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David Bushnell & His Turtle

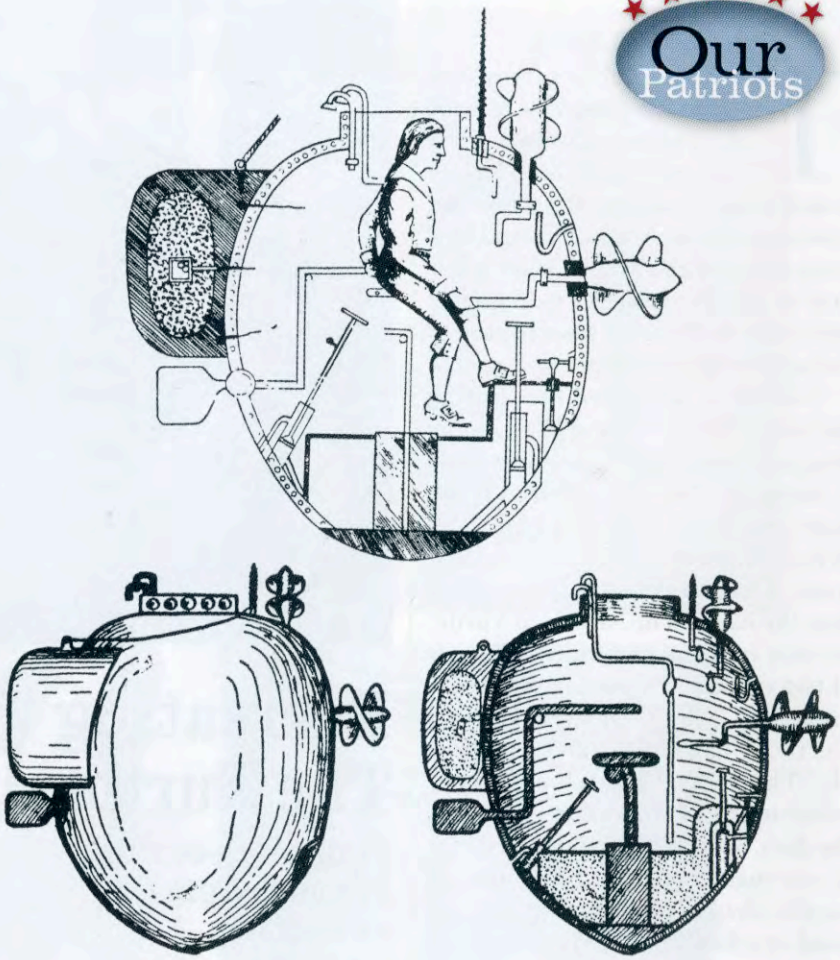
Colonial Inventor Launches Era of Submarine Warfare

More than 200 years ago, America's first fully submersible warship hit the ocean, forever changing the face of military combat. Designed by David Bushnell, who is known as the "father of submarine warfare," the warship was so advanced that it continues to fascinate Americans today. In August 2006, the U.S. Coast Guard cornered three Rhode Island men who set their replicated version of the submarine afloat in New York Harbor. Fortunately, the mischievous adventurers were not terrorists as they were initially suspected to be, but simply a few ordinary guys trying to recreate history. **BY ART RANDALL**

Bushnell's invention evolved at a Connecticut clock factory where he and Phineas Pratt, a fellow medical student at Yale University, had been working to help pay their college expenses. Both Bushnell and Pratt despised the British. Looking for a way to serve their country and play their part in the Revolution, the young men began purchasing clocks with hand-wound alarms. The attached alarm allowed the clock to release the cock of its flintlock mechanism at a predetermined time. The two minds simultaneously made a connection that would give American soldiers the upper hand in battle: They could make a bomb that would explode at a certain time. Having already developed the prototype, the clock needed only a few changes before becoming the first crude model of a detonator.

Though no pictures or drawings of the actual device exist, word-of-mouth renderings give clues about the device's function, size, description and appearance. It was a simple mechanism, which was the primary reason for its high reliability and effectiveness.

Bushnell and Pratt filled a waterproof tube with black powder and placed it adjacent to a flintlock mechanism tied directly to the cock. The apparatus worked like a handgun. Pulled back in a ready-to-fire position, the cock was linked to the clock mechanism. When it was time for the bomb to explode, the mechanism would release the cock, which would strike the flint. The sparks would ignite the small tube, detonating the 50-pound bomb.



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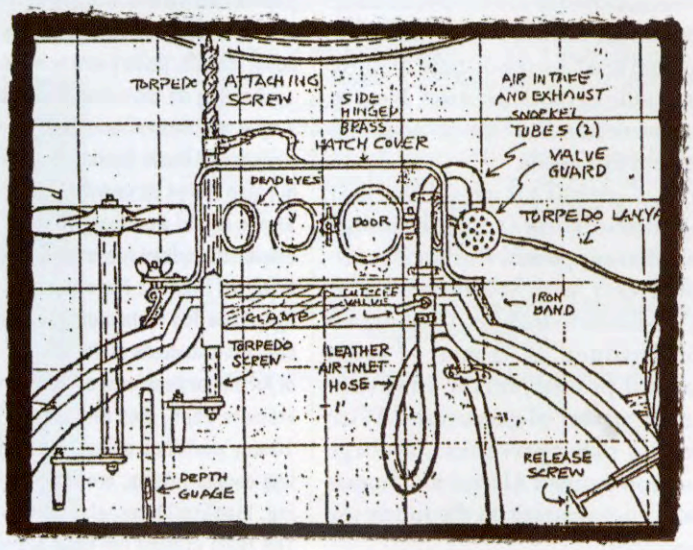
(opposite page) Right side view of a replica of David Bushnell's Turtle, first used on September 6, 1776, in an unsuccessful attempt to attach a bomb to the hull of the British warship, the HMS *Eagle*. **(above)** This 1875 drawing by Lt. Francis Barber is the most familiar rendering of the Turtle. **(below)** Frank Tinsley's late 19th-century drawing gives a close-up view of the Turtle's mechanics.



COURTESY OF SUBMARINE FORCE MUSEUM

DESIGNING THE TURTLE

The Bushnell/Pratt bomb didn't fail to explode in tests, even when underwater. The men had finally found a way to sink British warships at a time most convenient for the Americans—and least convenient for the British. Now it was time to take the last step: Finding a safe way to attach the bomb's mechanism to the hull of the British ship.

With plans anchored for igniting the bomb, Bushnell and Pratt began designing and building a submarine in Saybrook, Conn., to deliver a bomb that would sink anchored or docked British ships in harbors or near the coast. The submarine appropriately bore the name "The American Turtle" because its shape reminded colonists of two turtle shells put together. Also known as "The Continental Navy Turtle," "The CNS Turtle" or simply "The Turtle," the submarine was constructed of wood that glowed in the dark, according to some accounts. A one-man crew navigated the small turtle-shaped submarine, using a hand-cranked screw for propulsion. A valve opened to immerse the tiny submarine and sink it to a desired depth. The passenger could use a hand pump to displace water, allowing the Turtle to rise to the ocean's surface.

To carry the bomb safely inside the Turtle, it was placed at the rear of the submarine, directly above the rudder. The captain sat directly across, facing the drill bit, and used a screw handle to move the ship in the desired direction. Next to his knee were handles that could pump water out of the Turtle.

Both Connecticut Governor John Trumbull and General George Washington supported Bushnell's submarine project, with Washington providing the funds to build it. Washington lauded Bushnell as "a man of great mechanical powers, fertile in invention and a master of execution." With discerning perceptiveness, George Washington penned a letter to Thomas Jefferson, commenting on the future use of submarines.

Recreating The Turtle

Eighteenth-century submarine proves its mettle

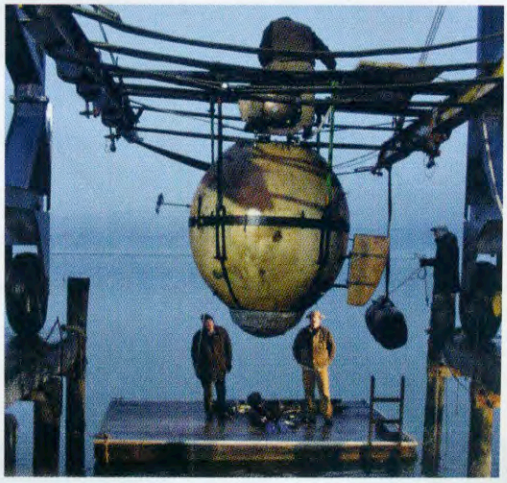
MORE THAN 200 YEARS HAVE PASSED since America's first submarine, the Turtle, has sailed in a naval battle, but its design continues to fascinate preservationists who try to replicate it. One of the most successful attempts has been by Rick and Laura Brown, directors of Handshouse Studios, an organization that uses hands-on projects to educate the public about the arts, history and science.

Relying on tools and technologies from the 1700s, the Browns and their team not only built a replica of David Bushnell's wooden submarine, but also tested its seaworthiness with the United States Naval Academy. Before embarking on construction, they researched original letters and histories from the Revolutionary era and investigated period technologies and materials. With help from students at the Massachusetts College of Art and professional craftsmen from the Timber Framers Guild, they remade the Turtle during a 10-day workshop using 18th-century processes like copper raising, bronze casting, brass brazing, blacksmithing, glass blowing and felting. The team crafted the body of the Turtle from a single log, splitting it with wedges and hewning it with hand tools.

The submarine was tested twice—first at Snug Harbor in Duxbury, Mass., and later at the U.S. Naval Academy in Annapolis—and proved to be watertight. When the Academy re-enacted the attack of the Turtle on the HMS *Eagle*, the submarine performed as originally described, proving the foresight of Bushnell's radical idea to use a one-man submarine to attach a bomb to the underbelly of British ships. In a 2003 exercise in Duxbury, Rick Brown demonstrated how the Turtle maneuvered on the open water with its forward propeller and rudder.

The Discovery Channel captured this reconstruction of the Turtle, along with its historic underwater sea mission, in the 2004 documentary series "Machines Lost in Time."

–Emily McMackin



(opposite page) Handshouse Studio's process of replicating the Turtle begins with Rick Brown, Joe Wood and Will Truax splitting a seven-foot sitka spruce log. • Matt Hincman, a student at the Massachusetts College of Art, checks the space inside half of the Turtle shell to determine scale. **(this page, clockwise from top left)** Team members at the studio suspend the two halves of the Turtle. • Greg Mullen, professor at Virginia Military Institute, installs a handmade brass forcing pump in the bottom of the Turtle. • The team lowers the replica into Duxbury Harbor for its first total submersion test. • A close-up shows the detail of the raised copper hatch with blown-glass windows. • Chris Gunn, Justin She and Will Truax carve the body of the vessel with traditional axes.

EXCEPT WHERE NOTED, IMAGES SUPPLIED BY HANDSHOUSE STUDIOS

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Top view of Handshouse's replica of Bushnell's Turtle

THE TURTLE VERSUS THE EAGLE

Once the design was completed, a plan was set. Bushnell's brother, Sergeant Ezra Bushnell of the Continental Army, knew the inner workings of the Turtle as well as David did and underwent extensive training to become its first captain to attack British ships. Unfortunately, on the eve of the Turtle's first attack, Ezra Bushnell was killed in battle. The Turtle was to attack the HMS *Eagle*, which was anchored off Bedloe's Island, an area known today as Liberty Island.

With minimal training on the Turtle, Sergeant Ezra Lee of Old Lyme, Conn., became the first captain of the submarine and took on the challenge of sinking British Admiral Howe's 64-gun frigate, the HMS *Eagle*, which had been blocking the entrance to New York Harbor. What must have gone through Sgt. Lee's mind as he approached the 64-gun destroyer in a 7-by-4-foot submarine equipped with only one bomb? Considering the size of the HMS *Eagle* compared to Bushnell's Turtle, Lee was clearly the underdog in his attempt to bomb Adm. Howe's men.

On the night of September 6, 1776, Bushnell launched his submarine, armed with a gunpowder-laden bomb, in New York Harbor. Even though there was a change in the tide, Lee maneuvered up to the *Eagle* successfully without being detected. He wisely moved toward the rudder—the most vulnerable point of a ship at the time.

After a period of drilling, Lee encountered copper sheeting, which he could not penetrate. The air in the Turtle became more stifling as each moment passed, forcing Lee to surface and open his glass port. Once he did, he attracted the attention of sailors on the *Eagle*'s deck.

While they immediately reported to their superiors that a strange object was closing in on them, Lee moved away from the ship and escaped. Most of the British ships, however, left the harbor without investigating the report, despite rumors that the Americans had been building a submarine. Most of the British simply shrugged it off as a technological impossibility for the ragtag Americans.

A member of the Turtle replica team tests Bushnell's vessel in Massachusetts' North River.

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Considering the size of the HMS *Eagle* compared to Bushnell's Turtle, Lee was clearly the underdog in his attempt to bomb Admiral Howe's men.

Bushnell then took the Turtle up to Fort Lee, where Washington's army was quartered. There it made another unsuccessful attempt to sink a British frigate. This time, another British ship spotted the Turtle and immediately launched two longboats to pursue Lee. He realized that he could not keep the bomb attached and still outrun the boats, so he released it, setting the detonation time as the bomb descended to the bottom of the harbor. As the two boats passed over the bomb, it exploded, scaring away the sailors in one boat while destroying the other boat.

Concerned that the Americans would cause more mischief, Adm. Howe moved his flagship to Staten Island and avoided any more activity with the Americans that day. Washington encouraged Bushnell to use the Turtle again, but Bushnell decided against it. He did, however, accept Washington's commission as a captain in the U.S. Army Corps of Engineers.

THE LEGACY OF THE TURTLE

In October 1776, the British found and sank the American ship carrying the Turtle. It was never recovered, and its design was never used again, ending the era of the first warship to attack an enemy vessel. The world of naval sea power had changed forever. Later came Robert Fulton's warship *Nautilus*, then the era of the CSS *H.L. Hunley* and the Union's *Alligator* of the Civil War. These designs would rule until the late 1800s when submarine pioneer Simon Lake and John Holland's Holland Torpedo Boat Company became part of the Electric Boat Company, moving from Elizabethport, N.J., to Groton, Conn., which became the center of submarine development and construction in the early 1900s.

After trying and failing to sell his submarine designs to other nations, Bushnell went on to design sea mines. Once he tired of that, he returned to medicine and became a country doctor in Georgia, using the name David Bush. He never let anyone know that he was the man who built the first submarine to attack an enemy vessel. After his death in Warrenton, Ga., in 1824, David Bush was discovered to be the David Bushnell, inventor of the Turtle.

Though neither he nor his Turtle ever sunk an enemy vessel, Bushnell's submarine was the first ever to be used for military purposes. Father of the first American combat submarine, the Turtle's progeny evolved from manpower to diesel power to nuclear power, protecting America from its enemies for 230 years.

Art Randall joined the U.S. Navy after high school. He volunteered for the submarine service in 1950 and was discharged in 1955. His wife is Peri Eleanor Randall, member of the St. Louis-Jefferson Chapter.