

For the suspension in this instrument I used a hair. It was quite fine, micrometered about 0.002 inch in diameter, and was probably from the head of a dark-haired lady. From the needles to the point of suspension there were about 8 inches of effective hair. Just how much better the instrument would be with a raw silk fiber I have no means of knowing at present, but it was as delicate as will be required for any ordinary work.

As to the "figure of merit," I have not had opportunity to determine that point, but will do so, and report later. The "efficiency" of the low-resistance instrument is rather greater than that of the high-resistance form, while the "figure of merit" is greater the more turns of wire are placed on. For measuring very low resistances, the low-resistance coils will give perhaps the best results.

SUCCESSFUL TRIALS OF THE HOLLAND SUBMARINE BOAT.

Extraordinary interest attaches to the trials of the Holland submarine torpedo boat which are now being carried out in New York Harbor, and it gives us much pleasure to state that the results thus far achieved have been very satisfactory. By the courtesy of Mr. John P. Holland, the inventor, our photographer accompanied the boat on her trial runs and secured the photographs which are herewith reproduced. In one of these the little boat is shown at her moorings beside the pier; another was taken when she was running at the surface, with only her conning tower above the water; a third view, perhaps the most striking of all, was taken when the boat was diving, and another view shows the stern torpedo gun and the tail-piece for protecting the rudders. These external views are supplemented by a longitudinal section which shows the construction and leading details of the interior.

The Holland submarine boat embodies the results of some twenty years of experimental work on the part of the designer, who firmly believes that this type is destined to become the most deadly weapon of future naval warfare. This is the first submarine boat of its type ever built and tested. Another and larger boat of the kind is now under construction for the government at Baltimore, and is practically completed; but the progress upon it was so slow that Mr. Holland determined to build at once a smaller vessel for use in harbor defense. The government vessel was described and illustrated in the SCIENTIFIC AMERICAN of April 25, 1896. She is a cigar shaped boat 85 feet long, 11½ feet in diameter and capable of 16 knots speed on the surface and 10 knots when submerged. Her displacement is 168 tons.

The "Holland" (as she is called) is much smaller, being only 55 feet long, 10¼ feet in diameter and of 75 tons displacement. The steel hull is cigar-shaped and approximates somewhat to the model of the Whitehead fish torpedo, being blunter at the head than the tail. Two sources of motive power are furnished, a gas engine being used at the surface and a motor run by storage batteries when the boat is submerged. The storage batteries, which are of great weight, are located amidships, down below the axis of the boat, and as their center of gravity comes well below the center of buoyancy of the hull, the boat is kept at all times on an even keel. Above the storage batteries on each side

of the ship are located the compressed air tanks from which fresh air is supplied to the crew when the boat is submerged. The motive power is furnished by a gas engine and an electric motor, both of which operate a common shaft, the gas engine being located just ahead of the motor. The gas engine is used mainly when the boat is running at the surface and the

stowed in a suitable chamber. They are automobile, or self-propelling, carrying their own compressed air engines and a storage tank of compressed air. They are shot out of the bow by a small charge of gunpowder, and as they pass from the discharge tube, a catch releases the little engines and starts the propellers. The torpedo then travels with the speed of the fastest torpedo boat for a distance of from 600 to 1,000 yards. Automatic steering mechanism keeps the flying vessel at the proper depth and on a wonderfully true course.

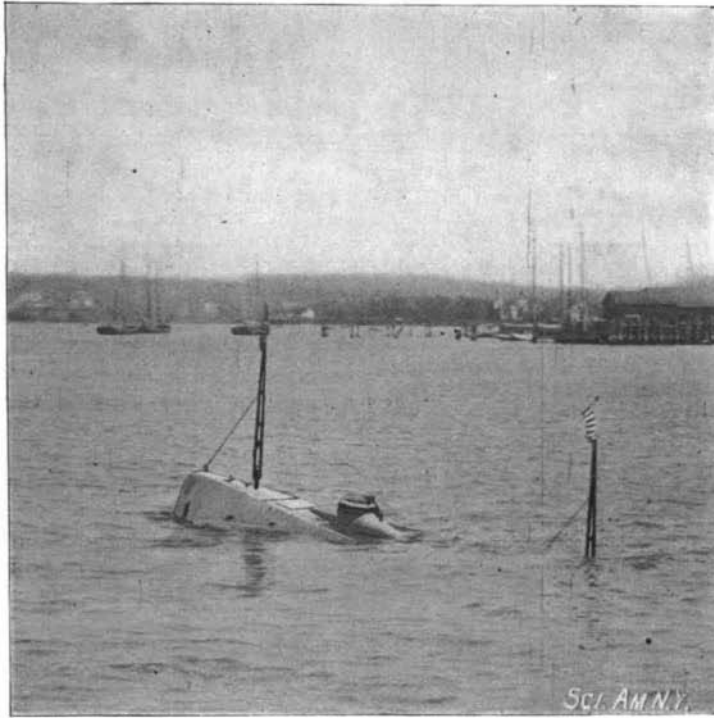
In addition to the Whitehead torpedoes the "Holland" carries two other discharge tubes for firing guncotton projectiles. Unlike the one just described, which lies in the longitudinal axis of the boat, these are upwardly inclined, one pointing forward and the other aft. The mouths of the tubes terminate at the ends of a kind of superstructure deck which is built up above the cylindrical portion of the boat and carries at the center of its length an armor-plated conning tower. The mouth of each of these tubes is closed by a sliding cover which is operated by means of a worm and pinion controlled by shafts leading into the interior of the vessel. The forward tube is called an aerial torpedo gun. It is capable of throwing a 100-pound guncotton shell a distance of three-quarters of a mile. The other tube, astern, is called an underwater torpedo gun, and it is capable of driving its shell with accuracy for a distance of 200 yards under water.

When the boat is at the surface of the water, she can be steered by observation through the port holes of the conning tower. When she sinks below the surface, a small tube, carrying at its top an inclined mirror or prism, in the manner of the camera lucida, will throw a picture of the surrounding waters upon a board in the conning tower. The vessel also carries a compass and an automatic gage showing the depth below the surface.

In making an attack upon a ship the "Holland" would advance, with her small and scarcely discernible conning tower above water, until she was within range for the use of her aerial torpedo gun. A shell containing 100 pounds of guncotton would be discharged, and she would at once sink below the surface, to avoid retaliation. At the moment of discharge an ingenious system of compensating weights will automatically admit to the tanks a sufficient amount of water to preserve the trim of the vessel. This is an entirely new device, and the "Holland" is the first submarine boat which has succeeded in overcoming the difficulty. When the boat had run up a little nearer to the hostile ship, she would discharge one, and if the first missed, two of her torpedoes. In the unlikely event of missing with the bow torpedoes, she would fire her rear torpedo gun at the enemy as it swept by overhead.

Our illustrations were taken during a series of tests which were carried out on March 27, for the benefit of Lieut. Sargeant of the Naval Auxiliary Board. The work was done in 30 feet of water and gave full satisfaction both to Mr. Holland and the government expert. The first trials consisted of a series of surface runs at a speed of 10 knots, in which the boat showed great maneuvering power, changing her course through 90° with astonishing rapidity.

The diving test was made at the same speed, and upon the diving rudders being thrown into position, the boat buried her

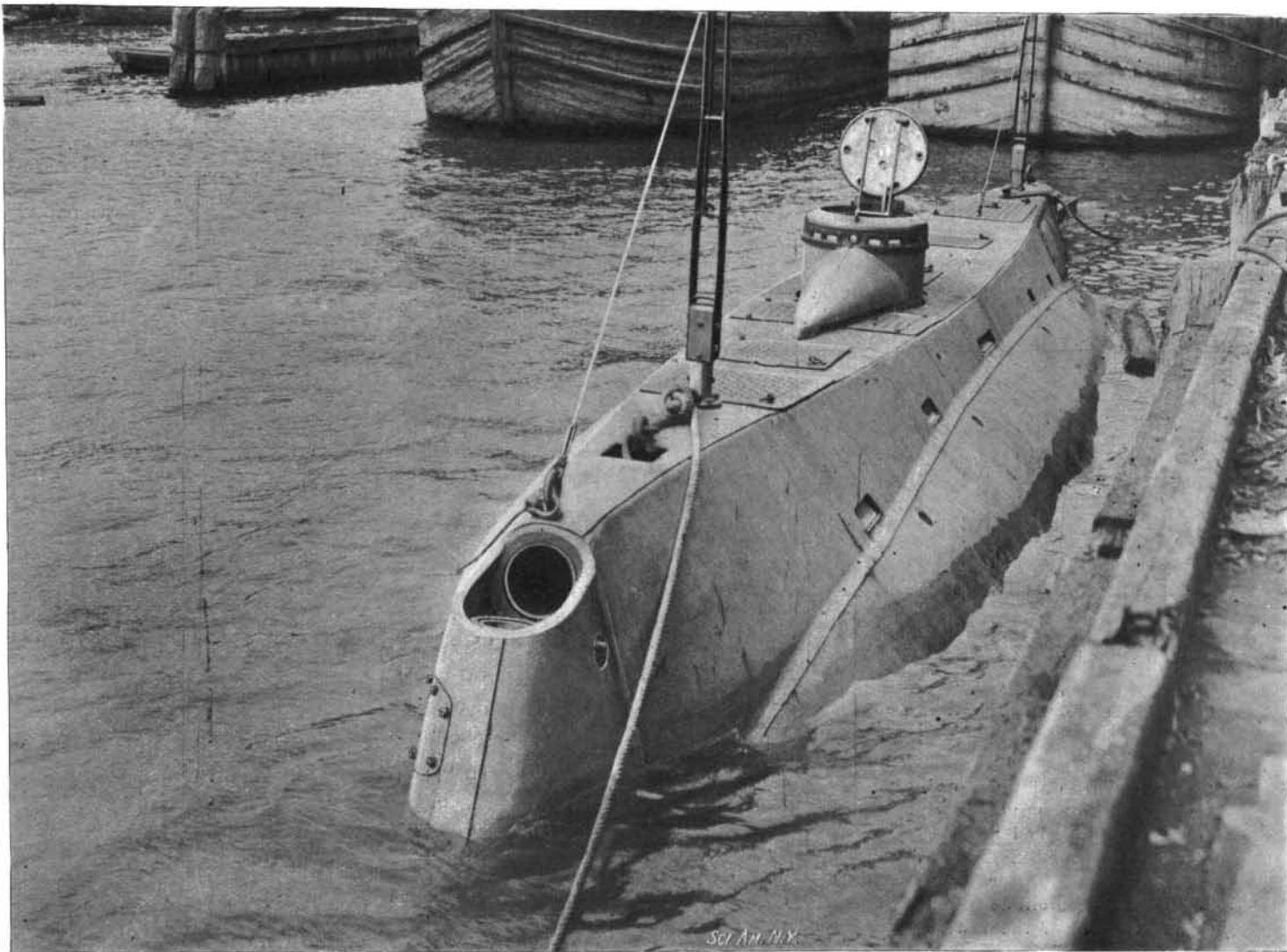


DIVING.

motor when it is entirely submerged. This arrangement, it will be seen, enables the motor to be utilized as a generator for charging the batteries.

The cellular bottom of the little vessel is utilized for the storage of the liquid fuel, and here are located the water ballast tanks which assist in trimming and in the operation of diving or rising to the surface. With the tanks filled and all the crew aboard there is a reserve buoyancy of 250 pounds, and the boat is caused to sink by altering the pitch of the horizontal diving rudders, the forward motion of the vessel, combined with the downward pitch of the rudders, combining to force her below the surface. She is maintained at the required depth by means of delicate automatic mechanism, similar to that used in the automobile torpedo.

The offensive powers of the Holland are, considering the size and her methods of attack, far greater than those of any other engine of war, whether ashore or afloat. In the first place, she carries in her bow or nose an under-water discharge-tube for launching the deadly Whitehead torpedo. Of these she carries several



BOW VIEW OF THE "HOLLAND," SHOWING MOUTH OF AERIAL TORPEDO GUN, THE SUPERSTRUCTURE DECK AND THE CONNING TOWER.

nose and went down at an angle of 15° with the surface. At a depth of 7 feet, as indicated by her flagpoles, she came to an even keel and ran forward steadily for several hundred yards. An ascent was then made, the boat coming up nose first at the same angle as she descended. The cover of the conning tower was then thrown open and Mr. Holland announced that he would dive completely out of sight. One of our illustrations was taken just at this moment and shows the inventor in the act of closing the cover. This time she dived completely out of sight, the flagpoles disappearing altogether. No trace of the vessel was visible until she made her appearance suddenly at a point several hundred yards distant from the point at which the descent was made.

Later a test was made of the bow aerial torpedo gun, and with a reduced air pressure of 600 pounds (as against the full pressure of 2,000 pounds to the square mile) a dummy torpedo was thrown a distance of 500 yards. Further reference to this formidable craft is made in our editorial columns.

The Book Crop of 1897.

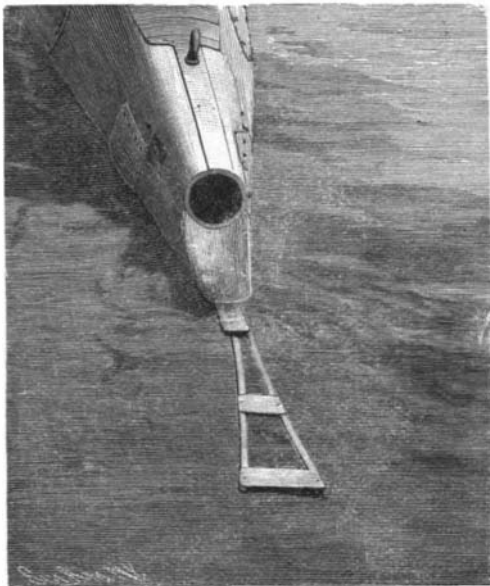
An early number of *The Publishers' Weekly* gives each year a résumé of the book trade of the preceding year, which, though intended primarily for publishers, yet contains matter of interest to readers in general.

In 1897 the number of books issued by the publishers of the United States was 4,928, a less number than had been issued in any previous year since 1893. In that year 4,484 books were published. "The promise of a still increasing volume of publication with which 1896 so hopefully closed," says *The Publishers' Weekly*, "was not fulfilled in 1897." That it was not, the editor ascribes to the delay over the tariff when the Dingley bill was passed. The general tension being relieved, there was a perfect flood of books during the last six months of the year.

The number of books of permanent value is reported as unusually large; "indeed, few other years in the history of the book trade have so many good works to their credit." It is pleasant to learn that this increase in the number of really good books was accompanied by continued prosperity for the booksellers.

In 1896 the publications amounted to 5,703 volumes; in 1897, to 4,928 only. The shortage was due largely to a decrease in the number of English novels republished here. In 1896 these amounted to 690; in 1897, to barely half, 352 all told. The importations of all classes of books were proportionately the same as hitherto; but the number of American books manufactured was much larger in proportion to the total output, being 3,300 out of 5,703 in 1896, and 3,318 out of 4,928 in 1897—not only a larger actual number, but an increase from 58 to 67 per cent of the total number of books published.

The Publishers' Weekly divides the publications of the year into nineteen principal departments. In each of these, except theology and religion, juvenile, phy-

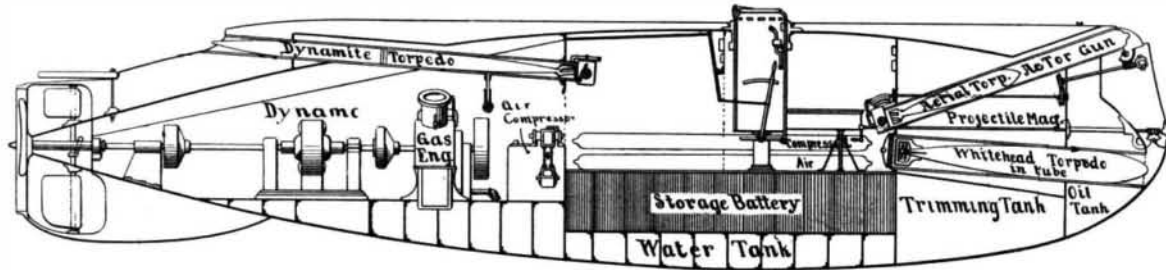


STERN VIEW OF THE 'HOLLAND' SHOWING STERN TORPEDO GUN AND TAIL PIECE FOR PROTECTING RUDDERS.

sical and mathematical science, and mental and moral philosophy, there was a falling off in the number of books published from the number published in 1896. "The figures in fiction are most noteworthy. Novels from all sources printed or imported in 1897 were only 869 to 1,114 in 1897. To these, however, might be added the 369 juvenile works, as the majority of them were wholly unsuitable for children's reading."

The principal changes in the other departments may be set forth briefly. On theological and religious sub-

jects 460 books appeared in 1896 and 492 in 1897; 553 law books were published in 1896, as against 509 in 1897; 682 books on literary history, as against 415; 293 books of poetry in 1896 and 247 in 1897; 209 books of memoirs and biography, as against 205; 177 on fine arts, as against 138, and 284 on political science, as against 196. Of the 4,928 different publications, 3,318, as has been said, were produced by American authors and manufactured here; 495, produced by foreigners, were manufactured here; and 1,115 were English works, imported here in sheets or bound. More than one-



LONGITUDINAL SECTION THROUGH HOLLAND SUBMARINE BOAT.

quarter of the English importations were of novels. In Great Britain the number of publications of 1897 exceeded that of 1896 by 1,353. Of these, 6,244 were new books and 1,682 new editions. In the departments of law, art and science, voyages, travels and research, and "miscellany, including pamphlets but not sermons," there were losses; in every other department, there was a decided gain in 1897 over the output of 1896. In fiction, 38 new novels were published every week, or more than six a day.

France as well as Great Britain records an increase in book production, the number of "books, musical compositions, engravings," being 13,799 in 1897, compared with 12,738 in 1896. Of these 13,799, however, 6,085 were musical compositions, and 1,671 were engravings; the number of books was thus 6,043. Although no details are obtainable, it probably will not wrong the French publishers and book producers to assume that fiction composed a large proportion of these 6,000 books.

REPORT OF THE NAVAL COURT ON THE DESTRUCTION OF THE "MAINE."

We have before us the printed "Report of the Naval Court of Inquiry upon the Destruction of the United States Battleship 'Maine' in Havana Harbor." It is a volume of some 300 pages, and includes the whole of the testimony given before the court. At the end of the report there are some two dozen photographs and drawings illustrative and descriptive of the wreck.

One does not have to read far in this most extraordinary report before the last charitable hope which one may have had, that the wreck was not a crime but an accident, is shut out, and one is forced to the conclusion that a submarine mine of enormous power was exploded beneath the ill-fated ship.

We have selected from the findings of the report and from the drawings such matter as will place our readers in possession of the full facts of the case. It tells its horrible story with too much distinctness to require much comment by way of explanation.

In the half section and plan of the "Maine" (Fig. 1) the normal and proper position of the keel and bow of the ship as she rode at anchor are shown in fine, unbroken lines. The thick lines show the shape into which these parts were distorted by the explosion. The bow it will be seen was twisted around through an angle of 90 degrees and now lies at right angles to the axis of the ship. The ship is blown completely in two a little forward of amidships, and forward of that, at frame 18, the keel has been blown up into an acute inverted V until it is near the surface of the water, or 30 feet above its normal position. These effects are shown in the drawing (Fig. 4) prepared by Ensign Powelson from the reports of the divers and from his own personal investigation. A more detailed view of this point, marked 1 A in Fig. 1, is shown in Fig. 2.

We give below the full findings of the court:

1. That the United States battleship "Maine" arrived in the harbor of Havana, Cuba, on January 25, 1898, and was taken to buoy 4, in from five and a half to six fathoms of water, by the regular government pilot. The United States consul general at Havana had notified the authorities at that place the previous evening of the intended arrival of the "Maine."

2. The state of discipline on board the "Maine" was excellent, and all orders and regulations in regard to the care and safety of the ship were strictly carried out. All ammunition was stowed in accordance with prescribed instructions, and proper care was taken whenever ammunition was handled. Nothing was stowed in any one of the magazines or shell rooms which was not permitted to be stowed there.

The magazines and shell rooms were always locked after having been opened; and after the destruction of the "Maine" the keys were found in their proper place in the captain's cabin, everything having been reported secure that evening at 8 o'clock. The tem-

peratures of the magazines and shell rooms were taken daily and reported. The only magazine which had an undue amount of heat was the after ten-inch magazine, and that did not explode at the time the "Maine" was destroyed.

The torpedo war heads were all stowed in the after part of the ship under the ward room, and neither caused nor participated in the destruction of the "Maine." The dry guncotton primers and detonators were stowed in the cabin aft and remote from the scene of the explosion. Waste was constantly looked after on board the "Maine" to avoid danger. Special orders in regard to this had been given by the commanding officer. Varnishes, driers, alcohol and other combustibles of this nature were stowed on or above the main deck, and could not have had anything to do with the destruction of the "Maine." The medical stores were stowed aft under the ward room and remote from the scene of the explosion. No dangerous stores of any kind were stowed below in any of the other storerooms.

The coal bunkers were inspected daily. Of these bunkers adjacent to the forward magazines and shell rooms four were empty, namely, B 3, B 4, B 5, B 6. A 15 had been in use that day and A 16 was full of New River coal. This coal had been carefully inspected before receipt on board. The bunker in which it was stowed was accessible on three sides at all times and the fourth side at this time, on account of bunkers B 4 and B 6 being empty. This bunker, A 16, had been inspected that day by the engineer officer on duty. The fire alarms in the bunkers were in working order, and there had never been a case of spontaneous combustion of coal on board the "Maine."

The two after boilers of the ship were in use at the time of the disaster, but for auxiliary purposes only, with a comparatively low pressure of steam, and being tended by a reliable watch. These boilers could not have caused the explosion of the ship. The four forward boilers have since been found by the divers and are in a fair condition. On the night of the destruction of the "Maine" everything had been reported secure for the night at 8 o'clock by reliable persons through the proper authorities to the commanding officer. At the time the "Maine" was destroyed the ship was quiet, and therefore least liable to accident caused by movements of these on board.

3. The destruction of the "Maine" occurred at 9:40 P. M., February 15, 1898, in the harbor of Havana, Cuba, she being at the time moored to the same buoy to which she had been taken upon her arrival. There were two explosions, of a distinctly different character, with a very short but distinct interval between them, and the forward part of the ship was lifted to a marked degree at the time of the first explosion. The first explosion was more in the nature of a report like that of a gun, while the second explosion was more open, pro-



CONNING TOWER OF HOLLAND BOAT.

longed and of greater volume. The second explosion was, in the opinion of the court, caused by the partial explosion of two or more of the forward magazines of the "Maine."

4. The evidence bearing upon this, being principally obtained from divers, did not enable the court to form a definite conclusion as to the condition of the wreck, although it was established that the after part of the ship was practically intact, and sank in that condition a very few minutes after the destruction of the forward part. The following facts in regard to the