NEW TYPE OF SUB-SURFACE TORPEDO BOAT.

When the torpedo boat first made its appearance, it was hailed as likely to produce a complete revolution in the principles of naval warfare. It was so swift, elusive, and deadly that it was supposed to hold the unwieldy warship at its mercy. Appearing as it did in the days of slow-firing guns, when shooting was very inaccurate, it was believed that the torpedo boat would be able, even in the daytime, to make a swift dash through the zone of gun-fire, and deliver the under-water blow before it was put out of action. But the torpedo boat found its answer in the rapid-fire gun and the searchlight. Its old-time terror has vanished, and we now know that its only chance to get in the fatal stroke will be at the close of a hard-fought engagement, when the rapid-fire guns have been dismantled, the personnel crippled, and the big ship is comparatively helpless against attack.

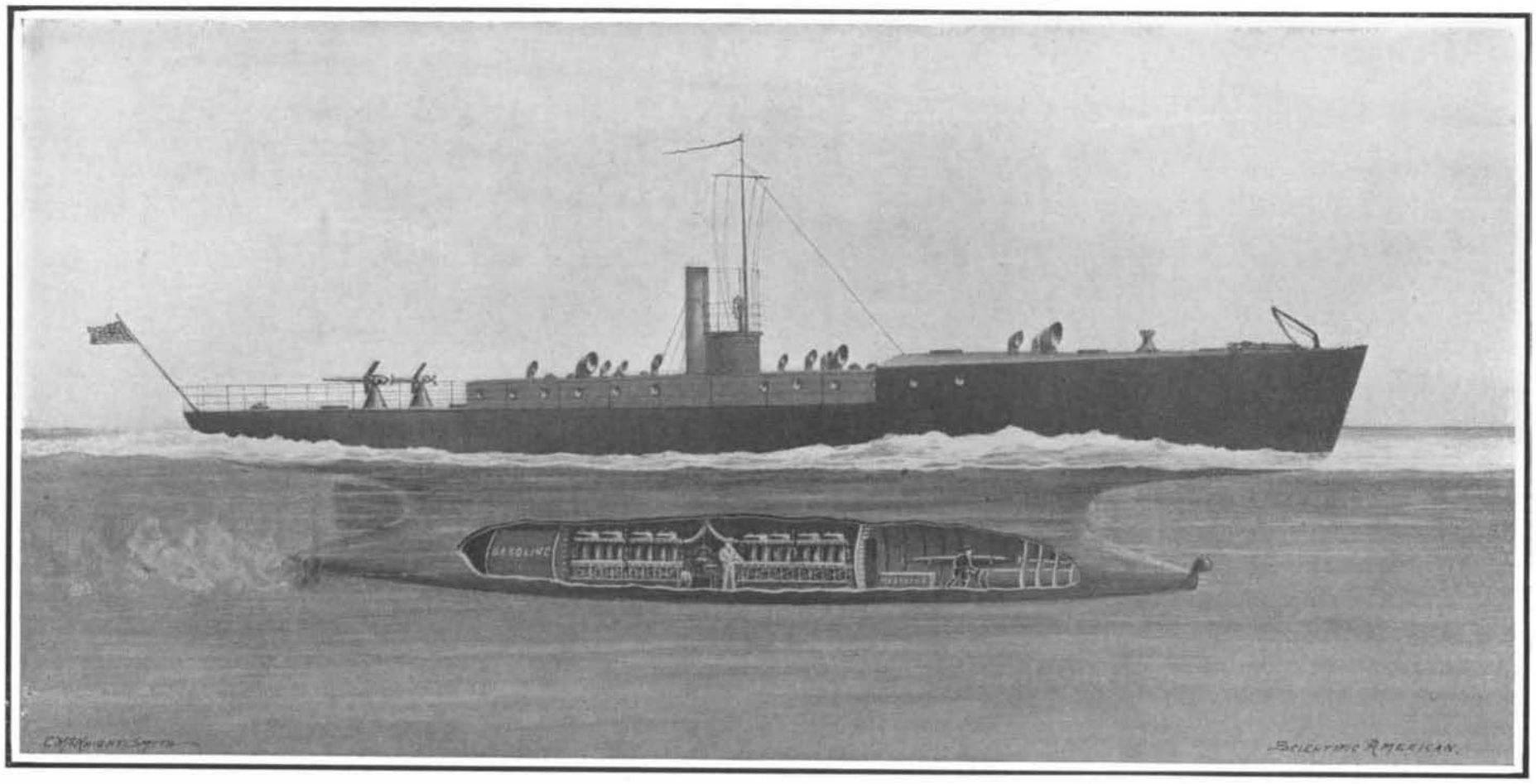
The curious vessel which forms the subject of the accompanying illustration represents an attempt to produce a torpedo boat which can attack in broad daylight and make a dash at the enemy, even after its own presence has been discovered. The vulnerability of the present type of destroyer lies in the fact that it is absolutely without armor protection, and, therefore, can be perforated by the smallest projectiles of the machine and rapid-fire guns of the enemy. A single one-pounder shell, passing through the light plating of the hull, might put a torpedo-boat destroyer out of commission, either by breaking some essential part of the engine or steering gear, or even by severing a tube in the boilers. When we remember that each of a warship's thirty or forty rapid-fire guns, ranging from the 1-pounder to the 6-inch 100-pounder, will be raining shot upon the oncoming torpedo boat at the rate of from ten to twenty a minute, it can be understood that attack by daylight or under the searchlight would be doomed to complete failure.

Hence, the *raison d'etre* of the submarine, in which invisibility is obtained by complete submergence of the boat beneath the surface of the water. That the submarine can torpedo a battleship with considerable accuracy, provided the ship is at anchor or is moving slowly, has been proved in various experimental trials; but the usefulness of the submarine is limited by its want of speed. In these days of battleships of 21 knots speed and armored cruisers of 25 knots speed, a submarine capable of steaming only 9 or 10 knots is of very doubtful value, except under certain conditions of harbor defense. For attack in the open, for use in engagements on the high seas, it is absolutely necessary that the attacking submarine possess speed equal to and superior to that of the warship.

The vessel which we illustrate is designed to combine the under-water protection of the submarine with the speed of the surface torpedo boat. It consists of a surface hull of the general form of a torpedo boat or high-speed motor boat, below which is suspended and rigidly attached (forming, indeed, part of the hull structure) a submerged torpedo-like body containing the torpedoes, the motive power (in this case internal-combustion engines), and the supply of gasoline. The above-water portion of the boat is built on the cellular plan, being subdivided by a number of longitudinal and transverse bulkheads. The whole hull, as thus divided up, is packed with cellulose, which has the quality of swelling up in contact with water and so sealing any perforation which may be made by shells. In making an attack, the boat would be headed direct for the ship and run at full speed. The exposed hull, of course, would be frequently struck and considerably torn up by the enemy's shell fire; but the vitals of the ship, lying deep below the surface of the water, would be comparatively safe from injury. It is expected that the craft would be able to hang together and take what was coming to it, until it got near enough to the ship to fire its torpedo.

Congress has so far taken cognizance of the design, that it has appropriated $22,500 for the purchase of a vessel of this type, if it should prove to be satisfactory on trial. The 25-knot vessel which we illustrate is the invention of Mr. Clarence L. Berger, of the Subsurface Torpedo Boat Company. She is a much larger and more powerful vessel than the one contemplated in the government appropriation, to meet which the same company is now having designed and built by Tams, Lemoine & Crane, of this city, a small 45-foot boat, of the same general character. The surface hull of the new boat will be modeled approximately on the lines of the racing motor boats designed by this firm of architects, of which the most famous is "Dixie II," which last year won the Harmsworth cup, and established itself as the fastest boat of its class in the world. Below water the plating of the boat will be carried down to form a sub-surface hull, which will be approximately pear-shaped in cross section; but, otherwise, will be similar in form to the Whitehead torpedo. At the head of this submerged section will be carried the enormously powerful charge of 1,000 pounds of gun-cotton, which is about six or seven times as much as is carried in an ordinary torpedo. Within the hull, back of the warhead, will be the internal combustion engines, tanks, propeller shaft, etc., and suitable connections from the motive power to the hull above. In the surface hull will be a small conning tower, built of ½-inch steel, within which the captain of the boat will have his station. The contract speed is 15 knots an hour; but it is not unlikely that 19 or 20 will be secured on trial. The boat will be its own torpedo; that is to say, no independent torpedo will be fired, but she will herself be run right up to contact with the ship to be attacked. The theory of handling upon which she is designed, is that the operator will remain in the conning tower, steering by hand until he is near enough to the enemy to make sure of a hit, when he will lash the wheel, dive overboard, and leave the torpedo, for such it will be, to cover the last short dash by itself.

Of course, the one or two men who man such a craft will take their lives in their hands; but the history of naval warfare shows that when deeds of daring that promise great results are to be achieved men of desperate courage are always available.



The motive power and torpedoes are contained in the submerged, pear-shaped hull. The surface hull, which is filled with cellulose, may be hit by shells without endangering the stability or stopping the boat.

A smaller, 45-foot boat, of this type is now being built for trial by the government.

TWENTY-FIVE-KNOT SUB-SURFACE TORPEDO BOAT.

New Test to Detect Traces of Moisture.

A new and delicate test for traces of moisture is based on the fact that the nearly colorless lead-potassium iodide is partially decomposed by water, yellow lead iodide being set free. Lead-potassium iodide is precipitated when 4 parts lead nitrate dissolved in 15 parts water are mixed with 15 parts potassium iodide dissolved in 15 parts water. The dried precipitate is dissolved in 15 or 20 parts of acetone, again precipitated by adding water, washed with ether and dried *in vacuo*. The compound iodide, thus prepared, is nearly white, but becomes pale yellow on keeping.

In tests for moisture a 20 per cent solution of the salt in acetone is dropped on filter paper. The paper turns deep yellow rapidly on exposure to moist air, and instantly when breathed upon. Moistening with acetone reproduces the original solution and destroys the color, so that the paper can be used repeatedly. In experiments with air dried by sulphuric acid of various strengths the moisture in air drawn from the outer atmosphere at 64½ deg. F. and passed through 78 per cent sulphuric acid was clearly detected, although it corresponded to a vapor tension of only 0.3 millimeter or little more than 1/100 inch. To detect water in liquids, the test paper is dried in a stream of dry air and the liquid is poured over it. The yellow coloration is produced instantly by commercial ether and "absolute" alcohol, dehydrated by the usual methods. Traces of water can be removed from alcohol by agitating it with solid lead-potassium iodide.

Artificial Camphor.

An English patent granted by J. N. Goldsmith in 1906 covers the following process of making artificial camphor: 250 parts of bornyl-ethyl-ether or isobornyl-methyl-ether, 7/10 part nitric acid of specific gravity 1.42, and 500 parts of water are heated under an inverted condenser, so that a uniform evolution of red vapors occurs. The reaction is completed in about three hours. A portion of the oily mass which floats on the liquid is then removed and shaken with water or lye. The oil is thus oxidized into solid camphor. The oxidation can be accelerated by adding sulphuric acid, and the action of the nitric acid, in the first part of the process, can be intensified by adding reducing substances, such as starch, molasses, or copper filings. The crude camphor is removed from the acid liquid and washed. It contains a by-product which gives it a yellowish color. When it is distilled with steam the greater part of the camphor passes over, leaving the impurities in the form of a brown oil. The distilled camphor is dissolved, and bleached with solution of caustic potash.