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SUBMARINES, INVENTORS AND INVENTIONS

By HAROLD YOUNG, '29



THE first submarine was invented about the time of Alexander the Great. This form was the crude diving-bells and primitive leather diving helmets with bladders to keep the upper end of the tube afloat on the surface of the water. Scientists of today are not sure that such vessels were ever built, but if they were built, they are not sure that they actually carried people when they submerged. Magnus Pegelius is credited with having built a submarine about 1605, while William Bourne, an English mathematician, is said to have constructed one in 1850.

Doctor Cornelius Van Drebel, a Netherlander, was the first to actually build and navigate a submarine. Van Drebel was walking along the banks of the Thames one pleasant evening in the year 1620, when he noticed some sailors dragging in behind their vessels, baskets full of fish. He saw that their vessels were weighed down in the water but that they rose a little when the ropes which held the baskets allowed them to slacken. The idea occurred to him that a ship could be held under water in a similar manner and could be run by oars. He took his idea to King James I of England and the king supplied him with funds from the royal treasury. Van Drebel designed and built three submarine boats between 1620 and 1624.

Van Drebel's submarines were large wooden row-boats decked over and made water tight by a covering of thick well-greased leather. In 1624, when they were complete, King James I journeyed in one of them on the Thames River. On this occasion there were twelve oarsmen besides the passengers and the vessel during the several hours under the surface, was kept at a depth of twelve to fifteen feet. Van Drebel said that his friend, Van der Wonde built a ship in which one could row and navigate under water from Westminster to Greenwich, the distance of two Dutch miles. It was capable of traveling even five or perhaps six miles. In this boat, a person could see under the surface of the water without a candle-light. The questions that arise in our mind are: Did Van Drebel anticipate by 150 years the discovery of oxygen?—or how did the people stay under the surface of the water in the submarine for several hours? Van Drebel died in 1634 at the age of 62, without leaving any notes or oral descriptions.

Eighteen years after Van Drebel's invention, a

Frenchman named LeSol built a submarine which he called "Rotterdam." This boat was 72 feet long and 12 feet high with an 8-foot beam. This submarine was built of wood having sharp tapering ends. The sloping sides of the superstructure served to deflect cannon balls that might be fired at it while it was traveling on the surface of the water. There was a single paddle-wheel amidship to propel the boat.

The earliest known picture of a submarine boat appeared in the Gentleman's Magazine in 1747. The name of the man who built this vessel was Symons and the boat was navigated on the Thames River. This, however, was not the original vessel of this type of the invention. A Frenchman by the name of Borelli, who was the first to suggest the water ballast for trim and submergence, designed this model in 1680.

Submarine navigation was a century and a half old before it claimed its first victim. In 1774 a man by the name of J. J. Day built a small boat with which he was able to submerge to a depth of 30 feet, being on board himself, and remain there twenty-four hours with no ill effect. At the end of this time Day rose to the surface. He thought he could repeat the experiment to any depth. On June 28, 1774, Day shut himself in the water-tight compartment of his boat and sank to the bottom of Plymouth Harbor, a depth of 22 fathoms or 132 feet, to remain for twelve hours. When the twelve hours were up and he did not reappear on the surface, a certain Mr. Blake sent for help and it was found that the harbor was much deeper than Day had figured it to be. He had been crushed by the great pressure of the water.

Between 1773 and 1776 David Bushnell built the first practical submarine boat to be used in actual warfare. Mr. Bushnell called his submarine the "Turtle," because it looked like a turtle floating with its tail down and a conning tower for a head. It has been compared with a modern soldier's canteen with an extra large mouth-piece and again with a hard-shelled clam wearing a silk hat. It was deeper than it was long and not much longer than it was broad. This submarine was operated by one man. The speed was about three knots an hour. Each submarine carried a cage of white mice to warn the men when the oxygen began to give out. Mice are very sensitive to a lack of oxygen and when the supply would get low they would die. The vessel was ballasted chiefly with lead, 200 pounds letting the submarine down forty or fifty feet. This

would enable the operator to rise suddenly to the surface in case of accident. Under ordinary conditions when the operator wished to descend he placed his foot to a brass valve by which he admitted water to any desired speed. A force pump on each side, convenient to the hand, was arranged for pumping this water out. To control the vertical movements more surely, a screw propeller on a vertical shaft was fitted to be operated by a crank. A glass tube eighteen inches long, one inch in diameter, and with a closed top was connected with the outside water and served as a gauge to indicate the depth. A cork covered with phosphorus floated on the water in the gauge and rendered the water level visible. A compass needle smeared with phosphorus gave means for laying the course, while a lead line could be used through a special opening in the bottom to ascertain the depth of the water. Every opening was well secured and the pumps were covered with strainers. To a great extent every working part was made of brass. The magazine was built of two heavy pieces of oak bolted together and hollowed out to contain 150 pounds of gunpowder and the clock work mechanism for igniting it. The magazine was detachable and rested upon the upper part of the hull. A short stout line connected it to a screw capable of being turned from the inside of the boat and arranged so that the outer end could be released after being driven into the bottom of the vessel. When compared with it, all previous boats are very crude contrivances. Thus it is not surprising that the operator, Sergeant Lee, was able to get underneath an English man-of-war, and was only prevented from blowing it up by his inability to drive the attacking screw through the copper sheating of the vessel. Lee worked all night trying to sink the English ship, but in no way could he put the screw in the bottom of the ship.

Robert Fulton was probably the first American who ever went to a European government to sell his invention. He went to Paris for the purpose of selling war supplies to the French government. He found anything but a ready market. For three years, beginning in 1797, Fulton tried constantly, but in vain, to interest the Directory in his plans for a submarine. Though a commission appointed to examine his designs reported favorably, the minister of the Marine would have nothing to do with them. Fulton built a beautiful little model submarine of mahogany and exhibited it, but with no results. He made an equally fruitless attempt to sell his invention in Holland. Nobody seemed to have the slightest belief or interest in submarines. Napoleon, overthrowing the Directory and becoming First Consul and absolute ruler of France in 1800, appointed three expert naval engineers to examine Fulton's plans, and on their approval, advanced Fulton 10,000 francs to build a submarine. Construction was begun at once and the boat was finished in May, 1801. It was a remarkably modern looking craft, and a great improvement on every model up to that time. It was the first submarine to have a fish-shaped metal hull. It was built of copper plating on iron ribs and was twenty-one feet and three inches long and six feet and five inches in diameter at the thickest point, which was well forward. A heavy keel gave stability and immediately above it were the water ballast tanks for submerging the vessel. Two men propelled the boat when beneath the surface by turning a hand winch to the shaft of a two-bladed metal propeller. The third member of the crew stood in the dome-shaped conning tower and steered, while Fulton himself controlled the pumps, valves, and diving-planes or horizontal rudders that steered the submarine up and down. Instead of forcing his boat under with a vertical-acting screw, like Bushnell, Fulton made it to dive foremost by depressing

its nose with the diving-planes and shoving it under by driving it ahead. Fulton was also the first to give a submarine a separate means of propulsion for above and below the surface. On her first trial in the Seine at Paris in May, 1801, the Nautilus remained submerged for twenty minutes with Fulton and one other man on board. The light was furnished for navigation by a candle. After that Fulton made the first compressed-air tank, a copper globe containing a cubic foot of compressed air, by which means the submerged crew could stay under for six hours. Robert Fulton built several boats which may be regarded as highly successful. They were of better shape for speed than that of Bushnell and equally complete as to details.

In 1860 the Plongeur was built at Rochefort from the designs of Bourgeois and Brun. The boat was not a success and is interesting from the fact that its motive power was derived from compressed air.

During the Civil War the Confederates built several semi-submarine boats, the only part above water being the ventilating hatch. One of these boats blew up the Federal gunboat Housatonic, but at the same time destroyed its own crew. After the close of the war little was done with submarine boats until 1880, though some were rebuilt by Halstead and others. Between 1880 and 1895 many inventors were at work on this great problem of submarine navigation.

When the Merrimac rammed the Cumberland, burned the Congress, and was fought to a standstill the next day by the little Monitor, all the world realized that there had been a revolution in the naval warfare. The age of wooden war ships was gone forever, the day of the ironclad had come. In 1888 Secretary Whitney decided that the adoption of submarines would be a good thing for the United States Navy, and the great Philadelphia ship-building firm of Cramps submitted two designs: Holland's and Nordenfeldt's. The former won the award. After twelve months had been spent in settling preliminary details, and when a contract for building an experimental boat was just about to be awarded there came a change in the administration and the matter was dropped. This was a great disappointment for Holland, and the next four or five years were lean ones for the inventor. He had built five boats and designed a sixth without their having brought him a cent of profit. It was not until March 3, 1893, that Congress appropriated the money for the construction of an experimental submarine, and inventors were invited to submit their designs. About 1895, after investigating the plans of rival inventors for several years, the United States Navy ordered a boat from the designs of John P. Holland. On April 11, 1900, the United States government purchased Holland's model for \$150,000. It had cost its builders, exclusive of any office expenses and salaries of officers, \$236,615.43. But it had been a profitable investment in the Holland Torpedo Boat Company, for on August 25th, the United States Navy contracted with it for the construction of six more submarines. In the autumn of the same year, though it was not announced to the public till March 1, 1901, five other of Holland's boats were ordered through the agency of Vickers Sons and Maxim by the British admiralty. Soon every maritime nation was either buying Holland's submarines, paying royalties on the inventor's patents, or building bigger, faster, and better submarines. The original, called the "Holland," had outlived its fighting value when it was condemned by Secretary Daniels in June, 1915, to be broken up and sold as junk. This order was revoked in time to at least reserve the hull of the Holland. The inventor's years were embittered by the belief that the submarines

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of today were distorted and worthless developments of his original type. Whether or not he was mistaken, only time can tell. To John P. Holland, more than any other man of science, the world owes the modern submarine. His death on August 12, 1914, was but little noticed in the turmoil and confusion of the first weeks of the great European War, but when the naval histories of that war are written his name will not be forgotten.
