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THE SCIENTIFIC AMERICAN SUPPLEMENT,

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TORPEDO SWIMMERS—OLD AND NEW.

For some days past the British war steamer Garnet has been lying at anchor in the harbor of New York, her officers and crew the recipients of the usual hospitalities accorded to visitors from friendly nations. In view of the various dynamite outrages that of late have been perpetrated, especially in London, it was rumored the Garnet was especially guarded with a view to prevent any secret attempt at injury to her hull. This rumor led Captain Paul Boyton, the famous swimmer, to undertake a practical test of one of his theories. It has long been maintained by him that by his swimming suit he can approach any vessel, however well guarded, and can fasten a torpedo to her bottom, and get away to a safe distance from which to view her destruction. He believes it hardly possible to detect him, and possible only after the work has been done. Torpedo warfare, conducted by the regular torpedo boat, is confessedly hazardous and costly. Several lives are exposed and several thousand dollars risked at each attempt. But Boyton's method of swimming out to a vessel, sinking underneath her, rising at the end that cuts the tide, and fastening his deadly and timed machine to her anchor chain, exposes only one life, risks only a few dollars of value, and accomplishes, with fifty times the certainty of any other scheme, a destruction sure, terrible, and complete. On the night of May 5 last the gallant Captain, who, by the way, is an Englishman, undertook to show to some of his friends the correctness of his assertions. According to the *Tribune*, he provided himself with the shell of a torpedo of the usual pattern, about two feet long, with clockwork at one end so arranged as to set it off five minutes after the machinery was started. It was loaded with little cracked stones instead of explosive material. It contained air chambers of sufficient size to float it easily, and was supplied with about ten yards of rope with which to tow it and to tie it up against the ship. The rope was slipped around the swimmer's foot, and he started off from the Staten Island shore toward the Garnet, half a mile or so distant.

As the swimmer approached the war vessel, he expelled the air from his suit and sank deep into the water, drifting with the tide under the ship, and reappearing near her anchor chains at the starboard bow. He reconnoitered gingerly about this perilous spot. If he was detected, the probability that they would shoot first and inquire afterward was fully impressed on his mind. He had no disposition to submit himself to this risk. He could hear the men in the bows whispering faintly, and the heavy plod, plod, of the watches on the decks. Finally he touched the anchor chain. He came nearer and nearer, and grasped it with his hand. Drawing his foot up, he undid the knot which had held the torpedo in tow, and carefully threw the rope over the anchor chain. He drew its end toward him, and tied it securely in three knots. Then he swam down to the torpedo, and placed it against the vessel on the starboard side just amidships. He shoved himself off. In five minutes more, had the torpedo been charged, the Garnet would have been blown up.

This recent midnight prank of Boyton's recalls the attempt of Sergt. Lee, of the American army, to blow up Lord Howe's flagship Eagle in the same waters in 1776. It is curious to note how closely that earliest attempt to use a submerged torpedo in actual warfare was imitated by Boyton, save that he was clad in rubber instead of oak, and loaded his torpedo with broken stone and an advertising card instead of gunpowder and means for exploding it. Both adventurers meant business, but not precisely in the same sense.

Sergt. Lee operated a torpedo boat invented by David Bushnell, afterward captain in the patriotic army. It had been tried with some success experimentally, and gave promise of being useful in serious warfare. The first opportunity for such use was offered when the British fleet of 37 men of war and 400 transports took possession of New York harbor. The fleet lay in the lower bay, just inside Sandy Hook.

From the description given of the Bushnell boat, it would seem to be more like a barrel than a boat. It was of oak, iron-banded, and only large enough for one person. When floating upright, the navigator's head was a little above the level of the water. By means of two force pumps, worked by the occupant's feet, the vessel could be made to sink or rise in the water, by forcing water out or in, and so changing its specific gravity. Its progress horizontally was governed by two revolving paddles in front, turned by a crank inside. The torpedo was fastened to the back of the boat by a screw, the release of which set in motion a clock connected with a gun-lock and flint. After the predetermined interval of time had elapsed, the clock would strike and ignite the powder.

The torpedo carried by Lee against the Eagle was charged with 150 pounds of powder (some say 130 pounds), and the clock was set to explode the charge in thirty minutes after the torpedo was placed. Lee was towed to the neighborhood of the fleet by a party in whale-boats, and then proceeded to attack the fleet alone. He succeeded in reaching the Eagle, a 64-gun ship, undetected, and spent a long time in a vain attempt to fasten the torpedo to her bottom with hooks and screws; a band of iron at the edge of the copper sheathing proving an especially serious obstacle. As daylight approached, he was compelled to leave the fleet and return to the city. Off Governor's Island he was intercepted by a British barge, when, to avoid capture, he exploded his torpedo, escaping from his pursuers during the panic which the explosion excited.

A Bushnell torpedo boat was used more successfully a year later in the harbor of New London, Conn., where a prize schooner, in charge of the man-of-war Cerberus, was blown up and destroyed.

As an act of discourtesy to a friendly visitor, Boyton's prank has little to commend it. As a practical demonstration of a new risk to war ships at anchor, even in a friendly port, it has a different and wider bearing. Bushnell's idea of matching one man against a ship may, after all, be the true one. It is obvious that one torpedo placer, able to swim Boyton-fashion on or under water, is much less liable to detection than a torpedo boat, and much less easily guarded against; for he could approach unseen and pass under the booms and networks which suffice to explode or ward off torpedoes of the usual sort. If Sergt. Lee's torpedo had been provided with a strong magnet, the strip of iron which thwarted him would have insured the success of his undertaking, and the use of torpedoes in naval warfare might have been hastened half a century, materially changing the current of more recent naval and political history.

RELATIVE MEASUREMENTS.

Every draughtsman, architectural or mechanical, knows the difficulty of making divisional spaces come out a complete whole; it is very difficult to complete a whole from subdivisions. Yet this is what modern practice in machinist work has accomplished—indeed, it is what the requirements of modern metal manipulation demand.

It may be possible to divide a linear measure into fractional parts, and have these make a complete whole with ordinary mechanical appliances; but to make diameters of cylinders, their inside and outside dimensions, the same is a test of mathematical exactness. Yet this is done. At the testing department of a prominent machinist and tool-making establishment the integrity of the gauges was shown by some singular tests. The gauges for diameters are plugs and templates of hardened steel. (Templates mean, in this connection, rings or disks with a bored and finished hole to receive the plug.) So closely are these fitted that a differing temperature corresponding with the warmth of the human body is sufficient to disturb the relative sizes. For instance, a template (ring) in the testing room, where a four-foot gas burner was lighted, was tested with a plug in a glass cabinet against the wall. The temperature of the cabinet as compared with that of the testing room varied eight degrees by thermometer, and yet the fits were so close that this variation affected the movement of the plug through the template.

But the most exactive test of relative measurements were given with these plugs and templates. A template or ring of just one inch diameter of hole would receive a plug of exactly one inch, both being of the same temperature. Then it was suggested that the relative measurement should be tested, and two half inch plugs were introduced side by side, inside the one inch template or ring. Would it be believed that those two half inch plugs held the ring as surely as would have held the solid one inch plug! Yet this was proved by repeated tests. In fact, the impinging of the two half inch plugs on the inside diameter of the template ring and on each other's diameters represented only infinitesimal lines, but the bearing was perfect. Another test of exactness in divisional measurements was that of taking, at a chance, a template (or ring of hardened steel), that had an interior diameter of two and one-sixteenth inches. Trials were made to place, side by side, a one inch plug and one of one and one-sixteenth. It is wonderful to say that they fitted exactly! And a still stronger test was made with a template of the same size—two and one-sixteenth inches. The test was made by placing three plugs, one of one inch diameter, one of half an inch diameter, and one of nine-sixteenths of an inch, aggregating thirty-three sixteenths, or two inches and one-sixteenth. These varying plugs exactly filled the diametrical space in the template which a single plug was to fit. Such measurements as these are close enough for very fine work; but they are demanded by the exactions of modern machinist production.

DURING the month of April last the Patent Office received 3,159 new applications for patents, the fees upon which aggregated $100,840, and yet Congress refuses, session after session, to grant a sufficient appropriation to employ a large enough clerical force to keep up the business of the Office. This is the largest sum in fees yet received by the Patent Office, the nearest approach to it being in the month of March, 1883, when the fees footed up $99,515.