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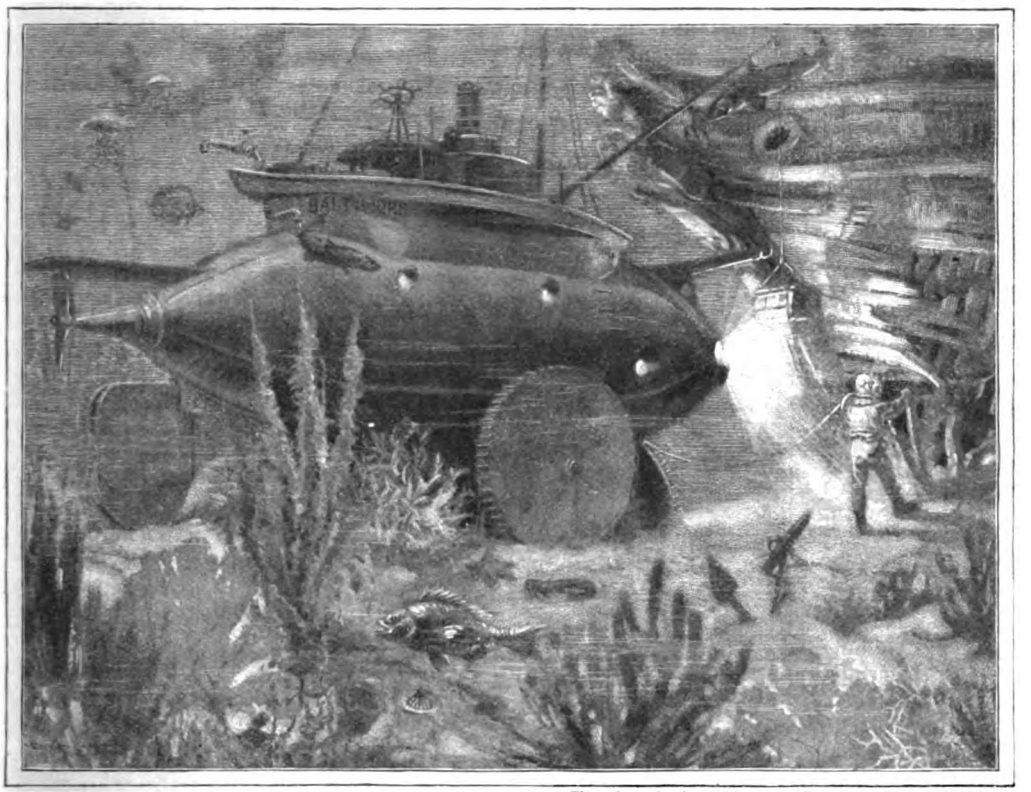


The submarine boat "Argonaut" on a wrecking expedition.

VOYAGING UNDER THE SEA.

I.—THE SUBMARINE BOAT "ARGONAUT" AND HER ACHIEVEMENTS.

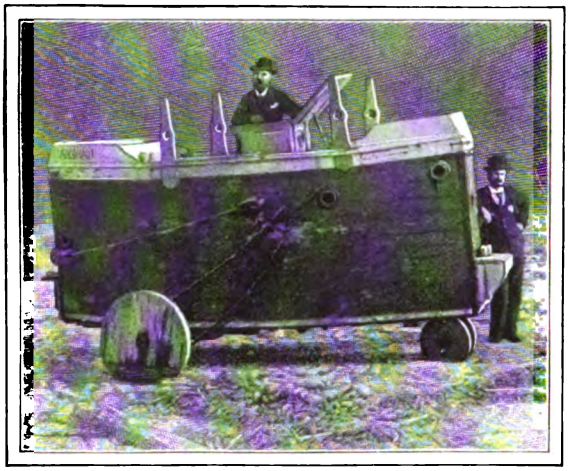
By Simon Lake,

Inventor and builder of the boat.

THE problem of submarine navigation has had the attention of inventors almost from time immemorial. It has led to the expenditure of immense sums of money and the sacrifice of many lives. One of the earliest experiments was an appliance that enabled a diver to disappear beneath the surface of the water at night, and walk along the bottom until he came beneath an enemy's ships, the bottoms of which he perforated with an auger, thus causing the ships to sink. But the father of submarine navigation may be said to be a Dutch inventor, Cornelius Debrell, who built in England, in the time of James I., a sub-

marine boat embodying the principle common to all submarine boats, that, namely, of the water-ballast compartments, with pumps for emptying them, to restore the buoyancy of the vessel. If the accounts of the matter are correct, Debrell submerged his boat a number of times, and kept it under water several hours at a time.

Following Debrell, a number of inventors worked at the problem, and devised vessels that they thought would solve it, among others Robert Fulton; and during the Civil War a number of submarine boats were built and tried with more or less success. It was by means of a submarine boat—of the kind called "Davids"—that the Confederates sank the Federal steamship "Housatonic," in Charleston Harbor, on the night of February 17, 1864. Since then the interest in the subject has been constant and keen, our own and the English, French, Spanish, Italian, and Russian governments making trial of many inventions submitted to them, and some of them spending large sums of money in experiments of their own.



THE "ARGONAUT, JUNIOR."

Mr. Lake built this, his first experimental submarine boat, in 1894. After several successful descents, she was abandoned, and now lies at Atlantic Highlands, half buried in the sand. Dimensions: length, 14 feet; width, 4½ feet; depth, 5 feet.

My own submarine boat, the "Argonaut," is quite different from any other thus far projected or constructed. All previous attempts have been to design a boat to navigate between the surface and the bottom; but the results have been, as a rule, unsatisfactory, owing to the disturbing influence of waves and currents, as well as the difficulty of maintaining trim and equilibrium. These craft should more properly be called diving boats. They are intended to be steered by vertical and horizontal rudders or vanes (as in the Nordenfelt, Gymnote, Holland, and Peral types) placed in various positions, but generally near the stern, or by changing the angle of the propellers, as in the Goubet, Baker, and Tuck types.

When it is desired to submerge such boats, they must first be very accurately balanced, so that the bow and stern are exactly alike. Then the vessel must be in equilibrium with the water; that is, she must weigh no more, no less, than the water she displaces, under which conditions the theory is that she can be guided through the water like a fish; but here the difficulty arises. Man has not, nor can he have, the training and instincts of fishes, and he cannot compete with nature in her own domain. With a navigator carefully trained to the business, a vessel might possibly succeed in navigating the deep to some extent in this manner; but it still remains, I think, somewhat of a question. All mariners know how difficult it is to steer an absolutely straight course on the surface; then how much more difficult is it to steer a straight course beneath the waves.

On the surface the vessel can only swing to the right or left. She does not go up in the air, because she is held to one plane by her weight; neither does she go down, because she is held to the same plane (the surface of the water) by her buoyancy; therefore, the rudder is able to control her. But below the surface all these conditions are changed. Every wave imparts an up-and-down motion to the particles of water beneath it, and, consequently, affects the course of the submarine vessel. Currents run in a variety of directions, and as soon as the screw or propelling mechanism starts in motion, it affects the equilibrium and trim of the boat. If one of the crew moves either forward or aft, the trim is affected, and all these things tend to elevate or depress the bow of the boat or affect her course; and as she can go either to the right or left, or up or down, or, indeed, in any direction, there is scarcely any limit to the difficulty of holding her securely to an appointed course under the surface of the water. Either she will be ducking down and running her bow into the bottom of the sea, or bobbing up again to the surface.

But with the "Argonaut" we experience none of the difficulties above recited. By referring to the accompanying skeleton sketch, her principles will be readily understood.

The hull of the vessel is mounted on three wheels. Of these, *E* is the rudder, for surface steering, and is also the guiding wheel when the vessel is running on the sea bottom; and *C* is one of the supporting and driving wheels, of which there are two, one on each side. *BB* are two anchor weights, each weighing 1,000 pounds, attached to cables, and capable of being hauled up or lowered by a drum and mechanism within the boat; *OOOO* are water-ballast compartments contained within the boat; *H* is the diver's compartment, situated forward, with an exit door opening outward in the bottom; while *G* is an air-lock.

SIMON LAKE.

Drawn from life by W. D. Stevens at Atlantic Highlands, October 16, 1898.

When it is desired to submerge the vessel, the anchor weights *BB* are first lowered to the bottom; water is then allowed to enter the water-ballast compartments until her buoyancy is less than the weight of the two anchors, say 1,500 pounds; the cables connecting with the weights are then wound in, and the vessel is thus hauled to the bottom, until she comes to rest on her three wheels. The weights are then hauled into their pockets in the keel, and it is evident that she is resting on the wheels with a weight equal to the difference between her buoyancy with the weights on the bottom, and the weights in their pockets, or 500 pounds. Now, this weight may be increased or diminished as we please, either by admitting more water into the ballast tanks or by pumping some out. Thus it will be seen that we have perfect control of the vessel in submerging her, as we may haul her down as fast or as slow as we please; and by having her rest on the bottom with sufficient weight to prevent the currents from moving her out of the course, we may start up our propeller or driving wheels and drive her at will over the bottom, the same as a tricycle is propelled on the surface of the earth in the upper air. In muddy bottoms, we rest with a weight not much over 100 pounds; while on hard bottoms, or where there are strong currents, we sometimes rest on the wheels with a weight of from 1,000 to 1,500 pounds. Thus the effect of currents and wave motion and the maintenance of trim and equilibrium are not factors in the successful navigation of the vessel; in fact, navigation becomes surer than on the surface, as one is traveling in a medium which does not constantly change like the surface water from the effects of winds, waves, and currents. When the divers desire to leave the vessel, they go into the diver's compartment, located in the forward portion of the ship, and close the door communicating with the living quarters. This door closes on rubber packing, and is air-tight. Air is then admitted into the compartment from compressed-air reservoirs, until the pressure of air equals that of the surrounding water. The bottom door may then be opened, and no water will come into the boat, as the pressure of air contained within the compartment offers an invisible barrier to its entrance, and the divers may pass in and out as frequently as they please.

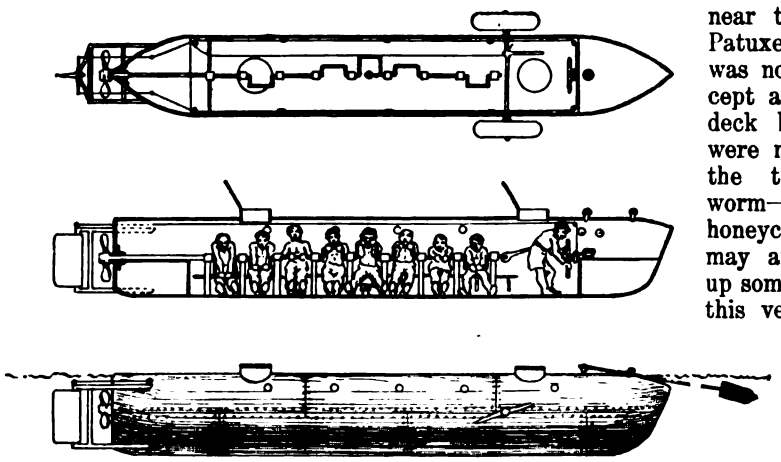
The "Argonaut" is fitted with a White and Middleton gasoline engine of thirty horsepower, which operates the screw, the driving wheels, the dynamo, the air compressors,

anchor hoists, and derrick-operating machinery. She is provided with two Mannesmann steel tubes, in which sufficient air may be stored, with what is contained in the boat, to last the crew for twenty-four hours without obtaining a fresh supply from the surface. In the "Argonaut," however, and probably in all such craft used for commercial pursuits, as a usual thing, there will be a connection with the surface, through which a constant supply of air may be drawn, either by the masts, as shown in the views, one of which supplies air to the interior of the vessel, the other being utilized as an exhaust from the engine, or through suction hose extending to a buoy on the surface. While the engine is running, there is about fifty cubic feet of air flowing into the boat per minute; and when the engine is closed down, there may be a flow of air maintained by an auxiliary blower, so that it is possible to remain below for days, or even weeks, at a time.

The course is directed by an ordinary compass when on the bottom, and it is found that the needle responds as quickly and is as accurate as when on the surface. Notwithstanding the fact that the "Argonaut" is quite a small vessel, a crew of five men have lived aboard her during an experimental cruise extending over two months, during which she traveled over 1,000 miles under her own power, partly on the surface and partly on the bottom. The trip was made to demonstrate the practicability of vessels of her type traveling on various kinds of bottoms; also to demonstrate her seaworthiness and capabilities in searching the bottom, in working on sunken wrecks, finding and taking up submerged cables, etc.

We have been out in some pretty rough weather, and found that she was perfectly seaworthy. Of course, being so small and of such weight, the seas at times would wash clear over her decks. This, however, caused no inconvenience to those below, as her stability was such that she would roll or pitch very little, even though the seas were breaking over her in great volume. We have been cruising on the bottom in rivers, in Chesapeake Bay, and beneath the broad Atlantic. In the rivers we invariably found a muddy bed; in the bay we found bottoms of various kinds—in some places so soft that our divers would sink up to their knees, while in other places the ground would be hard, and at one place we ran across a bottom which was composed of a loose gravel resembling shelled corn. Out in the ocean, however, was found the ideal submarine course, consisting of fine gray sand, almost as hard as a macadamized road, and very level and uniform.

During this trip we investigated several sunken wrecks, of which there are a great many in Chesapeake Bay and on the coast adjacent thereto. The vessels we boarded were coal-laden craft and of themselves not of much value; but the coal would pay handsomely for its recovery, which could be readily accomplished with the proper equipment. We found one old wreck said to have gone down some forty years ago near the mouth of the Patuxent River. There was nothing in sight except a few timbers and deck beams, and these were nearly consumed by the teredo — a boring worm—which completely honeycombs any timber it may attack. We pulled up some of the planks of this vessel, which had a numerous growth of oysters, mussels, and several kinds of submarine vegetation clinging to them. The portion of the timbers not eaten by the teredo was found



THE CONFEDERATE SUBMARINE BOAT WHICH SANK THE UNITED STATES STEAMSHIP "HOUSATONIC" IN CHARLESTON HARBOR DURING THE CIVIL WAR.

Three different crews were drowned in this boat before she accomplished her purpose. As shown in the two upper diagrams, her propeller and two forward paddles were worked with a shaft propelled by eight men. The steersman, in front, discharged the torpedo, shown in the lower view.

to be almost as hard as iron and thoroughly impregnated with the dark blue mud in which the hull lies buried. After the timbers were hauled to the surface, in sawing them in two, we noticed a very strong odor of yellow pine, and so learned that they must be of that wood, though they were as black as ebony. Toad fish had evidently found this old wreck a congenial habitation, and when the diver's hand comes in contact with the slimy back of one of these horrible-looking, strong-jawed, big-mouthed fish, he pulls it back pretty quickly. The piece we pulled up had within it three of these fish, which had taken up their abode in portions of the timber that had been eaten away, and one was a prisoner in a recess which, evidently, he had entered when small and had grown too large to get out. In a wreck near Cape Henry, fish were very numerous, principally bass and croakers, though two or three small sharks were seen in the vicinity.

It might prove interesting to copy one day's experiences from our log-book. This day we submerged for the purpose of discovering how much weight was necessary to prevent the current from moving the "Argonaut" in a strong tideway (Hampton Roads), and also to discover if there was any difference in starting our machinery again under water after it had been shut down for several hours. I copy verbatim from the log-book under date of July 28, 1898.

Submerged at 8.20 A.M. in about thirty feet of water. Temperature in living compartment, eighty-three degrees Fahrenheit. Compass bearing west - north - west, one-quarter west. Quite a lively sea running on the surface, also strong current. At 10.45 A.M. shut down engine; temperature, eighty - eight degrees Fahrenheit.

After engine was shut down, we could hear the wind blowing past our pipes extending above the surface; we could also tell by the sound when any steamers were in the vicinity. We first allowed the boat to settle gradually to the bottom, with the tide running ebb; after a time the tide changed, and she would work slightly sideways; we admitted about 400 pounds of water additional, but she still would move occasionally, so that a pendulum nine inches long would sway one-eighth of an inch (thwartship). At 12 o'clock (noon) temperature was eighty-seven degrees Fahrenheit; at 2.45 P.M. the temperature was still eighty-seven degrees Fahrenheit. There were no signs of carbonic acid gas at 2.45, although the engine had been closed down for three hours and no fresh air had been admitted during the time. Could hear the whistle of boats on the surface, and also their propellers when running close to the boat. At 3.30 the temperature had dropped to eighty-five degrees. At 3.45 found a little sign of carbonic acid gas, very slight, however, as a candle would burn fairly bright in the pits. Thought we could detect a smell of gasoline by comparing the fresh air which came down the pipe (when hand blower was turned). Storage lamps were burning during the five hours of submergence, while engine was not running.

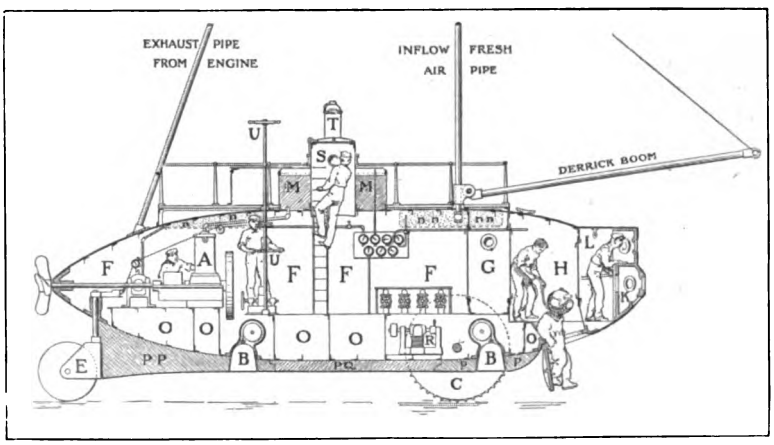
At 3.50 engine was again started, and went off nicely. Went into diving compartment and opened door; came out through air-lock, and left pressure there; found the wheels had buried about ten inches or one foot, as the bottom had several inches of mud. We had 500 pounds of air in the tanks, and it ran the pressure down to 250 pounds to open the door in about thirty feet.

The temperature fell in the diving compartment to eighty-two degrees after the compressed air was let in.

Cooked clam fritters and coffee for supper. The spirits of the crew appeared to improve the longer we remained below; the time was spent in catching clams, singing, trying to waltz, playing cards, and writing letters to wives and sweethearts.

Our only visitors during the day were a couple of black bass that came and looked in at the windows with a great deal of apparent interest.

In future boats, it will be well to provide a smoking



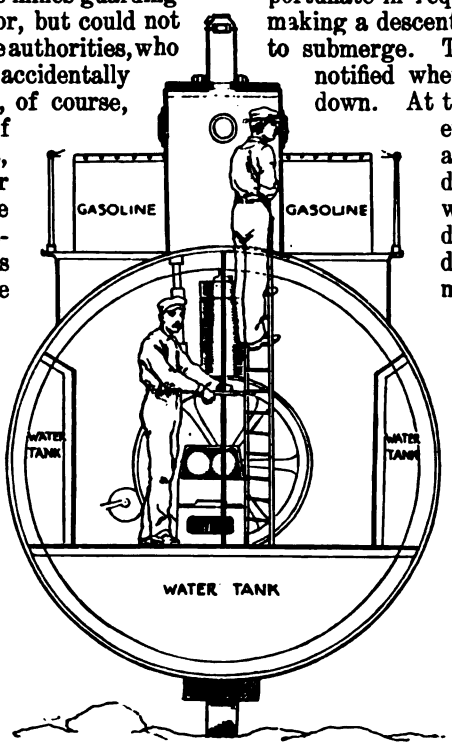
LONGITUDINAL SECTION OF THE LAKE SUBMARINE BOAT "ARGONAUT."

A, Gasoline engine, thirty horse-power, which supplies all the power used in moving and operating the boat. BB, the two anchor weights used in sinking the boat. C, one of the two driving wheels. E, rudder and guiding wheel. FFFF, the "living-room," in which are placed the engine and all the other machinery and apparatus for operating the boat. G, the air-lock: it affords passage to and from the diver's room without reducing the air pressure. H, the diver's room, whence free passage is secured into the sea. K, bow compartment where the search-light is placed. L, the forward lookout compartment. MM, gasoline tanks. NN, compressed-air reservoirs. OOOO, water-ballast compartments. PP, permanent keel. PQ, drop keel. R, dynamo. S, conning-tower. T, binnacle. The compass in this binnacle is in direct view from the outside steering gear; but from the conning-tower it is read by reflection. U, outside steering gear. In general form, the "Argonaut" is cylindrical, or cigar-shaped, with a very bluff bow and a pointed stern, and is thirty-six feet long.

compartment, as most of the crew had their smoking apparatus all ready as soon as we came up.

Started pumps at 6.20, and arrived at the surface at 6.30. Down altogether ten hours and fifteen minutes. People on pilot boat "Calvert" thought we were all hands drowned..

We spent some time with Hampton Roads as headquarters, and made several descents in the waters adjacent thereto; we were desirous of making a search for the cables which connected with the mines guarding the entrance to the harbor, but could not obtain permission from the authorities, who were afraid we might accidentally sever them, which would, of course, make their entire system of defense useless. It was, therefore, necessary for us, in order to demonstrate the practicability of vessels of this type for this purpose, to lay a cable ourselves, which we did, across the channel leading into the Patuxent River. We then submerged, and, taking our bearings by the compass, ran over the bottom, with the door in our diving compartment open, until we came across the cable, which we hauled up into the compartment with a hook only about four and one-half feet long; and we could not avoid the impression that it would be a very easy thing to destroy the efficiency of the present mine system. And how many lives might have been saved, and millions of dollars besides, had our navy been provided with a craft of this type to lead the way into Santiago, Havana, or San Juan, off which ports squadrons were compelled to lie for weeks and months, owing to fear of the mines!



Amidships cross-section of the "Argonaut."

I have frequently been asked my sensations on going beneath the water—whether I had any fear of not being able to come up again and whether it did not require a lot of courage. I usually reply that I have always been too busy and interested for fears or sensations, and that it does not require any courage on my part, as I am so thoroughly satisfied of the correctness of the principles upon which the "Argonaut" is constructed and the strength of the structure as to have no doubts or fears of any kind; but I do think it requires courage on the part of those who do not understand all the principles involved and who simply trust their lives in my hands. Quite a number of people have made descents in the vessel, but in only one or two instances have I seen them show any signs of fear.

In one instance, during our trials in the Patapsco, several gentlemen were very importunate in requesting the privilege of making a descent the next time we were to submerge. They were, accordingly, notified when the boat was to go down. At the appointed time, however, some of them did not appear, and of those who did, not one at the last would venture. I have no doubt had we made the descent at the time they made the request all would have gone; but thinking about it for a couple of days made them change their minds.

On another trip, we had a college professor on board who could not understand exactly how our men could get out of the boat. I told him to come into the diver's compartment and I would explain it to him. Accordingly, he reluctantly, as I thought, entered the compartment, which in the "Argonaut" is a little room, only four feet long and a little wider. After closing the door, I noticed that the color was leaving his face, and a few beads of perspiration were standing out upon his forehead, and had he been any one else than a professor or, possibly, a newspaper man, I would not have gone any further with the experiment. The door, however, was closed and securely fastened. I then opened the valve a full turn, and the air began to rush in with a great noise. He grabbed hold of one of the frames, and glanced with longing eyes at the door we had just entered. I then turned off the air, and said, "By the way, Professor, are you troubled with heart disease?" He said, placing his hand over his heart, "Why, yes, my heart is a little affected." Remarking,

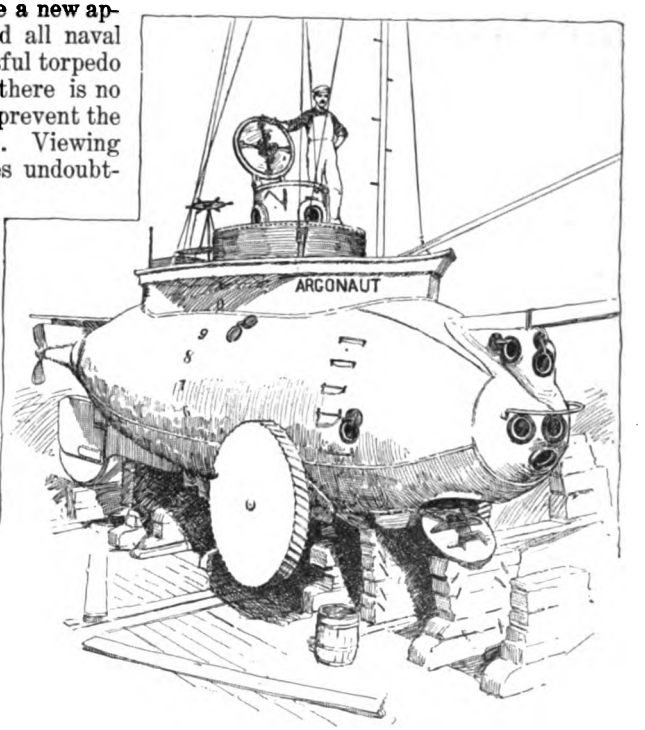
"Oh, well, this little depth will not hurt you," I turned on the air again after saying to him, "If you feel any pain in your ears, swallow as if you were drinking water." He immediately commenced swallowing, and during that half minute or so we were getting the pressure on I believe he swallowed enough to have drunk a bucketful of water. After getting the desired pressure, I stooped down and commenced to unscrew the bolts holding the door which leads out into the water. Our professor said, "What are you doing now?" I answered, "I am going to open this door so you can see the bottom." Throwing out his hands, he said, "No, no. Don't do that. I would not put you to that trouble for the world." However, about that time, the door dropped down, and as he saw the water *did not* come in, the color returned to his face, and he exclaimed, "Well, if I had not seen it, I would never have believed it!"

WHAT SUBMARINE VESSELS WILL DO FOR THE HUMAN RACE.

The object hitherto sought in building submarine vessels has been to provide a new appliance for carrying on war; and all naval authorities agree that if a successful torpedo boat of this type can be built, there is no means known to naval science to prevent the destruction of any squadron afloat. Viewing them from this point, submarines undoubtedly will be one of the greatest agencies ever known for the promulgation of that universal peace so much desired by all people who love their fellowman and who would rather see international differences settled by arbitration than by the sword. When every nation with a seacoast has among its defenses a number of submarine torpedo boats, it will be worse than folly to think of invading its territory from the sea. No transport ships would dare approach its coast-line and attempt to land an army if a number of these little destroyers were known to be prowling about the vicinity. In all probability the fear they would inspire would be so great as to break down the nerves of the best disciplined navy. Men can stand up and fight an enemy that they can see and at whom they can strike; but to be in a position where they do not know at what instant—whether asleep or awake—without any warning whatever, they may be blown into another world, will inspire such terror that no one could long endure the strain.

Had the Cubans been provided with one or two of these little craft, Spain could never have invaded and laid waste their beautiful territory with her army of 200,000 men. Consequently Cuba would have been in the position which all countries should be in, that the majority of the inhabitants could have managed their own affairs without interference from outsiders.

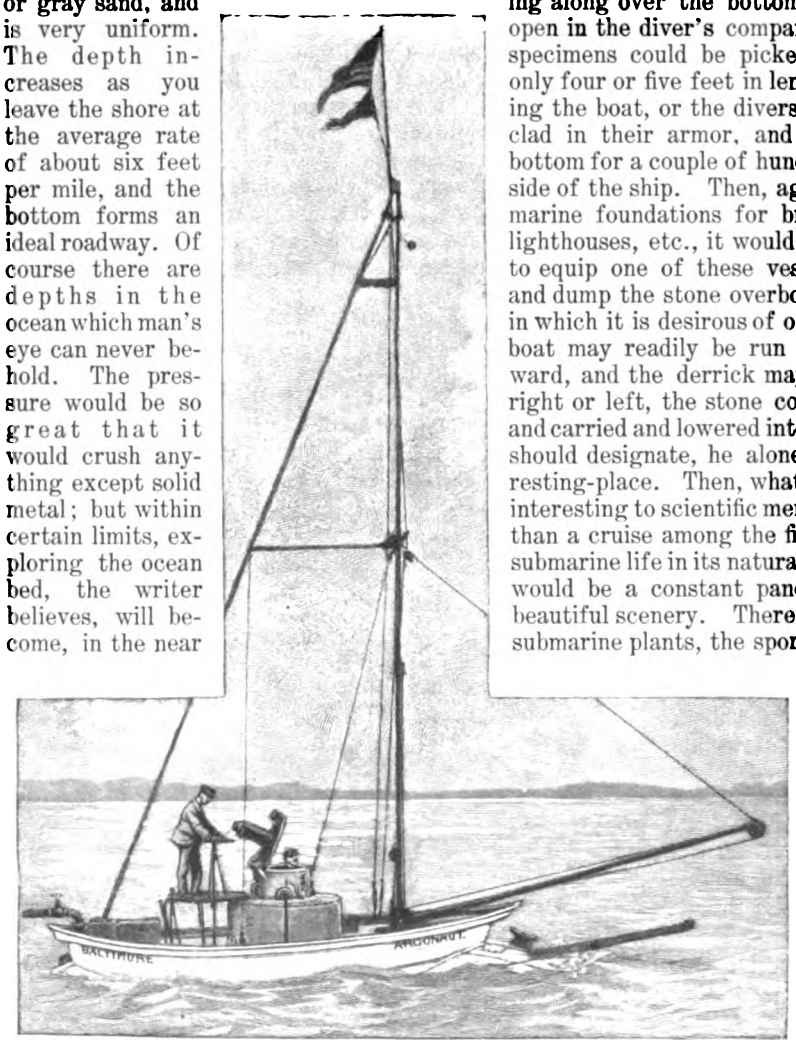
Warfare, however, is only one feature of their usefulness. While submarine torpedo boats will, in all probability, in future wars between maritime nations, destroy millions of dollars' worth of battleships, cruisers, etc., yet the submarine wrecking boat will undoubtedly recover from the bottom of the sea many times the value of the vessels lost in war. Of the cargoes, treasures, and vessels lost in the merchant service, the aggregate amounts to over one hundred millions



THE "ARGONAUT" IN DRY-DOCK,

Drawn from photographs by Mr. Lake. The door of the diver's compartment, just under the bow, is open, and resting on some of the keel blocks. Through this door the divers leave the boat when it is submerged, compressed air in the compartment preventing the entrance of water.

of dollars per year, according to the official report of Lieutenant-Commander Richardson Clover, Chief Hydrographer of the United States Navy; and as the loss has been going on for many years, the wealth lying at the bottom of the ocean transcends the fabulous riches of the Klondike. One authority said many years ago: "There is every reason to believe that the sea is even richer than the earth, owing to the millions of shipwrecks which have swallowed up so many a royal fortune." Fortunately the majority of these great losses occur in waters in which it will be practical to operate with submarine boats of the "Argonaut" type. By referring to our coast lines, it will be found that the bottom is principally composed of a hard, white or gray sand, and is very uniform. The depth increases as you leave the shore at the average rate of about six feet per mile, and the bottom forms an ideal roadway. Of course there are depths in the ocean which man's eye can never behold. The pressure would be so great that it would crush anything except solid metal; but within certain limits, exploring the ocean bed, the writer believes, will become, in the near future, almost as common as traveling on the surface.



THE "ARGONAUT" SAILING ON THE SURFACE.
From a photograph.

In addition to their great value in the wrecking business, submarine vessels will be of immense service in the coral, sponge, or pearl fisheries. These fisheries are principally carried on by native divers, who become so expert that they can remain under water for a minute or so, during which time they may get a handful of shells or a sponge. They can make but a few dives in a day, and can operate only during fair weather, and there is also great danger from sharks, which usually abound in great numbers in the waters where the pearl, sponge, or coral is found. What an immense harvest the submarine could recover here as she went wheeling along over the bottom. With the door open in the diver's compartment, the choice specimens could be picked up with a rake only four or five feet in length, without leaving the boat, or the divers could be sent out clad in their armor, and could search the bottom for a couple of hundred feet on either side of the ship. Then, again, in laying submarine foundations for breakwaters, piers, lighthouses, etc., it would only be necessary to equip one of these vessels as a derrick, and dump the stone overboard in the vicinity in which it is desirous of operating. As the boat may readily be run backward or forward, and the derrick may be swung to the right or left, the stone could be picked up, and carried and lowered into place as the diver should designate, he alone guiding it to its resting-place. Then, what would prove more interesting to scientific men or men of wealth than a cruise among the fishes and a view of submarine life in its natural element? There would be a constant panorama of new and beautiful scenery. There you would see the submarine plants, the sportive actions of the denizens of the deep, the beautiful coral, shells, and flowers with which in some localities the ocean bed is carpeted; and to this would be added the zest of probably running across a valuable treasure ship. In fact, it would be the most interesting exploration men could make.

II.—A VOYAGE ON THE BOTTOM OF THE SEA.

By Ray Stannard Baker.

SIMON LAKE planned an excursion on the bottom of the sea for October 12th. His strange amphibian craft, the "Argonaut," about which we had been hearing so many marvels, lay off the pier at Atlantic Highlands. Before we were near enough to make out her hulk, we saw a great black letter A, framed of heavy gas-pipe, rising forty feet above the water. A flag rippled from its summit. As we drew nearer, we discovered that there really wasn't any hulk to make out—only a small oblong deck shouldering deep in the water and supporting a slightly higher platform, from which rose what seemed to be a squatty funnel. A moment later we saw that the funnel was provided with a cap somewhat resembling a tall silk hat, the crown of which was represented by a brass binnacle. This cap was tilted back, and as we ran alongside, a man stuck his head up over the rim and sang out, "Ahoy there!"

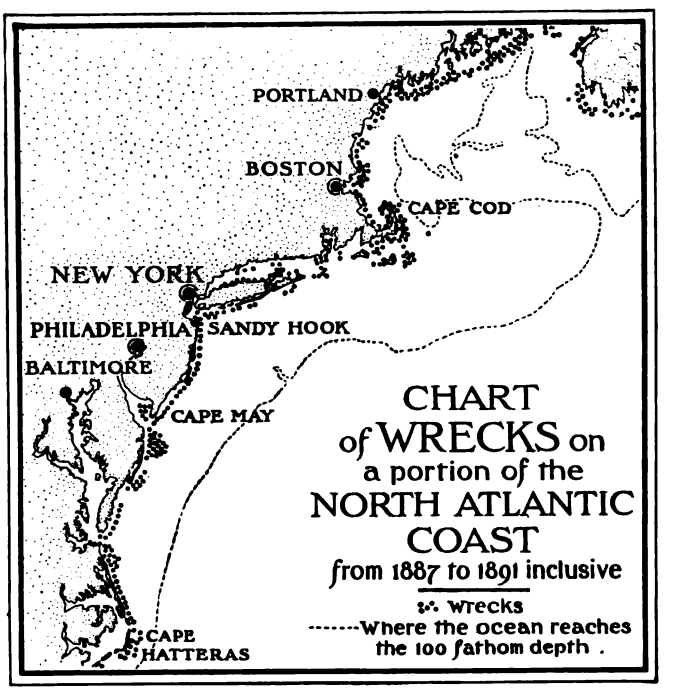
A considerable sea was running, but I observed that the "Argonaut" was planted as firmly in the water as a stone pillar, the big waves splitting over her without imparting any perceptible motion.

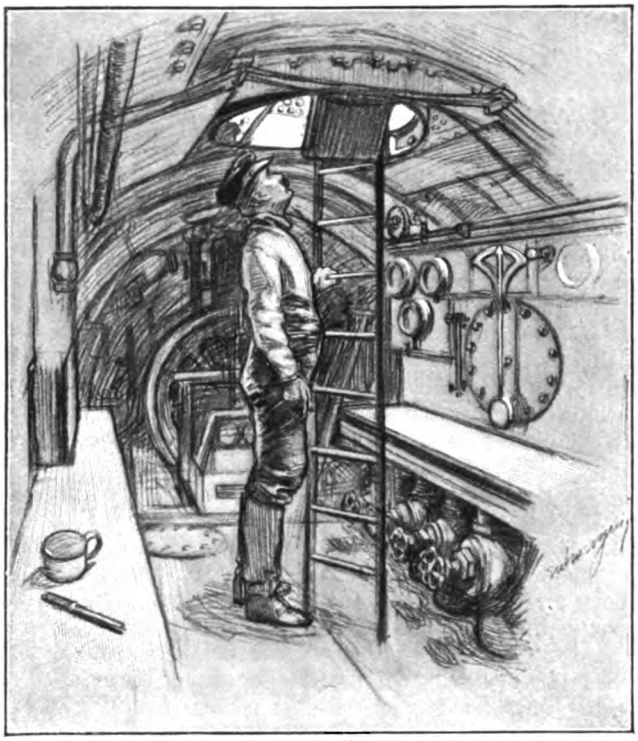
"She weighs fifty-seven tons," said Mr. Lake, "and there are only two or three tons above water. I never have seen the time when she rolled."

We scrambled up on the little platform, and peered down through the open conning-tower, which we had taken for a funnel, into the depths of the ship below. Wilson had started his gasoline engine, and I was wondering what became of the exhaust, which I heard rattling in the pipes, when I saw a white plume of steam rising from the very summit of the gas-pipe frame above us. "This leg of the A," explained Mr. Lake, "carries off the burnt gases, and this one brings in the fresh air while we are submerged. You see the pipes are tall enough, so that we can use them until we are more than fifty feet under water. Below that, we have to depend on the compressed air in our tanks, or on a hose reaching from the upper end of the pipe to a buoy on the surface." Mr. Lake had taken his place at the wheel, and we were going ahead slowly, steering straight across the bay toward Sandy Hook and deeper water. The "Argonaut" makes about five knots an hour on the surface, but when she gets deep down on the sea bottom, where she belongs, she can spin along more rapidly.

"Are you ready to go down?" asked Mr. Lake. The waves were already washing entirely over the lower platform, and occasionally breaking around our feet, but we both nodded solemnly.

"Open the center compartments," Mr. Lake shouted down the conning-tower. "I'm flooding the ballast compartments," he explained. "Usually we submerge by letting down two half-ton iron weights, and then, after admitting enough water to overcome our buoyancy, we can readily pull the boat to the bottom by winding in on the weight-





SUBMERGING THE "ARGONAUT."
The man is looking up at the compass in the binnacle.

cables. Unfortunately, we have lost one of the weights, and so we have to depend entirely on the compartments."

The "Argonaut" was slowly sinking under the water. We became momentarily more impressed with the extreme smallness of the craft to which we were trusting our lives. The little platform around the conning-tower on which we stood—in reality the top of the gasoline tank—was scarcely a half dozen feet across, and the "Argonaut" herself was only thirty-six feet long. Her sides had already faded out of sight, but not before we had seen how solidly they were built—all of steel, riveted and reinforced, so that the wonder grew how such a tremendous weight, when submerged, could ever again be raised.

"We had to give her immense strength," said Mr. Lake, "to resist the water pressure at great depths. She is built of the same thickness of steel as the government used for the 2,000-ton cruisers 'Detroit' and 'Montgomery.' She'll stand a hundred feet, although we never took her deeper than fifty. We like to keep our margins safe."

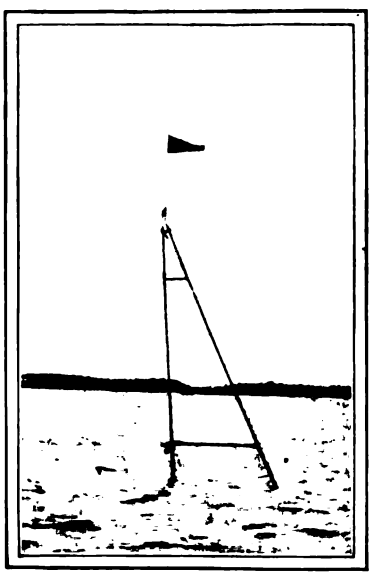
I think we made some inquiries about the safety of submarine boats in general. Other water compartments had been flooded, and we had settled so far down that the waves dashed repeatedly over the platform on which we stood—and the conning-tower was still wide open, inviting a sudden engulfing rush of water.

"You mustn't confuse the 'Argonaut' with ordinary submarine boats," said Mr. Lake. "She is quite different and much safer."

He explained that the "Argonaut" was not only a submarine boat, but much besides. She not only swims either on the surface or beneath it, but she adds to this accomplishment the extraordinary power of diving deep and rolling along the bottom of the sea on wheels. No machine ever before did that. Indeed, the "Argonaut" is more properly a "sea motocycle" than a "boat." In its invention Mr. Lake elaborated an idea which the United States Patent Office has decided to be absolutely original.

"I think we better go below," said Mr. Lake, with a trace of haste in his voice.

I went first, slipping hand over hand down the ladder. Mr. Stevens followed, and a great wave came slapping in after him, sousing down over his shoulders. Mr. Lake quickly shut down the conning-tower



AT THE BOTTOM OF THE ATLANTIC.

The "Argonaut" here lies submerged in twenty-eight feet of water, off Virginia Beach, Virginia, where the ocean bed is pure white sand. From a photograph.

cap and screwed it fast over its rubber rims.

We found ourselves in a long, narrow compartment, dimly illuminated by yellowish-green light from the little, round, glass windows. The stern was filled with Wilson's gasoline engine and the electric motor, and in front of us, toward the bow, we could see through the heavy steel doorways of the diver's compartment into the lookout room, where there was a single round eye of light.

"She's almost under," said Mr. Lake.

I climbed up the ladder of the conning-tower and looked out through one of the glass ports. My eyes were just even with the surface of the water. In the trough of the waves I could catch a glimpse of the distant sunny shores of New Jersey, and here and there, off toward Staten Island, the bright sails of oyster smacks. Then, the next wave came driving and foaming entirely over the top of the vessel, and I could see the curiously beautiful sheen of the bright summit of the water above us. It was a most impressive sight. Not many people ever have had the opportunity of looking calmly upon the surface of the sea from below. Mr. Lake told me that in very clear water it was difficult to tell just where the air left off and the water began; but in the muddy bay where we were going down the surface looked like a peculiarly clear, greenish pane of glass moving straight up and down, not forward, as the waves appear to move when looked at from above.

Now we were entirely under water. The ripping noises that the waves had made in beating against the upper structure of the boat had ceased. As I looked through the thick glass port, the water was only three inches from my eyes, and I could see thousands of dainty, semi-translucent jelly-fish floating about as lightly as thistle-down. They gathered in the eddy behind the conning-tower in great numbers, bumping up sociably against one another and darting up and down with each gentle movement of the water. And I realized that we were in the domain of the fishes.

I returned to the bottom of the boat, to find that it was brilliantly lighted by electricity, and to have my ears pain me sharply.

"You see the air is beginning to come down," said Jim, the first mate, "and we are getting a little pressure."

I held up my hand, and felt the strong gust which was being drawn down through the tall air-pipe above us. It was comfort-

THE "ARGONAUT" SUBMERGED—A SCENE IN THE LIVING-ROOM.

On the left, Mr. Lake is seated; the steersman is in the center. The feet of the lookout in the conning-tower can be seen on the ladder to the right.

ing to know that the air arrangements were in working order.

Mr. Lake now hung a small mirror at an angle of forty-five degrees just at the bottom of the conning-tower, and stepped back to the steering-wheel. Upon looking into the mirror, he could see the reflection of the compass, which is placed at the very highest tip of the brass binnacle that crowns the conning-tower.

"We can't use a compass down here," said he, "because there is too much machinery and steel." He has found by repeated experiments that the compass points as accurately under water as on the surface.

Jim brought the government chart, and Mr. Lake announced that we were heading directly for Sandy Hook and the open ocean. But we had not yet reached the bottom, and John was busily opening valves and letting in more water. I went forward to the little steel cubby-hole in the extreme prow of the boat, and looked out through the watch-port. The water had grown denser and yellower, and I could not see much beyond the dim outlines of the ship's spar reaching out forward. Jim said that he had often seen fishes come swimming up wonderingly to gaze into the port. They would remain quite motionless until he stirred his head, and then they vanished instantly. Mr. Lake has a remarkable photograph which he took of a visiting fish, and Wilson tells of nurturing a queer flat crab for days in the crevice of one of the view-holes. As I turned from the watch-port, my eye fell on an every-day-looking telephone, with the receiver hung up next the steel walls.

CUTTING A CABLE BROUGHT UP THROUGH THE DOOR OF THE DIVER'S COMPARTMENT.

From a photograph.

"Oh, yes," said Jim, "we have all the modern conveniences. That's for telephoning to the main part of the boat when the diver's compartment is closed and we can't get through."

He also showed me a complex system of call bells, by means of which the man at the lookout could direct the engineer. "When we are down in unknown waters," he said, "we have a big electric search-light which points out the way."

At that moment, I felt a faint jolt, and Mr. Lake said that we were on the bottom of the sea. "The bottom here is very muddy," he said, "and we are only resting a few hundred pounds' weight on our wheels. By taking in or pumping out water, we can press downward like a locomotive or like a feather. Where we have good hard sand to run on, we use our wheels for driving the boat; but in mud like this, where there's nothing to get hold of, we make our propeller do the work."

Here we were running as comfortably along the bottom of Sandy Hook Bay as we would ride in a Broadway car, and with quite as much safety. Wilson, who was of a musical turn, was whistling "Down Went McGinty," and Mr. Lake, with his hands on the pilot-wheel, put in an occasional word about his marvelous invention. On the wall opposite, there was a row of dials which told automatically every fact about our condition that the most nervous of men could wish to know. One of them shows the pressure of air in the main compartment of the boat, another registers vacuum, and when both are at zero, Mr. Lake knows that the pressure of the air

is normal, the same as it is on the surface, and he tries to maintain it in this condition. There are also a cyclometer, not unlike those used on bicycles, to show how far the boat travels on its wheels; a depth gauge, which keeps us accurately informed as to the depth of the boat in the water, and a declension indicator. By the long finger of the declension dial we could tell whether we were going up hill or down. Once while we were out, there was a sudden, sharp shock, the pointer leaped back, and then quivered steady again. Mr. Lake said that we had probably struck a bit of wreckage or an embankment, but the "Argonaut" was running so lightly that she had leaped up jauntily and slid over the obstruction.

Strange things has Mr. Lake discovered about the bottom of the sea. He has found that nearly all sea roads are level, a fact of great importance to sea-carriages like the "Argonaut."

"People get the impression from the sea-bottom contours," he says, "that the ocean is filled with vast mountain ranges and deep valleys. As a matter of fact, these contours, in representing thousands of miles of width on a printed page, greatly exaggerate the depth, which at its greatest is only a few thousand feet, thus giving a very false idea. Some shores slope more than others, but I venture to say that there are few spots on the bottom of the Atlantic that would not be called level if they were bare of water."

We had been keeping our eyes on the depth dial, the most fascinating and interesting of any of the number. It showed that we were going down, down, down, literally down to the sea in a ship. When we had been submerged for more than an hour, and there was thirty feet of yellowish-green ocean over our heads, Mr. Lake suddenly ordered the machinery stopped. The clacking noises of the dynamo ceased, and the electric lights blinked out, leaving us at once in almost absolute darkness and silence. Before this, we had found it hard to realize that we were on the bottom of the ocean; now it came upon us suddenly and not without a touch of awe. This absence of sound and light, this unchanging motionlessness and coolness, this absolute negation—this was the bottom of the sea. It lasted only a moment, but in that moment we realized acutely the meaning and joy of sunshine and moving winds, trees, and the world of men.

DIVER LEAVING THE "ARGONAUT" UNDER WATER.

The compartment from which the divers descend is heavily charged with compressed air to prevent the water from entering when the door is opened into the sea, the pressure being increased one atmosphere, or fifteen pounds, to the square inch for every thirty-five feet of descent below the surface.

A minute light twinkled out like a star, and then another and another, until the boat was bright again, and we knew that among the other wonders of this most astonishing of inventions there was storage electricity which would keep the boat illuminated for hours, without so much as a single turn of the dynamo. With the stopping of the engine, the air supply from above had ceased; but Mr. Lake laid his hand on the steel wall above us, where he said there was enough air compressed to last us all for two days, should anything happen. The possibility of "something happening" had been lurking in our minds ever since we started. "What if your engine should break down,

so that you couldn't pump the water out of the water compartments?" I asked.

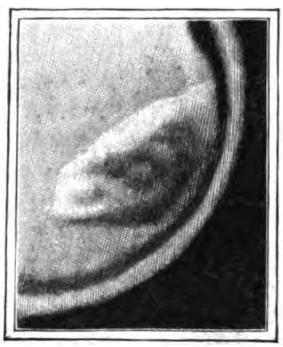
"Here we have hand-pumps," said Mr. Lake promptly; "and if those failed, a single touch of this lever would release our iron keel, which weighs 4,000 pounds, and up we would go like a rocket."

I questioned further, only to find that every imaginable contingency, and some that were not at all imaginable to the uninitiated, had been absolutely provided against by the genius of the inventor. And everything from the gasoline engine to the hand-pump was as compact and ingenious as the mechanism of a watch. Moreover, the boat was not crowded; we had plenty of room to move around and to sleep, if we wished, to say nothing of eating. As for eating, John had brought out the kerosene stove and was making coffee, while Jim cut the pumpkin pie.

"This isn't Delmonico's," said Jim, "but we're serving a lunch that Delmonico's couldn't serve—a submarine lunch."

By this time the novelty was wearing off and we sat there, at the bottom of the sea, drinking our coffee with as much unconcern as though we were in an uptown restaurant. For the first time since we started, Mr. Lake sat down, and we had an opportunity of talking with him at leisure. He is a stout-shouldered, powerfully built man, in the prime of life—a man of cool common sense, a practical man, who is also an inventor. And he talks frankly and convincingly, and yet modestly, of his accomplishment.

"When I was ten years old," he said, "I read Jules Verne's 'Twenty Thousand Leagues under the Sea,' and I have been working on submarine boats ever since." At seventeen he invented a mechanical movement, at twenty he was selling a steering-gear which he had just patented. In 1894 he began to build his first submarine boat, the "Argonaut, Jr.," and for more than four years he has been slowly perfecting, patenting, and financing his invention.



FISH LOOKING IN AT THE WINDOW OF THE "ARGONAUT."

Both pictures are from photographs taken by Mr. Lake out of the forward look out window of the "Argonaut," while she was running up the Patapsco River to Baltimore.

Having finished our lunch, Mr. Lake prepared to show us something about the practical operations of the "Argonaut." It had been a good deal of a mystery to us how workmen penned up in a submarine boat could expect to recover gold from wrecks in the water outside, or to place torpedoes, or to pick up cables.

"We simply open the door, and the diver steps out on the bottom of the sea," Mr. Lake said, quite as if he was conveying the most ordinary information.

At first it seemed incredible, but Mr. Lake showed us the heavy, riveted door in the bottom of the diver's compartment. Then he invited us inside with Wilson, who, besides being an engineer, is also an expert diver. The massive steel doors of the little room were closed and barred, and then Mr. Lake turned a cock, and the air rushed in under high pressure. At once our ears began to throb, and it seemed as if the drums would burst inward.

"Keep swallowing," said Wilson the diver.

As soon as we applied this remedy, the pain was relieved, but the general sensation of increased air pressure, while exhilarating, was still most uncomfortable. The finger on the pressure dial kept creeping up and up, until it showed that the air pressure inside of the compartment was nearly equal to the water pressure without. Then Wilson opened a cock in the door. Instantly the water gushed in, and for a single instant we expected to be drowned there like rats in a trap.

"This is really very simple," Mr. Lake was saying calmly. "When the pressure within is the same as that without, no water can enter."

With that, Wilson dropped the iron door, and there was the water and the muddy bottom of the sea within touch of a man's hand. It was all easy enough to understand, and

yet it seemed impossible, even as we saw it with our own eyes.

Mr. Lake stooped down, and picked up a wooden rod having a sharp hook at the end. This he pulled along the bottom. "You see how easily we can pick up a cable and cut it," he said. "Why, we could crawl along from here and cut all the submarine cables and mine wires connecting with New York in half a day, and no one ever would be the wiser. More than that, if the 'Argonaut' had been at Santiago, we could have cleared the harbor of Spanish mines within forty-eight hours. Then we could have crept under the Spanish fleet, where our divers would have stepped out and deliberately set mines or even fastened torpedoes to the bottoms of the ships. When the work was done, we could have backed away, until we were well out of reach of the effects of an explosion. And then, a connection of the wires, and Sampson would have been saved the trouble of smashing Cervera!"

Indeed, it seemed the simplest thing in the world. But the "Argonaut's" most serious work is in wrecking. Mr. Lake explained how difficult it is for divers to go down to wrecks from the surface, owing to the great weight of air-tubing and life-line which they are compelled to drag and the unsteadiness of the attendants' boat. In great depths the diver cannot stay submerged more than an hour at most, and three-quarters of the time is frequently spent in getting up and down.

"You see we are at the bottom all the time," said Mr. Lake; "we just push our nose up into the wreck, the diver steps out with a short air-tube, and works right in the path of our search-light. He can come back in a minute for tools, or to rest, and go out again without delay, no matter how high the waves are running on the surface."

As we came up, Mr. Lake told us of his plan to build at once a 100-foot boat for practical work, the "Argonaut" being regarded more as an experiment.

We were now rising again to the surface, after being submerged for more than three hours. I climbed into the conning-tower and watched for the first glimpse of the sunlight. There was a sudden fluff of foam, the ragged edge of a wave, and then I saw, not more than a hundred feet away, a smack bound toward New York under full sail. Her rigging was full of men, gazing curiously in our direction, no doubt wondering what strange monster of the sea was coming forth for a breath of air.

RESTING UNDER THE SEA.

From a flash-light photograph of the "Argonaut's" crew "turned in" in the living-room. The door in front opens into the air-lock, diver's room, and forward lookout compartment (see the longitudinal section). On the right is the telephone by which communication is had with the forward compartments when the diver's room is in use.