



**The Official Newsletter of the Washington Metropolitan Area (WMA) Chapter of
the International Council on Systems Engineering (INCOSE)**

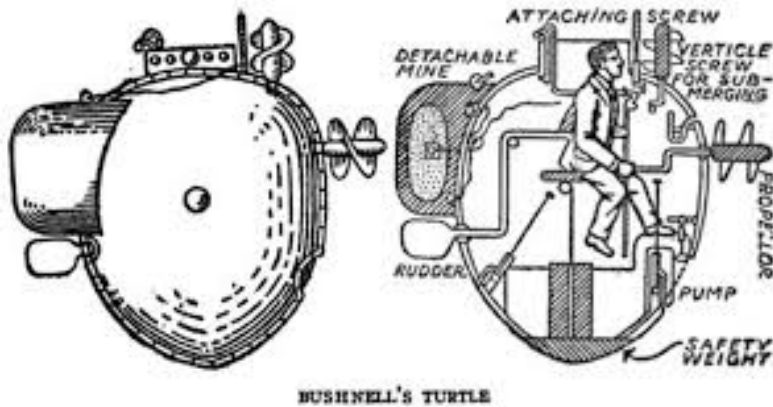
INCOSE WMA Newsletter Volume 2019, Issue 2

4 July 2019



**In honor of the 4th of July, INCOSE WMA wanted to
showcase some of the Systems Engineering feats that
helped build our Nation!**

World's First Submarine Attack



On this day in 1776, during the Revolutionary War, the American submersible craft *Turtle* attempts to attach a time bomb to the hull of British Admiral Richard Howe's flagship *Eagle* in New York Harbor. It was the first use of a submarine in warfare.

Submarines were first built by Dutch inventor Cornelius van Drebel in the early 17th century, but it was not until 150 years later

that they were first used in naval combat. David Bushnell, an American inventor, began building underwater mines while a student at Yale University. Deciding that a submarine would be the best means of delivering his mines in warfare, he built an eight-foot-long wooden submersible that was christened the *Turtle* for its shape. Large enough to accommodate one operator, the submarine was entirely hand-powered. Lead ballast kept the craft balanced.

Donated to the Patriot cause after the outbreak of war with Britain in 1775, Ezra Lee piloted the craft unnoticed out to the 64-gun HMS *Eagle* in New York Harbor on September 7, 1776. As Lee worked to anchor a time bomb to the hull, he could see British seamen on the deck above, but they failed to notice the strange craft below the surface. Lee had almost secured the bomb when his boring tools failed to penetrate a layer of iron sheathing. He retreated, and the bomb exploded nearby, causing no harm to either the *Eagle* or the *Turtle*.

During the next week, the *Turtle* made several more attempts to sink British ships on the Hudson River, but each time it failed, owing to the operator's lack of skill. Only Bushnell was really able to competently execute the submarine's complicated functions, but because of his physical frailty he was unable to pilot the *Turtle* in any of its combat missions. During the Battle of Fort Mifflin, the *Turtle* was lost when the American sloop transporting it was sunk by the British.

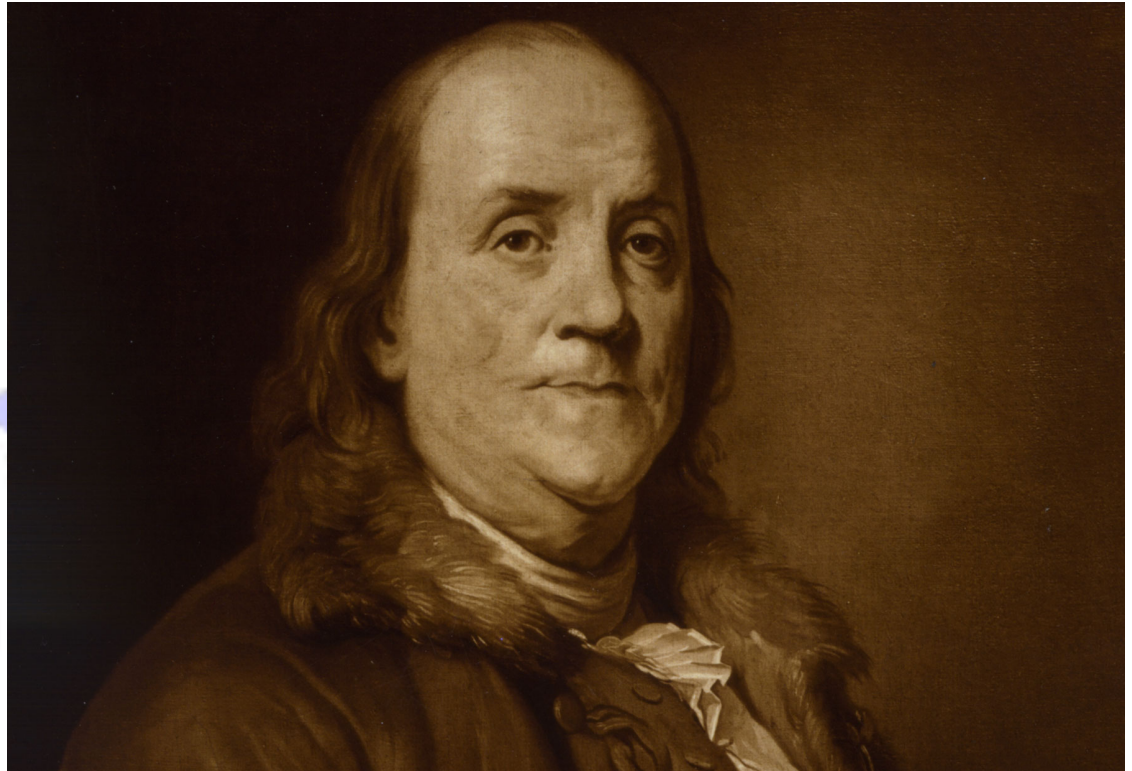
Despite the failures of the *Turtle*, General George Washington gave Bushnell a commission as an Army engineer, and the drifting mines he constructed destroyed the British frigate *Cerberus* and wreaked havoc against other British ships. After the war, he became commander of the U.S. Army Corps of Engineers stationed at West Point.

<https://www.history.com/this-day-in-history/worlds-first-submarine-attack>

Benjamin Franklin: Scientist and Inventor

In 1748, Franklin, then 42 years old, had expanded his printing business throughout the colonies and become successful enough to stop working.

Retirement allowed him to concentrate on public service and also pursue more fully his longtime interest in science. In the 1740s, he conducted experiments that contributed to the



understanding of electricity, and invented the lightning rod, which protected buildings from fires caused by lightning. In 1752, he conducted his famous kite experiment and demonstrated that lightning is electricity. Franklin also coined a number of electricity-related terms, including battery, charge and conductor.

In addition to electricity, Franklin studied a number of other topics, including ocean currents, meteorology, causes of the common cold and refrigeration.

<https://www.history.com/topics/american-revolution/benjamin-franklin>

More of Benjamin Franklin's Gifts

Benjamin Franklin's long list of inventions includes bifocals, the lightning rod, the glass armonica, a library chair, swim fins, a long-reach device, the Franklin stove, and the catheter.

- **Swim fins**: An avid swimmer, Ben developed early swim fins. As a boy, he fashioned two oval wooden pallets with thumb holes. With one on each hand, he paddled through water, observing that they helped him to swim faster. He later developed swim fins to reduce what he called a "laborious and fatiguing operation."
- **Franklin stove**: In 1741, Ben invented the Franklin stove, an iron furnace that allowed people to heat their homes safely while using less wood.
- **Bifocals**: Ben's vision deteriorated as he grew older. He loved to read and grew tired of switching between two pairs of glasses—one that helped him to see things close, another to see things farther away. So he cut the lenses from both pairs in half, then put half of each lens in a single frame, inventing bifocals.
- **Mail order**: A mail-order catalog is a publication containing a list of general merchandise from a company. Those who publish and operate mail-order catalogs are referred to as catalogers within the industry, who also buy or manufacture goods and then market those goods to prospective customers. Mail ordering uses the postal system for soliciting and delivering goods. According to The National Mail Order Association, Benjamin Franklin invented and conceptualized mail order cataloging in 1744.
- **Flexible urinary catheter**: In medicine, a catheter is a tube that can be inserted into a body cavity, duct, or vessel. Catheters thereby allow drainage, injection of fluids, or access by surgical instruments. Prior to the mid 18th-century, catheters were made of wood or stiffened animal skins which were not conducive to navigating the anatomical curvature of the human urethra. Extending his inventiveness to his family's medical problems, Benjamin Franklin invented the flexible catheter in 1752 when his brother John suffered from bladder stones. Dr. Franklin's flexible catheter was made of metal with segments hinged together in order for a wire enclosed inside to increase rigidity during insertion.
- **Armonica**: Also known as the glass harmonica or glass armonica, Benjamin Franklin invented a musical instrument in 1761, an arrangement of glasses after seeing water-filled wine glasses played by Edmund Delaval in Cambridge, England. Dr. Franklin, who called his invention the "armonica" after the Italian word for harmony, worked with London glassblower Charles James to build one, and it had its world première in early 1762, played by Marianne Davies. In this version, 37 bowls were mounted horizontally nested on an iron spindle. The whole spindle turned by means of a foot-operated treadle. The sound was produced by touching the rims of the bowls with moistened fingers. Rims were painted different colors according to the pitch of the note.

Other Notable Inventions

1776 Swivel chair

A swivel or revolving chair is a chair with a single central leg that allows the seat to spin around. Swivel chairs can have wheels on the base allowing the user to glide the chair around their work area without getting up. This type of chair is common in modern offices and is often also referred to as an office chair. Using an English-style Windsor chair which was possibly made and purchased from Francis Trumble or Philadelphia cabinet-maker Benjamin Randolph, Thomas Jefferson invented the swivel chair in 1776.

Jefferson heavily modified the Windsor chair and incorporated top and bottom parts connected by a central iron spindle, enabling the top half known as the seat, to swivel on casters of the type used in rope-hung windows. When the Second Continental Congress convened in Philadelphia, Jefferson's swivel chair is purported to be where he drafted the United States Declaration of Independence. Jefferson later had the swivel chair sent to his Virginia plantation, Monticello, where he later built a "writing paddle" onto its side in 1791. Since 1836, the chair has been in the possession of the American Philosophical Society located in Philadelphia.

1782 Flatboat

A flatboat is a rectangular boat with a flat bottom and square ends generally used for freight and passengers on inland waterways. After serving in the Pennsylvania Lineduring the American Revolutionary War, Jacob Yoder invented and built a large boat at the Redstone Old Fort on the Monongahela River, which he freighted with flour and carried to New Orleans in May 1782. This was the first attempt to navigate the Ohio and Mississippi rivers for commercial purposes.

1785 Artificial diffraction grating

In optics, a diffraction grating is an optical component with a regular pattern, which diffracts light into several beams. The first man-made diffraction grating was invented around 1785 in Philadelphia by David Rittenhouse who strung 50 hairs between two finely threaded screws with an approximate spacing of about 100 lines per inch.

1787 Automatic flour mill

Classical mill designs were generally powered by water or air. In water-powered mills, a sluice gate opens a channel, starts the water flowing, and a water wheel turning. In 1787, American inventor Oliver Evans revolutionized this labor-intensive process by building the first fully automatic mill using bucket elevators, screw conveyors, and the hopper boy to spread, cool, and dry the meal between grinding and bolting. This was the first time that anyone had conceived and executed a system of continuous, fully automatic production.

1792 Cracker

A cracker is a type of biscuit that developed from military hardtack and nautical ship biscuits. Crackers are now usually eaten with soup, or topped with cheese, caviar, or other delicacies. The holes in crackers are called "docking" holes as a means to stop air pockets from forming in the cracker while baking. Crackers trace their origin to the year 1792 when John Pearson of Newburyport, Massachusetts invented a cracker-like bread product from just flour and water that he called "pilot bread". An immediate success with sailors because of its shelf life, it also became distinctly known as a hardtack or sea biscuit for long voyages away from home while at sea.

1793 Cotton gin

The cotton gin is a machine that separates cotton fibers from seedpods and sometimes sticky seeds, a job previously done by hand. These seeds are either used again to grow more cotton or, if badly damaged, disposed of. The cotton gin uses a combination of a wire screen and small wire hooks to pull the cotton through the screen, while brushes continuously remove the loose cotton lint to prevent jams. In 1793, Eli Whitney invented the cotton gin and later received a patent on March 14, 1794.

Whitney's cotton gin could have possibly ignited a revolution in the cotton industry and the rise of "King Cotton" as the main cash crop in the South. However, it never made him rich. Instead of buying his machine, farmers built inferior versions of their own which led to the increasing need for African-American slave labor.

1795 Wheel cypher

The Jefferson disk, or wheel cypher, is a cipher system for encrypting messages and used as a deterrent for codebreaking. Using 26 wheels, each with the letters of the alphabet arranged randomly around them, Thomas Jefferson invented the wheel cypher in 1795. Falling in and out of use and obscurity, the wheel cypher was "re-invented" twice: first by a French government official around 1890, and then just prior to World War I by an officer in the United States Army. Designated as M-94, the latter version was used by the United States Army and other military services from 1922 to the beginning of World War II.

1796 Rumford fireplace

The Rumford fireplace created a sensation in 1796 when Benjamin Thompson Rumford introduced the idea of restricting the chimney opening to increase the up-draught. Rumford fireplaces were common from 1796, when Benjamin Rumford first wrote about them, until about 1850. Thomas Jefferson had them built at Monticello, and Henry David Thoreau listed them among the modern conveniences that everyone took for granted. Rumford and his workers changed fireplaces by inserting bricks into the hearth to make the side walls angled and added a choke to the chimney to increase the speed of air going up the flue. It produced a streamlined air flow, reducing turbulence so the smoke would go up into the chimney rather than choking the residents. Rumford fireplaces are appreciated for their tall classic elegance and heating efficiency. This simple alteration in the design of fireplaces were copied everywhere in an age when fires were the principal source of heat. The Rumford fireplace is still used in the 21st century.

1796 Cupcake

A cupcake, fairy cake, patty cake or cup cake is a small cake designed to serve one person, frequently baked in a small, thin paper or aluminum cup. As with larger cakes, frosting and other cake decorations, such as sprinkles, are common on cupcakes. The earliest reference of cupcakes can be traced as far back as 1796, when a recipe notation of "a cake to be baked in small cups" was written in American Cookery by Amelia Simms. However, the first use of the term "cupcake" was in Seventy-five Receipts for Pastry, Cakes, and Sweetmeats in 1828 in Eliza Leslie's Receipts cookbook where it referred to the use of a cup for measuring the ingredients.

1801 Suspension bridge

A suspension bridge is a type of bridge in which the deck, the load-bearing portion, is hung below suspension cables on vertical suspenders that carry the weight of the deck below, upon which traffic crosses. Primitive in their earliest form, the ancestor to what is now considered a suspension bridge, the simple suspension bridge, was developed sometime around 2000 BC in China and India, relying upon ropes thrown across a narrow gorge or river, from which people could hang as they crawled across.

With the extreme dangers of swinging back and forth, these simple suspension bridges were deemed impractical as horses as well as carriages later found it difficult to maneuver across their wooden planks.

The world's first suspension bridge in a modern sense, the Jacob's Creek Bridge at approximately 70 feet in length, was invented by James Finley of Uniontown, Pennsylvania in 180, who designed vertical towers to elevate the curved iron cables and to stiffen trusses in order to make the deck of bridges architecturally sound for passing travelers. Nowadays, suspension bridges use steel cables. However, the suspension bridge and its basic, fundamental design of which Finley is duly accredited to inventing, is still evident today in suspension bridges found throughout the world.

1801 Fire hydrant

A fire hydrant is an active fire protection measure, and a source of water provided in most urban, suburban and rural areas with municipal water service to enable firefighters to tap into the municipal water supply to assist in extinguishing a fire. Before the existence of fire hydrants, a primitive fire suppression system known as "fire plugs" consisted of burying a wooden water pipe (often no more than a hollowed out log) along the streets for teams of bucket brigades to form and fight fires. Wooden pegs would then need to be hammered over fire plugs in order to stop the flow of water.

The invention of a post or pillar type fire hydrant is generally credited to Frederick Graff Sr., Chief Engineer of the Philadelphia Water Works around the year 1801. It had a combination hose/faucet outlet and was of "wet barrel" design with the valve in the top. It is said that Graff held the first patent for a fire hydrant, but this cannot be verified due to the fact that the patent office in Washington D.C. was burned to the ground in 1836 where all patent records from that time period were destroyed in the process. In 1863, Birdsill Holly invented the modern version of the fire hydrant. While Holly was only one of many involved in the development of the fire hydrant, innovations he introduced are largely responsible for the fire hydrant taken for granted today. In 1869, Holly was issued U.S. patent #94749, for an "improved fire hydrant."

1804 Burr Truss

The Burr Arch Truss, Burr Truss, or the Burr Arch, is a combination of an arch and a multiple kingpost truss design typically implemented in the construction of covered bridges. The design principle behind the Burr arch truss was that the arch should be capable of holding the entire load on the bridge while the truss was used to keep the bridge rigid. In 1804, American architect Theodore Burr, a cousin of then Vice President of the United States, Aaron Burr, designed and built the first Burr Truss on a bridge over the Hudson River in Watertown, New York.

1805 Amphibious vehicle

An amphibious vehicle is one which can be used on land or water. The self-propelled variant was invented by Oliver Evans who named it the "Orukter Amphibolos". Its steam-powered engine drove either wooden wheels or a paddle wheel used as a means of transport, on land and in water. Evans demonstrated his machine in Philadelphia's Center Square in 1805, built on commission from the Philadelphia Board of Health. Evans' steam engine differed fundamentally from later models, operating at a high pressure, 25 or 30 pounds. Many years later, Evans' invention would be sold off for parts. On July 16, 2005, Philadelphia celebrated the 200th anniversary of Oliver Evans's Orukter Amphibolos. Many historians describe Oliver Evans' invention as the United States' first land and water transporter.

[https://en.wikipedia.org/wiki/Timeline_of_United_States_inventions_\(before_1890\)](https://en.wikipedia.org/wiki/Timeline_of_United_States_inventions_(before_1890))

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