch of the Navy feel it had earned its salt, the Office has on issue more than 4400 standard nautical charts of the world's navigable waters; 68 volumes of Sailing Directions presenting textual and graphic descriptions of foreign harbors and coastlines; and other services dealing with hydrographic, oceanographic and meteorological information.

Hydro, needless to say, is busy.

UP-TO-DATE information keeps ships on course. *Rt:* Navymen in Hydro's Yokosuka branch check chart supply.



NAVY DIVING QUALS

What's the difference between a Scuba, Master, First Class, Salvage, or Second Class Diver? And how about pay—do qualified divers receive any added compensation? Or what?

Here's a rundown on the Navy's various designations and details concerning special pay for diving duty.

Briefly, all divers fall into one of two categories, depending upon the type of diving equipment they use. Those that use self-contained breathing apparatus are often referred to as "free swimmers" and are classed as Scuba divers. The others, those who use special helmets or diving suits and receive air from the surface, come under the surface-supplied category. This includes shallow-water as well as deep-sea diving.

Shallow-water diving is made by those who dive to depths less than 36 feet and use a helmet or diving suit that receives air through a hose from the surface. Deep sea diving is made by men who dive to depths greater than 36 feet and receive their air through a hose from the surface.

The Navy has three different deep sea diving classifications. They are Master, First Class and Second Class Diver. These different ratings are assigned to men according to their degree of qualification. These qualifications are spelled out in detail in Article C-7408, *BuPers Manual.*

Master Divers are the Navy's leading divers. They are designated by the Chief of Naval Personnel only, in accordance with the needs of the service and with the recommendations of the individual's commanding officer and a special selection board. To be eligible, any qualified Diver First Class must meet the following requirements:

- Be a Chief Petty Officer.
- Have served a minimum of two years with the designation and qualifications of a diver first class (this includes Scuba diver qualifications).
- Have served as a qualified diver for a minimum of 12 months aboard a helium-oxygen-equipped diving vessel (ASR), and a vessel equipped for ship salvage (ARS/ARSD).
- Demonstrate ability to take charge of all phases of helium-oxygen diving (see page 61).
- Demonstrate ability to plan and take charge of all diving operations.
- Demonstrate ability to take charge of operation and maintenance of a submarine rescue chamber.
- Demonstrate knowledge of all Navy-procured types of self-contained underwater breathing equipment, including their advantages and limitations.
- Know the methods and materials used in unbeaching ships on strand under various conditions of beach, sea and water; and refloating sunken vessels.
- Understand the principles of the General Gas Law and its derivatives (Boyle's and Charles' Law); understand the principles of Dalton's Law of partial pressures and Henry's Law of fluid saturation; understand the theory of inert gas saturation and desaturation of body fluids and tissues; understand the principles involved in the computation of various decompression tables; recognize the different forms of decompression sickness and know the required treatment of them.
- Understand the effect upon the respiratory system of such poisonous gases as may be encountered in diving, and know the treatment required.
- Know the name and use of equipment required for safe diving operations.
- Know the causes, symptoms, treatment of, and preventive measures for all types of diving accidents.
- Have a comprehensive knowledge of the scope, content and application of Navy publications and instructions pertaining to diving such as the *Diving Manual* (NavShips 250-538), and applicable sections of the *Bureau of Ships Manual, Manual of the Medical Department* and *BuPers Manual.*

With all of these qualifications, Master Divers are required to direct

ON DECK—Dressers attend to students as they prepare for test dive into muddy Anacostia river at School for Deep Sea Divers in Washington, D.C.

other divers in underwater salvage, repair, construction, demolition, recovery and rescue work. They must supervise personnel during diving operations from topside or underwater as necessary. When not serving in this capacity, Master Divers often survey the job themselves to determine the most effective method of accomplishing the task, especially when the depth of water is greater than 150 feet.

It is also the job of the Master Diver to see that all divers under his supervision are properly trained and that they keep up to date on the latest techniques and maintenance of all types of diving gear and associated salvage, rescue and repair equipment.

They also treat personnel who are afflicted with maladies common to diving, such as caisson disease.

Master Divers are assigned a primary job code number for an Underwater Mechanic—ESM-5311-Master Diver. So long as they remain on diving duty and keep up their qualifications, Master Divers receive $33 per month diving pay in addition to their basic pay and allowances.

All Navy deep sea divers, regardless of their rank, rate or diving classification, are also paid an extra $5.50 for each hour or fraction of an hour when engaged in actual salvage or repair operations in depths over 90 feet. This $5.50 hourly rate is also paid for dives in depths less than 90 feet when the officer in charge determines that extraordinary hazardous diving conditions exist.

Divers First Class are deep sea divers, trained, qualified and designated at the U.S. Naval School for Deep Sea Divers, Washington, D.C.

They are responsible for underwater salvage, repair, construction, demolition, recovery and rescue work at depths greater than 150 feet. They must be able to operate underwater hand and power tools, gas and electric cutting torches, and electric welding equipment.

They are also required to lay out beach gear for hauling off stranded vessels, rigs for lifting submerged objects by washing tunnels and reeving lines, wires or chains under the object; enter submerged vessels to perform salvage or repair work; connect air hoses to submarines during salvage operations; operate and maintain diving gear and associated salvage, and repair equipment.

Divers First Class receive an extra $20 per month so long as they remain designated as such and are assigned to diving duty. In addition, they receive two cents per minute during any dive for which they do not receive the $5.50 hourly rate; and five cents per foot of total depth of dives over 120 feet or equivalent pressure. The amount payable to Divers First Class at the two cents per minute and five cents per foot rate is limited to $13 per month.

(There are over 200 **Salvage Divers** in the Navy today who are being phased into the Diver First Class Program through 13 weeks of "cross training" at the U.S. Naval School for Deep Sea Divers. All Salvage Divers must attend this course and convert to Diver First Class by June 1962 or revert to Diver Second Class.)

Divers Second Class are trained, qualified and designated by commands authorized by the Chief of Naval Personnel.

WHAT'S IN A NAME

Underwater Jeep Drivers

One night back in 1954 USS *LST 291* was churning her way through the waters of the Great Bahamas after completing two weeks of amphibious training exercises at Vieques, Puerto Rico. On her decks she carried 114 vehicles and 56 tons of equipment.

About 1800 yards off James Point, Eleuthera Island, a resounding crunch shattered the silence of the night. The LST had hit a submerged coral reef, which tore a two-foot hole in her evaporator room and twisted, warped and gashed her hull at many other points. Water poured in through the openings to flood all of the lower compartments. Personnel were ordered over the side. Before long two DEs arrived to take them off the island to which they had gone after the grounding. A volunteer salvage party was left with the ship.

The first step in the salvage operations was to flood all compartments. This was done to increase the weight of the ship and prevent further damage from the heavy seas which had been driving her closer to the beach and scraping new holes in her bottom.

When frogmen from Underwater Demolition Team Two reached the scene they began a survey. In spite of a 25-knot wind and far from ideal weather conditions, they made a mass underwater swim, in Scubas, to explore a reported channel across the reef. They found a shallow channel, but revealed that it was obstructed by coral pinnacles up to 100 feet in diameter. These would have to be blasted out of the way before the ship could be brought off.

About 400 pounds of explosives were used in the first effort. More was rushed in by sea and air, and the channel began to take shape. While the frogmen blasted, utility landing craft from two LSDs were busy removing cargo, and salvage operations aboard the LST, directed by Commander Robert K. Thurman, USN, had also gotten under way. Divers flown in from COMSERVLANT or furnished by salvage ships, carried out this part of the job. Large amounts of grease, oil and gasoline in the water made the going rough for them.

During the salvage operations, vehicles in the ship's flooded tank deck had to be removed. As a result, two of the divers found themselves qualifying as "underwater jeep drivers."

To do this, the underwater motorist would seat himself behind the wheel of a submerged vehicle. Then, while a heavy crane pulled, he would steer the jeep into position beneath a hatch so that the crane could lift the car out. This went on until all the jeeps were removed from their underwater parking lot.

After 11 days of hard work the LST was finally ready to be filled with compressed air and refloated. By then the frogmen had blasted out a 1000-foot channel, the cargo had been salvaged and the holes and gashes in the hull had been patched.

A towline was attached to the salvage ships, USS *Discovery* (ARS 43) and *Opportune* (ARS 41). Then landing craft began washing heavy streams of water under the LST's stern to move her off the ledge which held her. After a few tense moments when the towline caught on a coral pinnacle and the LST almost got out of the channel, the ship at last floated clear of the reef and turned on her running lights.

The UDT men, the ships that had come to the LST's aid and the salvage crew—including the underwater jeep drivers—had completed their task.

To qualify as a Diver Second Class, an individual must graduate from the six-week qualification course and:

- Understand the care, preservation and use of all air diving equipment such as compressors, hose, helmets, suits and Scuba.
- Test, repair and adjust all air diving equipment and determine whether they are safe for use.
- Know the nomenclature of diving equipment and function of component parts.
- Dress and tend diver expertly.
- Know standard diving signals; know the instructions for keeping diving log and entries required.
- Understand the theory and practice of decompression and use of the decompression table; know the cause, symptoms, treatment and prevention of air embolism; know the dangers of oxygen poisoning during the administration of oxygen under pressure, its usual symptoms, warnings and treatment.
- Demonstrate the back-pressure armlift method of manual artificial respiration.
- Have knowledge of first aid related to the treatment of common diving accidents.
- Know the physics of diving.
- Know the methods and procedures employed in searching for and recovering objects on the bottom.
- Know how and when to use a recompression chamber; know how to administer oxygen properly for treatment purposes.
- Demonstrate practical application of marlinespike seamanship to diving operations.
- Perform work at depth of 50 feet of water for one hour—this to constitute a qualifying dive.
- Know the contents and use of the *Diving Manual.*
- Estimate an underwater situation and give an intelligent description of same.
- Care for and operate Navy standard rescue breathing apparatus.
- Use oxygen-electric torch underwater.
- Use and know the advantages, limitations and safety precautions of open-circuit demand Scuba.

Divers Second Class receive $13 each month in addition to their basic pay and allowances so long as they remain qualified and are assigned to diving duty. They also receive the extra two cents per minute and five cents per foot for dives that do not qualify for the $5.50 hourly rate, but not to exceed $20 per month.

All divers are required to requalify every six months or else lose their designation. Master and Divers First Class are required to make four requalification dives in depths of 150-170 feet; 170-200 feet and over 200 feet; while Divers Second Class must make a series of four dives at any depth up to 150 feet.

Qualified divers are authorized to wear a distinguishing mark on the right sleeve of their uniforms. It consists of a diving helmet and breast plate with the letter "M" for Master, the letter "S" for Salvage Diver, and the figures one or two, for First or Second Class Diver, centered on the breastplate of the diver's insignia.

Scuba divers do not have any special distinguishing mark nor are they authorized to draw special pay for diving.

In addition to the special pay for diving duty explained above, some divers are entitled to an extra $55 per month incentive pay for the performance of hazardous duty. This includes:

- Master and Divers First Class who are assigned to duty (aboard ASR) involving the use of helium-oxygen for a breathing mixture in the execution of deep sea diving.
- Duty at a submarine escape training tank, when such duty involves participation in the training.
- Duty at the Naval School for Deep Sea Divers or the Navy Experimental Diving Unit, when such duty involves participation in training. —H. George Baker, JOC, USN.

Under the Seas

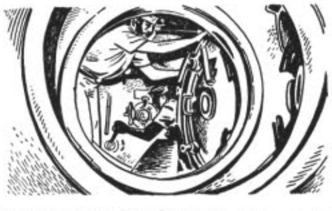
A publication has recently become available which should enable you to understand your submarine Navy better.

The Complete Book of Submarines by CAPT William C. Chambliss, CDR Charles W. Rush, Jr., and CDR H. J. Gimpel tells the story of the submarine from its beginning through the modern nuclear boats. The authors tell of the training that makes submariners, and relate man wartime exploits of our underseas crafts. They also probe into the future and discuss the possible commercial uses of subs.

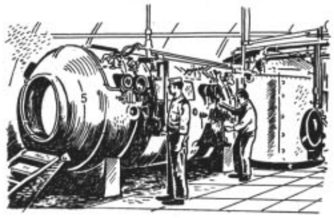
HERE'S YOUR NAVY

The U. S. Navy has always been interested in diving—but it has been investigating *deep-sea diving* problems since 1912. By 1925 the experiments had grown to such an extent that the Experimental Diving Unit was set up as a permanent activity under the Bureau of Construction and Repair (now BuShips). The EDU is located at the Naval Gun Factory, Washington, D. C.

One of its principal items of laboratory apparatus in diving research is the pressure tank and recompression chamber unit. This consists essentially of three sections: the wet tank, with the dry tank (or igloo) above it, and the recompression chamber. All sections are capable of withstanding internal pressures up to 350 pounds per square inch (785 feet of sea water).



In operation, the vertical cylindrical wet tank is filled with water to a depth of about seven feet. Divers enter by way of the igloo and the wet tank hatch. The wet tank is then sealed shut, or (depending on the type of dive) the wet tank and igloo are operated as a single unit or lock. In either case, air is admitted to the space above the water to build up pressure to simulated depths of up to several hundred feet.



Three line officers, three medical officers and 18 enlisted divers at EDU are at present working on more than 20 continuing projects. Several of these pertain to the physiological aspects of diving. Others include equipment development and evaluation, extending the limits of helium-oxygen diving, and underwater television.

The unit maintains a small but well equipped laboratory containing many types of gas analyzing equipment and other instruments which assist in diving-physiology studies. There are also a carpenter's shop, metalsmith's shop and machine shop.

Here's List of Instructions and Schools for Underseas Sailors

THE NAVY under the sea covers a lot of ground. And for men who work in this part of the Navy, there's a lot to learn. This knowledge is picked up from Navy training courses, Navy schools, and from various instructions and manuals.

Here's a rundown where pertinent information about this phase of the Navy can be found. A list of schools is also included. Note: This is *not* a complete list. For additional training, see your Education Officer. For general information see BuMed, BuPers, BuShips, diving manuals.

DIVING

SOURCE	***SUBJECT***
BuPers Manual	
Article C-7313	**Officer qualifications for Scuba training.**
Article C-7314	**Officer qualifications for deep-sea helium-oxygen diving.**
Article C-7315	**Qualifications for Salvage Diving Officer.**
Article C-7408	**Diver qualifications.**
Article C-7418	**Qualifications for enlisted Scuba divers.**
Article A-4202	**Diving pay.**
BuMed Manual	
Article 15-30	**Physical requirements for deep-sea and Scuba divers.**
BuPers Inst. 1500.15C	**Selection and training of candidates for diving duty.**
BuPers Inst. 1500.36	**Mobilization planning guide for Diver's Second Class schools.**
BuPers Inst. 1520.4D	**How to apply for officer deep-sea diver's training.**
BuAer Inst. 9940.1	**Use of self-contained underwater breathing apparatus (Scuba).**
OpNav Inst. 9940.1B	**Divers and their equipment.**

UNDERWATER DEMOLITION (UDT)

BuPers Manual	
Article C-7305	**Officer qualifications for Underwater Demolition Teams.**
Article C-7406	**Enlisted qualifications for Underwater Demolition Teams.**
BuPers Inst. 1520.7	**How to apply for underwater demolition training.**
BuShips Inst. 3990.1	**Underwater noise measurements of submarines.**
OpNav Inst. 10126.3	**Coral Shoe for use by Underwater Demolition Teams and Explosive Ordnance Disposal Units.**

EXPLOSIVE ORDNANCE DISPOSAL (EOD)

BuPers Manual	
Article C-7306	**Officer qualifications for EOD.**
Article C-7407	**Enlisted qualifications for EOD.**
BuPers Inst. 1320.5A	**Duty involving the demolition of explosives.**
BuPers Inst. 1500.31	**Mobilization planning guide for EOD schools.**
OpNav Inst. 8027.1A	**Responsibilities for EOD.**
OpNav Inst. 8027.5A	**Requirements for EOD equipment.**
OpNav Inst. 8027.6	**Naval responsibilities for explosive ordnance disposal.**

SUBMARINES

SUBJECT	***SUBJECT***
BuPers Manual	
Article C-7303	**Qualifications for submarine officers.**
Article C-7304	**Enlisted qualifications for sub duty.**
Article C-7309	**Qualifications for submarine medical officers.**
Article C-7310	**Qualifications for submarine engineering duty officer.**
Article A-4301	**Submarine pay.**
Article D-1502	**Submarine training for officers.**
BuPers Inst. 1520.6G	**Application for officer submarine training.**
BuPers Inst. 1540.2C CH-1	**Assignment of enlisted personnel to initial submarine duty.**
OpNav Inst. 3360.11	**Training policy for ASW personnel.**

OCEANOGRAPHY

SecNav Inst. 5430.33	**Navy's responsibility for the provision of oceanographic services to the Department of Defense.**
OpNav Inst. 9010.130	**Approved characteristics of Oceanographic Research ship (AGS).**

SCHOOLS *(Submarines)*

Catalog of U.S. Naval Training Activities and Courses.

Page 53	**Submarine Periscope repair (8 weeks), at U.S. Naval Opticalmen Class A school, Great Lakes, Ill.**
Page 78 & 95	**Torpedoman's Mate (class A) course (10-19 weeks), Key West, Fla. and San Diego, Calif.**
Page 74	**Underwater cutting and welding (6 weeks) at San Diego, Calif.**
Page 78	**Advanced Undersea Weapons School at Key West, Fla. Courses range from 2 to 19 weeks.**
Page 86	**U.S. Naval Schools, Mine Warfare, Yorktown, Va. Courses offered are:** **1. Submarine Mine Warfare Familiarization (officer), 1½ weeks.** **2. Submarine Mines Maintenance (officer), 6 weeks.** **3. Submarine Mines Assembly (class C), 6 weeks.** **4. Submarine Automatic Degaussing (class C), 6 weeks.**
Page 95	**U.S. Fleet Submarine Training Facilities, San Francisco, Calif.**
Page 97	**U.S. Naval Submarine School, New London, Conn.**

SCHOOLS *(Diving)*

Page 79 (see also BuPers Inst. 1500.25E)	**U.S. Naval School, Deep Sea Divers, in Washington, D.C. Courses offered are:** **1. Diving Officers, 26 weeks.** **2. Diving Officers, 10 weeks.** **3. Salvage Officers, 16 weeks.** **4. Salvage Officers, 5 weeks.** **5. Medical Officers, 8 weeks or less.** **6. Medical Deep Sea Diving Technician (enlisted), 27 weeks.** **7. Divers "Cross-Training"** **(a) Deep Sea Diving (13 weeks).** **(b) Salvage Diving (7 weeks).** **8. Divers, Second Class (enlisted), 6 weeks.** **9. Divers Refresher (Master, First Class, Deep Sea, and Salvage Diver), 10 weeks or less.** **10. Helium-oxygen divers refresher (officer and enlisted), 2 weeks.** **11. Divers requalification (Master, First Class, Deep Sea, Salvage, and Diver Second Class), 2 weeks or less.**
Page 91	**Scuba Divers School (officer and enlisted), 5 weeks at Key West, Fla.**

BOOKS

FOR THOSE INTERESTED IN UNDERWATER READING

DO YOU LIKE READING about a fascinating, adventurous subject? Whether your interest in the world under water is as a professional, a trainee, a sportsman or a hobbyist, you will find many books to give you pleasure and information. The books listed below are among many available in your ship and station libraries.

Underwater Diving—Techniques

Handbook for Skin Divers—Bronson-Howard; 1958. Handy self-reference written for persons interested in skin diving.

The Science of Skin and Scuba Diving—Conference for National Cooperation in Aquatics; 1957. A valuable guide for adventuring with safety underwater.

Free Diving—Rebikoff; 1956. Describes self-contained underwater breathing apparatus, techniques and available equipment.

Shallow Water Diving and Spearfishing—Schenck & Kendall; 1954. A primer for the sportsman and hobbyist.

Skin Diving and Exploring Underwater—Sweeney; 1955. A professional diver and former Navy instructor's "how-to" book with detailed information on equipment and its use.

The Complete Manual of Free Diving—Tailliez; 1957. Authoritative technical manual by French naval underwater research group.

Underwater Sport—Vanderkogel & Lardner; 1955. Pointers on what you can and cannot do under water.

History, Exploration, and Adventure Below

Half Mile Down—Beebe; 1951. History of diving and underwater explorations.

Silent World—Cousteau; 1953. Fascinating account of the blue twilight seascape.

Danger is My Business—Craig; 1938. Autobiography of a deep sea diver.

Treasure-Diving Holidays—Grile; 1954. Underwater adventures in the West Indies and Mediterranean.

The Undersea Adventure—Diolé; 1953. A sea explorer's philosophical observations on marine life and psychology of diving.

4000 Years Under the Sea—Diolé; 1954. Diving for ancient treasures, mostly from Mediterranean civilizations.

Man Under the Sea—Dugan; 1956. Man's underwater exploits from primitive to present times.

Men Under the Sea—Ellsberg; 1939. Navy underwater rescue and diving experiences.

Deep Down Under—Floherty; 1953. Diving for salvage, construction, pearling, sport by frogmen, aqualungers and mask and finners.

Diving to Adventure—Hass; 1951. Water hunting and photographing underwater life.

2000 Fathoms Down—Huout & Willm; 1955. Story of two pioneers in a free moving bathyscaph.

Man and the Underwater World—Latil & Rivoire; 1956. History of man's attempts to penetrate the sea from the time of ancient Greeks to the bathyscaph.

Fathoms Below—Meier; 1943. Underwater salvage from sailing ships to *Normandie.*

Earth, Sky and Sea—Piccard; 1956. A scientist-adventurer in bathyscaph and balloon.

The Blue Continent—Quilici; 1954. Dangers and fascinations of aquatic big game hunting in the Red Sea.

The Underseas Navyman— World War II and After

Combat Beneath the Sea—Brou; 1957. Underseas war of all countries, describing swimmers, demolition teams and ordnance disposal squads.

Sea Devils—Borghese; 1954. True story of daring "human torpedoes" in Italian Navy's suicide corps.

The Big Dive—Crossen; 1959. A suspense novel based on the actual disappearance of a British frogman.

No Banners, No Bugles—Ellsberg; 1949. Salvage diving in the Med.

WAY BACK WHEN

Straight Down and Still Going

On a hot day in August 1913, the battleship USS *Nebraska* (BB 14) was holding torpedo practice in Guacanagabo Bay, Cuba. Instead of coming to a stop at the end of their run where they were supposed to float until recovered, most of the torpedoes kept right on going. One, it was noticed ran for a considerable distance, then sank in 120 feet of water.

In *Nebraska's* recovery launch was the diving officer, Chief Gunner C. J. Miller, USN. With him were men dressed in diving gear whose job it was to locate sunken torpedoes. Within a short time the launch was over the spot and the Gunner sent a man down to survey the situation.

The diver came up on his own accord and informed Gunner Miller that "the torpedo was on its way to h---" (the mud being very soft), that he "could only see the tail and that the propellers were still turning over."

Armed with a shovel the diver went down after the torpedo. He worked for over an hour before he was hauled up, exhausted from his strenuous work. He informed the diving officer that he had dug a hole 20 feet deep and that the torpedo was still underway.

A relief diver went down. About a half-hour later he asked for a heavily weighted five-inch line to be sent down. This was made fast to the tail of the torpedo. The diver came up and informed Gunner Miller that he had put a timber hitch on her as he could only get one turn. The Gunner said that was enough.

Windlass and funnel were shipped and they hove the launch down to one inch freeboard. But it was no go. *Nebraska,* meanwhile, was maneuvering close by and the OOD suggested passing the hawser to the ship. It was rove through her hawsepipe and a turn taken around the winch.

The first few turns straightened the line out taut to such an extent that the ship's head was swung around by the tension. Another few turns and the torpedo shot out of the water 10 feet from the ship.

The elusive torpedo and the launch were taken aboard.

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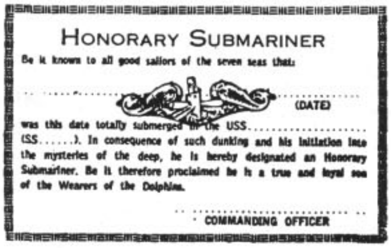

HONORARY SUBMARINER

Be it known to all good sailors of the seven seas that:

.... (DATE)

was this date totally submerged in the USS....................
(SS......). In consequence of such dunking and his initiation into the mysteries of the deep, he is hereby designated an Honorary Submariner. Be it therefore proclaimed he is a true and loyal son of the Wearers of the Dolphins.

....
COMMANDING OFFICER

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H. M. U-Boat—Drummond; 1958. Adventures of a German submarine captured by the British.

The Sea Wolves — Frank; 1955. The story of German U-Boats at War.

Twenty Million Tons Under the Sea—Gallery; 1956. Biography of the Nazi submarine U-505 captured by the U.S. Navy.

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Sunk—Hashimoto; 1954. Story of the Japanese submarine fleet, 1942-1945.

Hellcats of the Sea—Lockwood; 1955. Submariners' "Operation Barney" when nine submarines invaded the Sea of Japan.

Sink 'Em All—Lockwood; 1951. Submarine warfare in the Pacific written by an expert.

Through Hell and Deep Water—Lockwood & Adamson; 1956. A biography of CDR Dealey, skipper of USS *Harder* and a history of his ship.

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The Complete Book of Submarines—Rush & others; 1958. Types of submarines and what goes into them.

U-Boat 977 — Schaeffer; 1953. Nazi skipper's version of his underseas operation.

Silversides—Trumbull; 1945. USS *Silversides'* adventures in the Pacific.

Undersea Patrol — Young; 1953. A first hand picture of World War II British submarine service.

Look Out for Synaceja

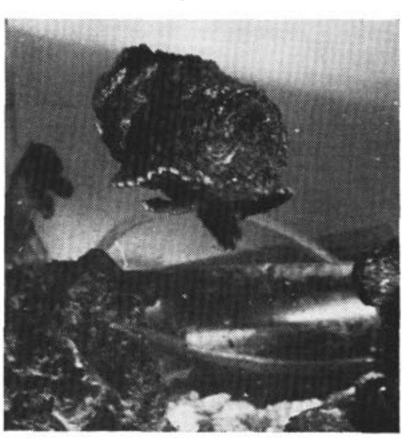
One of the most unusual passengers to travel aboard USNS *T-LST 618* was a *Synaceja horridis*. In plain English, that would be a stonefish.

This unusual MSTS passenger was captured by a former crew member who was netting tropical fish when *LST 618* was operating in the South Pacific. It was discovered when a fishing companion accidentally stepped on it in a tidal pool. Luckily the man was wearing shoes, for the poison secreted from the dorsal fins of the stonefish are so fatal that there is but one recorded incident of man' surviving its sting. South Sea natives claim that the only remedy to forestall death is immediate amputation. The sting of the stonefish is classed with the bite of the bushmaster snake.

This is one more good reason for wearing swim shoes in tropical waters where coral abounds.

The stonefish is extremely ugly and has a funnel type mouth. Its eyes are vicious looking with white circles and are set on the top of the head very much in the same manner as those of a flounder or flatfish. They usually imbed themselves in small rocks or coral along the ocean floor and are just about invisible. They diet on fish and marine plant life.

Live specimens of this deadly fish were all but non-existent in the U.S., until "Rocky," as the *Synaceja horridis* was named by LST crew members, arrived in the States. He was donated to the Steinhart Aquarium in San Francisco's Golden Gate Park where he is now on display and under study.



WHAT'S-IT — 'Rocky' floats through water like butterfly using his under fins in flapping motion like wings.

ALL HANDS
SPECIAL
SUPPLEMENT

UP FROM THE BOTTOM

Few ships have been sunk for months, raised and recommissioned, then gone on to fight a war. *Squalus* did. Redesignated as *Sailfish*, she survived 12 war patrols during World War II, won a PUC for sinking an aircraft carrier.

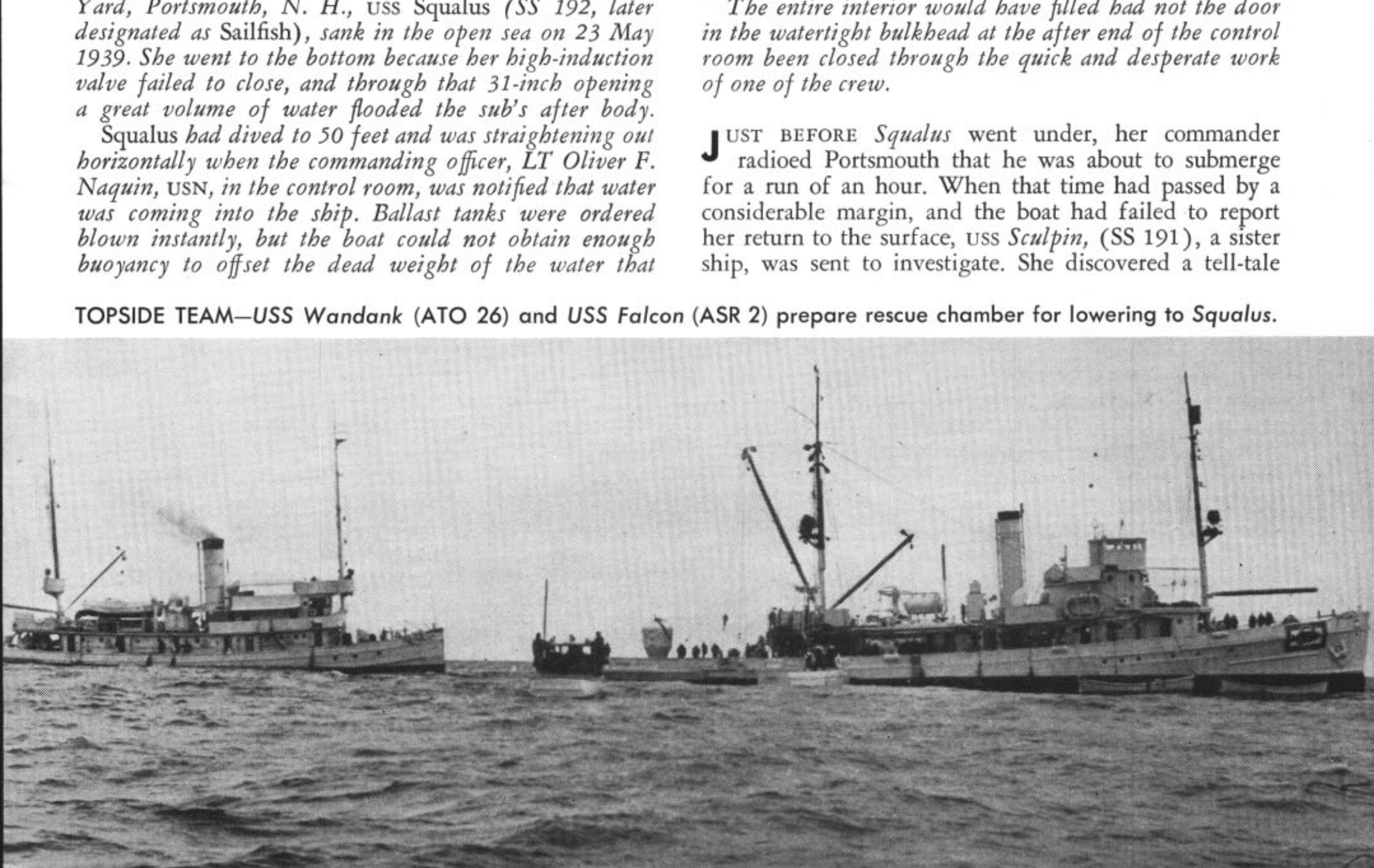
While on a practice run from her base at the Navy Yard, Portsmouth, N. H., USS Squalus *(SS 192, later designated as* Sailfish*), sank in the open sea on 23 May 1939. She went to the bottom because her high-induction valve failed to close, and through that 31-inch opening a great volume of water flooded the sub's after body.*

Squalus *had dived to 50 feet and was straightening out horizontally when the commanding officer, LT Oliver F. Naquin,* USN, *in the control room, was notified that water was coming into the ship. Ballast tanks were ordered blown instantly, but the boat could not obtain enough buoyancy to offset the dead weight of the water that flooded the four after compartments.*

The entire interior would have filled had not the door in the watertight bulkhead at the after end of the control room been closed through the quick and desperate work of one of the crew.

JUST BEFORE *Squalus* went under, her commander radioed Portsmouth that he was about to submerge for a run of an hour. When that time had passed by a considerable margin, and the boat had failed to report her return to the surface, USS *Sculpin,* (SS 191), a sister ship, was sent to investigate. She discovered a tell-tale

TOPSIDE TEAM—*USS Wandank* (ATO 26) and *USS Falcon* (ASR 2) prepare rescue chamber for lowering to *Squalus*.



BACK IN SERVICE—Extensively overhauled and recommissioned, *USS Sailfish* (SS 192) played big part in WW II.

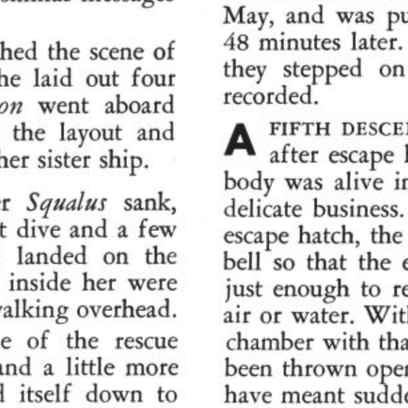
smoke bomb floating on the surface, and then located a marker buoy that had been released from a well in the forward deck of *Squalus.*

That buoy carried a telephone circuit in the cable which linked it with the submarine; and the commanding officer of *Sculpin* was thus able to communicate with the survivors in the forward compartments of *Squalus.* The buoy cable parted within minutes after contact was made, but it was still possible for *Sculpin* and *Squalus* to maintain communications by tapping in Morse code with a hammer on the hull of *Sculpin* and hearing similar messages from *Squalus.*

USS *Falcon* (ASR 2, ex-AM 28) reached the scene of the disaster early the following day. She laid out four point moorings and divers from *Falcon* went aboard *Sculpin* to familiarize themselves with the layout and equipment to be found aboard *Squalus,* her sister ship.

SLIGHTLY LESS THAN 26 hours after *Squalus* sank, Martin Sibitzky, BM1, made the first dive and a few minutes later telephoned that he had landed on the forward deck of *Squalus* and that men inside her were tapping on her hull as they heard him walking overhead.

Sibitzky shackled the downhaul line of the rescue chamber to the forward escape hatch, and a little more than an hour later the chamber pulled itself down to the hatch. Adjustments were made and the two operators of the chamber descended through the lower compartment to open the exposed hatch to the torpedo room. LT Naquin named seven men to make the first trip—LT Nichols to inform *Falcon* of conditions inside *Squalus,* a test engineer and five enlisted men who were the weakest of the survivors.



Twice more that afternoon the bell repeated its journey, removing all but eight of the crew. In darkness the last trip was started, the last contact made with *Squalus* and the last eight men, including LT Naquin, taken aboard.

On this last ascent, the downhaul wire jammed when the chamber was 150 feet below the surface. Those inside could do nothing to release it nor could the chamber be pulled free by *Falcon.* Three divers successively went down into the dark and frigid deep and the last one finally succeeded in cutting the cable.

However, the chamber could not be allowed to rise free lest, with increasing speed, it should strike *Falcon* in its rise, to the disaster of the men in the chamber. The crew was ordered to give the chamber just enough dead weight by admitting water ballast to make it barely float—a dangerously difficult operation under the best of circumstances. Unfortunately, the chamber lost all buoyancy and sank back to the sea bed not far from the *Squalus* it had left only a short time before.

There, after juggling with the ballast, the chamber was given moderate dead weight and was then pulled to the surface, hand over hand, by the crew of *Falcon.* The chamber had started its fourth trip about 2050, 24 May, and was pulled alongside *Falcon* three hours and 48 minutes later. The emotions of the 10 men inside, as they stepped on the deck of *Falcon,* have not been recorded.

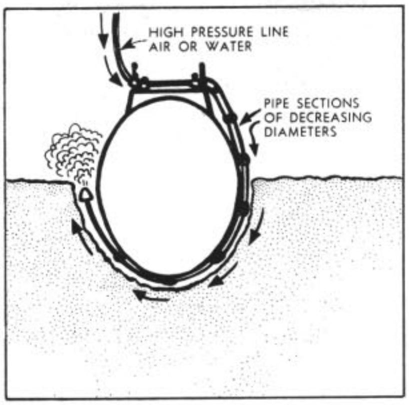
A FIFTH DESCENT was made the following day to the after escape hatch to determine whether or not anybody was alive in that flooded section. This, too, was a delicate business. After the chamber was secured to the escape hatch, the chamber was made to serve as a diving bell so that the escape-hatch cover could be eased open just enough to release a small volume either of pent-up air or water. Without first equalizing the pressure in the chamber with that of the sea the hatch cover would have been thrown open violently when released, which would have meant sudden death. *Falcon* could have given them no help.

Fortunately, the rescue crew met the situation with coolness and skill. When the hatch cover was slightly unseated, water oozed out—conclusive evidence that the 26 men trapped in the after section of *Squalus* were dead.

Submarine salvage was beginning to be a familiar story to Falcon, *then based at the naval submarine base, New London, Conn. She had been used to raise* USS S-51 *which had sunk off Block Island in 132 feet of water in September 1925, and in recovering* USS S-4 *which went down off Provincetown, Mass., in 102 feet of water in December 1927. (See* ALL HANDS, *May 1950, pp. 59-63 for excerpts of Tom Eadie's personal story of the rescue attempts of* S-4).

Commissioned in 1918, Falcon *operated off the East Coast of the United States during World War I and, at the end of hostilities, was sent overseas to help in lifting the North Sea Mine Barrage. (See "Taking Up The Mines,"* ALL HANDS, *May 1956,* *pp. 59-63). Designated AM 28 in 1920,* Falcon *was converted to a submarine rescue ship and redesignated ASR 2 in 1936. She was stricken from the Naval Register 19 Jul 1946.*

At the time of the Squalus *rescue,* Falcon *was, perhaps, the best-equipped ship and her men the best qualified in the country to do her job. With an over-all length of 187 feet, extreme beam of 36 feet and standard displacement of 1060 tons, she was equipped for rescue and salvage work by powerful wrecking pumps, an extensive compressor plant, steam-driven winches, mooring and towing bitts, and the like. She could make 14 knots, had a complement of 74 men. Her commanding officer at the time was LT George A. Sharp,* USN.



DIG THIS—Drawing shows how tunneling lance was used to excavate mud to get chains around ship's stern.

ON PAGE 53 of this issue, reference is made to the study of the helium-oxygen formula for diving. Here's the way it worked on the *Squalus* job:

In her main deckhouse, readily accessible, *Falcon* had a recompression chamber with an internal diameter of six and one-half feet and a length of 14 and one-half feet. The chamber had an air lock at the outer end and was large enough to accommodate 20 men. The "iron doctor" had plenty to do in the case of *Squalus*.

Ordinarily two divers went down at a time; but only one man descended when an oxygen-helium mixture was substituted for air. The helium and oxygen were combined in definite proportions at the Portsmouth Navy Yard, and the mixture was delivered to *Falcon* in flasks at 1100 pounds pressure. This artificial atmosphere was supplied when divers were working at depths between 240 and 160 feet; but at lesser depths they were provided with straight air.

The average time of decompression for an ascending diver was only 20 minutes. When a diver had been brought up to about 50 feet below the surface, he was quickly lifted aboard *Falcon* and placed in the iron doctor where the pressure was immediately raised to correspond with that at a 50-foot submergence and the diver, with his cumbersome suit removed, breathed oxygen to speed up his decompression.

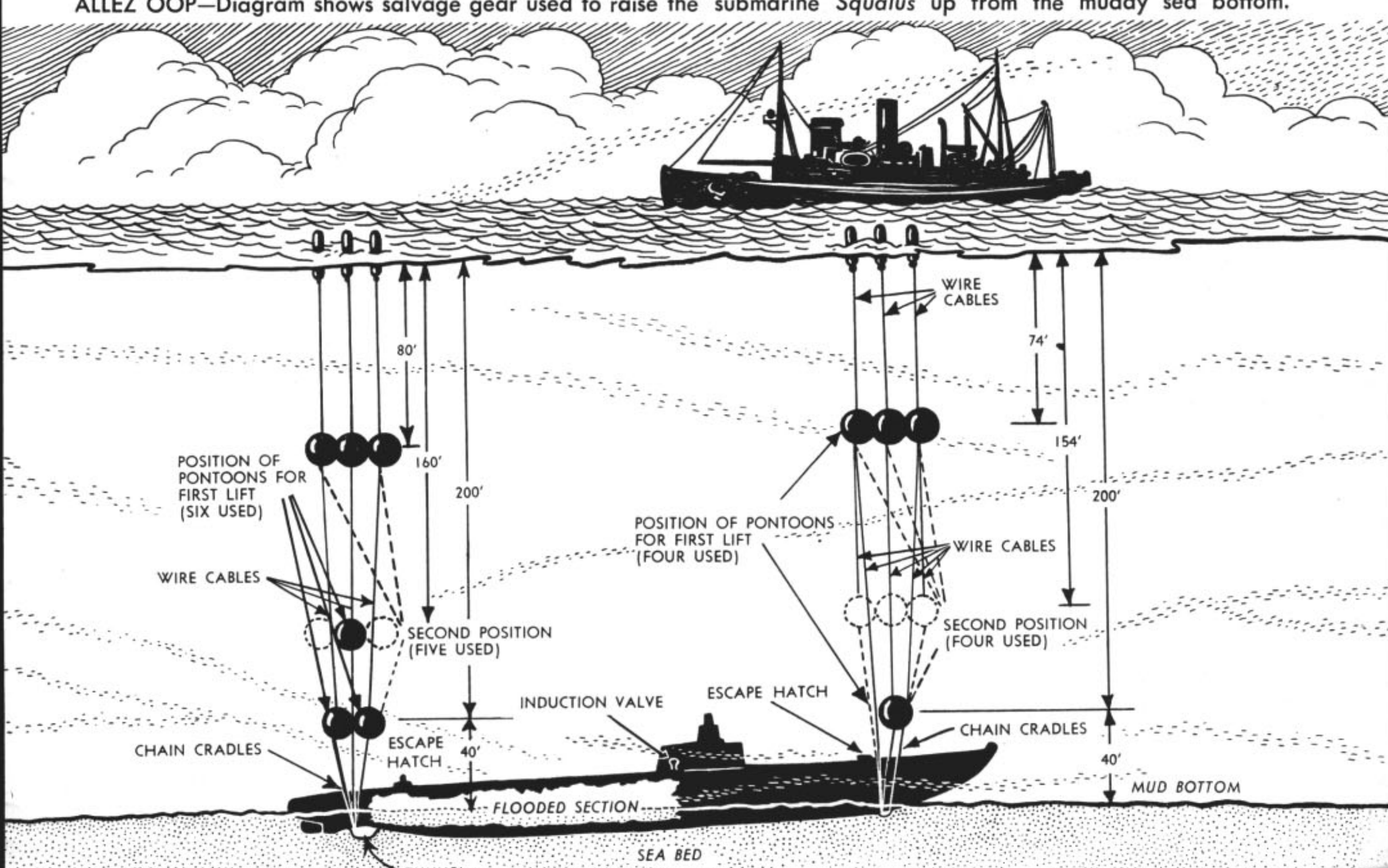
This shortened the time the men were held in the cold sea water and helped make life more comfortable for them. For instance, after a stay of 20 minutes on the bottom, 95 minutes would be required for decompression when air was used; but decompression with the oxygen-helium mixture took only 63 minutes.

THE OXYGEN-HELIUM MIXTURE, especially in cold weather, had a chilling effect on the diver; and those on *Squalus* were hampered at first by frosting of the water vapor inside the helmet. (In plain English, this meant that the water was so cold it froze the diver's breath on the glass of his helmet.)

The diver was clothed in an undersuit that enveloped every part of him but his face and was heated by current from a storage battery. At the height of salvage operations, *Falcon* had on board 49 of the Navy's best divers.

The first step toward salvage of *Squalus* was to place her forward compartments, from which the men had been rescued, under compressed air so as to prevent

ALLEZ OOP—Diagram shows salvage gear used to raise the submarine *Squalus* up from the muddy sea bottom.



FIRST NINE survivors to be rescued by diving bell from sunken *Squalus* are shown on board Coast Guard cutter.

water in the flooded after part from finding its way through the hull and the separating bulkhead into the fore part of the craft. Later, some of the forward ballast tanks were filled with water to help break the after body of *Squalus* free from the grip of the mud.

SQUALUS had an over-all length of 310 feet, beam of 27 feet, and a standard surface displacement of 1450 tons. Her submerged displacement exceeded 2000 tons. The difference between the two trims was the weight of water admitted to her ballast tanks so that she would be responsive to the diving rudders at her stern and the two diving planes at her bow.

Underwater, she was driven by electric motors which drew their energy from storage batteries. She could change from surface condition to complete submergence in about one minute.

In order to submerge, air must be allowed to escape from empty ballast tanks as sea water rushes into them. Furthermore, all hatches must be closed, as well as other air intakes, and many valves must be manipulated rapidly and in a closely ordered routine—every man at his station and doing his work at the right instant.

The air-venting valves are at the top of the ballast tanks; and while they are manipulated from within the main pressure hall, still they can be reached from the deck of the vessel and opened or closed for salvage purposes.

It is also possible from outside to make air connections with fuel-oil tanks to blow them. Both the oil and ballast tanks lie between the pressure-resisting hull and the nonpressure-resisting hull that gives the submarine her ship-shaped external form. Likewise from the deck can be made hose connections with the main compartments either to pump water out of them or to force it out with the aid of compressed air.

Twelve such connections were used to give *Squalus* buoyancy when raising her and when moving her shoreward. The remainder of the buoyancy was supplied by pontoons that both lifted the submarine and held her suspended at different depths while making the 15-mile journey to the drydock.

SUBMERGIBLE PONTOONS were first used by the Navy in 1915 to recover USS *F-4* from water 46 feet deep near the channel entrance to Honolulu Harbor, and later in raising S-51 and S-4. Some of the pontoons used for S-4 were also used in the far more difficult task of recovering *Squalus*. A total of 10 pontoons were used with *Squalus*—two with a buoyancy of 60 tons and eight were 80-ton units. The smaller ones weighed 30 tons apiece and the larger ones 42 tons each.

After the deck of *Squalus* was cleared of all hampering rigging and stray lines, the next step was to get under her the half lengths of the 90 feet of chain of each of six slings. This was not too difficult at the bow, where much of the keel was clear of the mud for about 100 feet; but the deeply embedded stern presented a pretty problem in tunneling.

Usually, such work is done by a diver guiding a high-pressure water line; but there is always the danger that the excavation will fill in and bury him. In the case of *Squalus,* a self-propelled nozzle, called a "lance," was used. This was fitted with sections of pipe from eight to 18 feet long, curved, and increasing in size from one inch to two and one-half inches. The ends of adjoining sections telescoped and were locked together at the joint with a toggle pin.

The diver guided the lance down from the deck of *Squalus* and kept the curved pipe close to and conforming to the hull. Water pressure up to 300 pounds per square inch was supplied by *Falcon's* fire pump; and the nozzle was designed to discharge rearward enough water to force the apparatus onward as the stream excavated the mud ahead. Small holes at intervals throughout its length allowed some of the water to escape and prevented the mud from filling in rearward and blocking the tube.

When the lance had made a circuit of the hull, a small wire cable was pulled through it and the tubing withdrawn. The receiving wire, progressively enlarged, served eventually to pull into place an entire sling which had been assembled aboard *Falcon.* Each sling was pulled into position beneath the sub by the winches aboard *Falcon* and the two ends of each sling were run through the two hawsepipes of a pontoon before it was sunk.

WHEN A PONTOON was alongside *Falcon* ready for sinking, an eight-inch manila hawser was attached at each end for lowering. At regular intervals, the hawsers were painted with colored bands which guided the men at the bitts and enabled them to pay out their lines in unison. To carry it down, the end compartments were flooded until the pontoon had a negative buoyancy between four and five tons. This made it easy to handle when sinking and made it sink rapidly.

When a pontoon reached its proper depth, it was moored to its two lifting slings by a cable clamp, known as a "flower pot," set on the top lift of each hawsepipe. The flower pot was a massive casting hollow from top to bottom, with its sloping interior fitted with roller bearings. Between the bearings and the steel cable were tapered wedges which dropped and jammed against the cable. When the pontoon tried to rise and pulled on the slings, the grip tightened.

At the start, the plan was to lift *Squalus* in three stages and to ground her twice on her journey back to the Navy Yard. As first arranged, the pontoons were set at three levels on the slings and when the topmost pontoons reached the surface, the sub was to be towed shoreward until she grounded.

On 13 July, the first lift was attempted. It didn't work. Here's the report:

"Lifted stern of *Squalus* with five pontoons about 85 feet clear of bottom. Then lifted bow with two pontoons, blowing ballast tanks forward. Both pontoons came to the surface, followed by the bow. Forward sling carried away and bow sank. One sling aft and two lower pontoons on sling surfaced. Stern sank with remaining pontoons, possibly in a damaged condition. Think *Squalus* on even keel on bottom. Two chains still remain under the stern."

In other words, the bow of the sub came up so fast that the sub literally stood on end, then slid out of the arrangement of slings, and went to the bottom again.

IT TOOK A MONTH of hard work before she was again ready to be raised.

On 12 August, early in the morning, *Falcon* again began blowing air down into the ballast tanks of *Squalus,* as well as into the pontoons arranged in three levels above the sub—each given a positive buoyancy of 10 tons. The object was to give the pontoons their full buoyancy, applying the air first to the topmost pontoons and then downward.

Ten pontoons were used—six above the stern and four above the bow—with a total lifting capacity of some 760 tons. The theory was that the stern would rise higher than the bow and, as the boat was towed stern first toward shallower water, that the bow would be the first to ground.

In the midst of a wide area of water seething with escaping air bubbles, the topmost pontoons broke above the surface and, after bobbing about for a time, settled down. Tired men on board *Falcon* grinned and shook hands. The toughest part of their job was done.

USS *Wandank* (AT 26), with a line down to the stern of *Squalus* and to the surface pontoons above the stern, led the procession toward shallower water near the Isle of Shoals, while *Falcon,* with a line to the bow of the submarine and hawsers to the trailing pontoons, took up her station at the rear. Over the bow of *Falcon* leading to the pontoons and to the suspended *Squalus* there were as many as 37 lengths of one-and-one-quarter-inch pneumatic hoses distributing compressed air. All went well until the stern of *Squalus* struck an uncharted ridge of mud and the whole procession came to an abrupt halt.

Five days later, after readjustments and with four pontoons at the bow and five at the stern, *Squalus* was raised again—without a hitch—and towed another five miles where she was again grounded—purposely, this time—some two miles west of the Isle of Shoals.

Here, in 90 feet of water, she was prepared for her final lift and for the long tow to the Navy Yard. The pontoons were rearranged again; this time, two were placed at the bow and two at the stern on opposite sides, and were held close to the deck and lengthwise with the submarine.

This meant a lot of work for the divers and for *Falcon.* Shallow water added to the difficulties. Stormy weather twice drove the salvage flotilla to port. Finally, on 13 September, *Squalus* was brought to the surface a fifth time and held there by her pontoons with only a small part of her body visible above water. In that condition, after twice touching bottom on the last long lap of her journey, the submarine was moored at the Portsmouth Navy Yard—just 113 days after she had left the station for her submerged sea run.

During much of the salvage work, Squalus' sister sub, *Sculpin,* stood by to aid the divers to familiarize themselves with the external details of the sunken craft.

In spite of the hazards faced by the divers and the men on board *Falcon,* no one was injured. During two of the lifting operations some 20,000 feet of air hose were used; and the deck of *Falcon* was often buried deep with thousands of feet of cables, hawsers and miscellaneous gear.

As might be expected, Squalus *was in somewhat disheveled condition upon her arrival at Portsmouth. Nevertheless, it was obvious in 1939 that every ship and every type of craft was soon going to be needed. Thus,* Squalus *was decommissioned and after six months of extensive overhaul she was recommissioned in May 1940 as* USS Sailfish *(SS 192) with then LCDR M. C. Mumma, Jr.,* USN., *as commanding officer.*

At the outbreak of the war, Sailfish *was at Manila and, on the following day, she steamed out along the west coast of Luzon to begin the first of her 12 war patrols. Five days later she was able to lay claim (officially unconfirmed, however), to the distinction of sinking one of the first enemy destroyers to be accounted for by a U. S. Navy sub in World War II.*

Her official record consisted of seven vessels—four cargo ships, one passenger-cargo ship, an aircraft ferry and a 20,000-ton escort aircraft carrier.

It was on her 10th war patrol that she sank the carrier Chuyo *and, in doing so, earned her Presidential Unit Citation "for outstanding performance in combat against strongly escorted enemy task forces and convoys in Japanese-controlled waters."*

She was decommissioned 27 Oct 1945 at Portsmouth, her "home" yard which she had not seen for years. This ship with two lives was finally stricken from the U. S. Naval Vessel Registry in April 1948.

SHIPSHAPE—Crew members of *USS Sailfish* (SS 192), the former *Squalus,* fly PUC flag won for carrier sinking.

TAFFRAIL TALK

THIS ISSUE on the Underseas Navy barely goes skin deep. It's a vast subject and there are many aspects of it that we have merely touched upon. For example, Navy's pioneering work in the field of submarine development, and the proud achievement of the world's first nuclear ship. But we have discussed these subjects before on different anniversaries of the Submarine Navy (ALL HANDS April 1955, April 1956, April 1958), and so the space in this issue went to other subjects.

We have tried to look at the subject from the individual's point of view—that is, what this strange world looks like and how it affects the salvage diver, the frogman, the ordnance disposaleer, the diving corpsman, the submariner and the scientist. There was a lot more that we wish we could have included, but you'll be hearing about those subjects in future issues. Meanwhile, if you can add to this subject, let's hear from *you.*

★ ★ ★

Just as we were going to press we received an interesting letter from Will Jacobs of Hartford, Conn., who had some queries about the Underseas Navy.

"I have been asked the same question many times," he says, "but I cannot find the answer. Maybe you can help.

"As you know, all qualified Navy deep sea divers wear an emblem on their uniform showing that they are a Master, First and Second Class Diver. Why don't Scuba divers or UDT personnel have a distinguishing patch? I feel that a qualified Scuba man is as important as a deep sea diver and should be shown some recognition. How do you feel about this?"

Those were good questions, but we didn't have the answers ourselves, so we went to the sources—the Training people and the Naval Uniform Board. Here's their answer:

"All qualified deep sea divers are trained to use all types of diving equipment including the self-contained breathing apparatus used by the free swimmer or Scuba diver. But Scuba divers are not qualified or trained in the use of surface supplied or deep sea diving gear.

"All graduates of the Navy's Underwater Swimmers School at Key West, Fla., are designated Scuba divers. However, upon completion of the school, the majority of them go on to EOD (Explosive Ordnance Disposal) or UDT (Underwater Demolition Team) training. When they complete this more advanced and highly specialized training, they drop their basic Scuba designator in favor of the higher qualifications and designations.

"Although the Navy uses Scuba divers quite extensively, there's only a limited number of billets for Scuba divers. When Scuba diving is required and authorized, it is generally done by qualified deep sea divers, EOD technicians and UDT men.

"EOD technicians, who are qualified Scuba as well as Divers Second Class, are authorized to wear an EOD distinguishing mark on their right sleeves. However, this mark does not indicate that the individual is a qualified diver. It consists of a mine superimposed on a crossed torpedo that points down to the right, and a bomb that points down to the left.

"As yet, UDT personnel, who are also qualified Scuba divers, do not have an authorized distinguishing mark."

That's the answer—for the present.

The All Hands Staff

The United States Navy

Guardian of Our Country

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends. The United States Navy exists to make it so.

We Serve with Honor

Tradition, valor and victory are the Navy's heritage from the past. To these may be added dedication, discipline and vigilance as the watchwords of the present and future. At home or on distant stations, we serve with pride, confident in the respect of our country, our shipmates, and our families. Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

The Future of the Navy

The Navy will always employ new weapons, new techniques and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war. Mobility, surprise, dispersal and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past. Never have our opportunities and our responsibilities been greater.

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• AT RIGHT: LOOKING AFT along her fish-shaped body, USS *Albacore* (AGS 569) cuts a narrow wake as undersea sailors cruise topside off Florida Keys. ➧

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★ SAFETY
★ ADVENTURE
IN YOUR NAVY