

Opportunist or Freedom Fighter



One of the major obstacles for John Holland as he started to develop actual prototypes for his submarine was a lack of money. While he could complete as many plans and equations as he wished on paper, the only way to truly test his theories was in the water. The *Holland I* cost \$4,000 to construct in 1878. This would be equal to over \$100,000 dollars today! An expensive proposal indeed. Holland did not make that much money as a teacher. Yet he was determined to see his ideas become a reality.

Without the patronage of the US Navy, Holland began exploring other funding sources. His brother Michael provided the solution. Michael was a member of the Fenian Society, the American branch of the Irish Revolutionary Brotherhood. One of the Society's leaders ran a newspaper, *The United Irishman*, which solicited donations from Irish-Americans for the Skirmishing Fund. Money from this fund was given to Holland for both *Holland I* and *Holland II*.

There is much speculation as to the extent of John Holland's dedication to the Fenian cause. He never joined the Society himself, although he did use the money they provided him. He was certainly no fan of Great Britain. In a newspaper interview conducted by the *Washington Evening Star* in 1900, Holland specifically mentions his concern that Britain would use naval superiority "upon the other people of the world." Something he hoped his invention would help to prevent.

Regardless of Holland's personal convictions, the fact remains that the *Holland II* was designed with the intention that it would be used as a weapon of terror.

When *New York Sun* reporter Blakely Hall nicknamed the craft *Fenian Ram* he was accurately describing its purpose.

Holland ended his relations with the Fenians during the development of the *Holland III*. One night in November 1883, a faction of the Fenians sneaked onto the dock where the *Fenian Ram* and the not yet completed *Holland III* were stored. They stole the ships in the night, accidentally sinking the *Holland III* off of Long Island in the process.

Ironically, in 1900 Electric Boat Company would actually sell a Holland submarine to the British Navy.

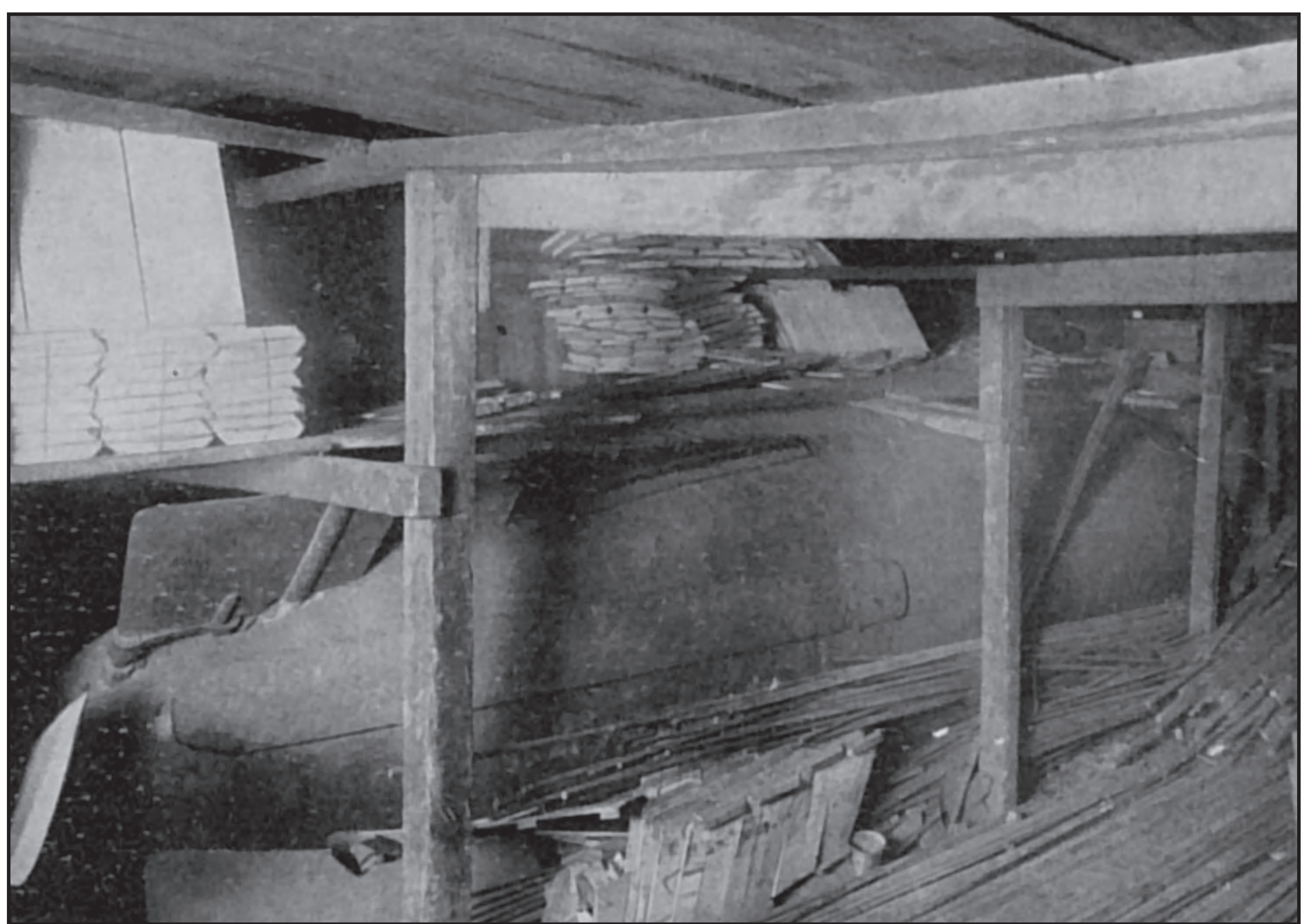
FENIAN RAM TO BE EXHIBITED IN NEW YORK FAIR

Samuel A. McCracken Finds Famous Sub Rusting on New Haven River Bank.

New York, Oct. 13.—The Fenian Ram, one of the early submarines built in 1874 by J. P. Holland for the purpose of attack in Ireland, which for the last 40 years rested on the bank of Mill River, New Haven, will be brought to New York city. It will be exhibited at the Ir' Fair.

The man who has discovered and brought this little submarine, the use of which preceded in date that recently sent from Philadelphia to the Musum of Natural History in New York, is Samuel A. McCracken, formerly general manager of the Barnum

The Bridgeport Times and Evening Farmer, October 13, 1916



The Fenian Ram relegated to storage in New Haven, Connecticut, circa 1910. *Courtesy of Dr. Richard Morris*

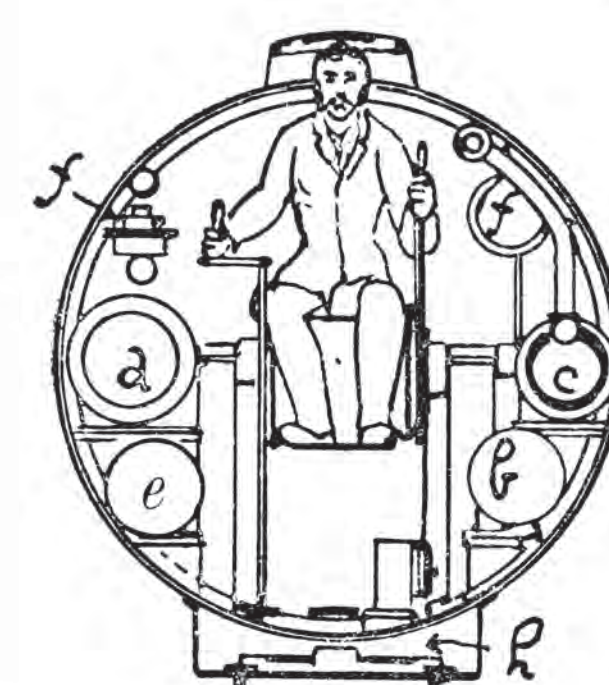
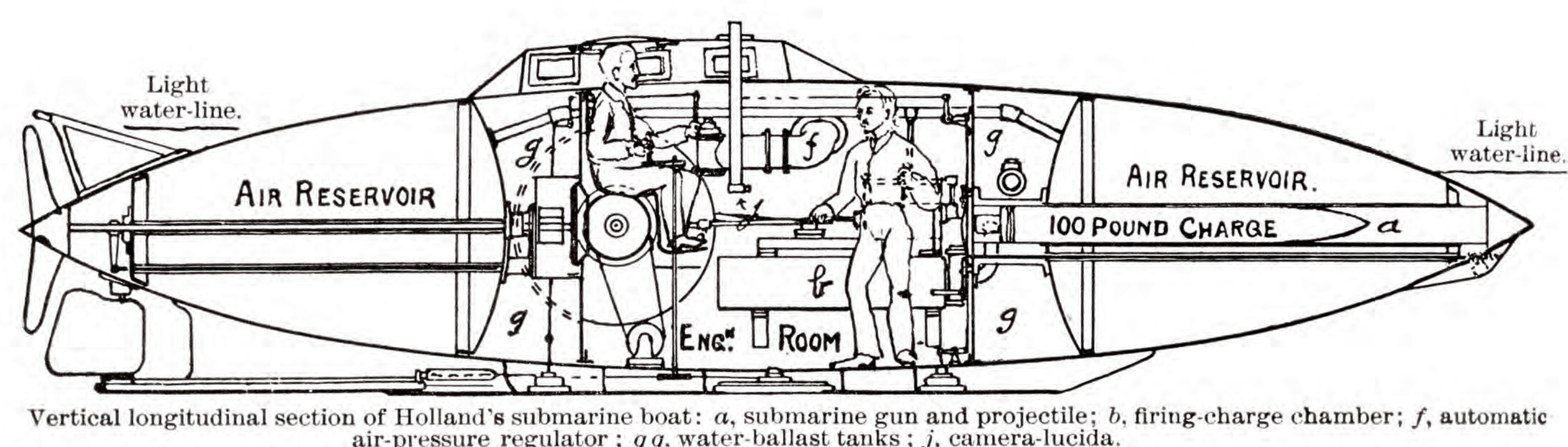


FIG. 5.—Vertical cross-section of Holland's submarine boat: *b*, firing-charge chamber; *c*, air-compressor; *d*, petroleum engine, 20 effective horse-power; *e*, engine air compressor; *ff*, automatic air-pressure regulators; *h*, man-hole for diver.

Diagrams from the *Universal Cyclopedia and Atlas Volume XI, 1902*

The Submarine's International Implications



John Holland dreamed that his submarine would stop naval warfare, by proving so dangerous to warships that navies would become redundant. As we know today, Holland's dream did not come true. While Holland's vessel did not put an end to the navies of the world, it did change them forever.

“...which may or may not play an important part in the navies of the world in the years to come...”

The New York Times, May 17, 1897, of the *Holland VI*

Despite a lack of interest from the United States Navy during his early trials, the world was watching with great interest. Irish revolutionaries funded his early work. The British government sent spies to learn about this potential threat. While in production, the *Fenian Ram* was visited by representatives of Germany, Italy, Sweden, Russia and Turkey. The Turkish Sultan was the first world leader to try and commission a vessel for himself, requesting that Holland build him one, in 1879.

When the *Holland VI* was commissioned by the United States Navy in 1900, it marked a moment of change for the navies of the world. Before the end of the same year, the United States had commissioned another six ships. The Russian Government ordered five and one was sold to the Netherlands. Even the British Navy, the intended victim of Holland's early work, ordered a ship, *HMS Holland I* in 1900.

Those nations that did not buy a Holland submarine were still affected by his designs and developments. Both the French and German Navies developed submarines based on Holland's work. Nor was the interest in submarines confined to Europe. The Japanese Government expressed interest in Holland's work as early as 1897. Two Japanese counts actually accompanied Holland on one of his trials on the *Holland VI*. In 1904, the Japanese government purchased seven Holland submarines, five from the inventor's former company and two from John Holland directly.

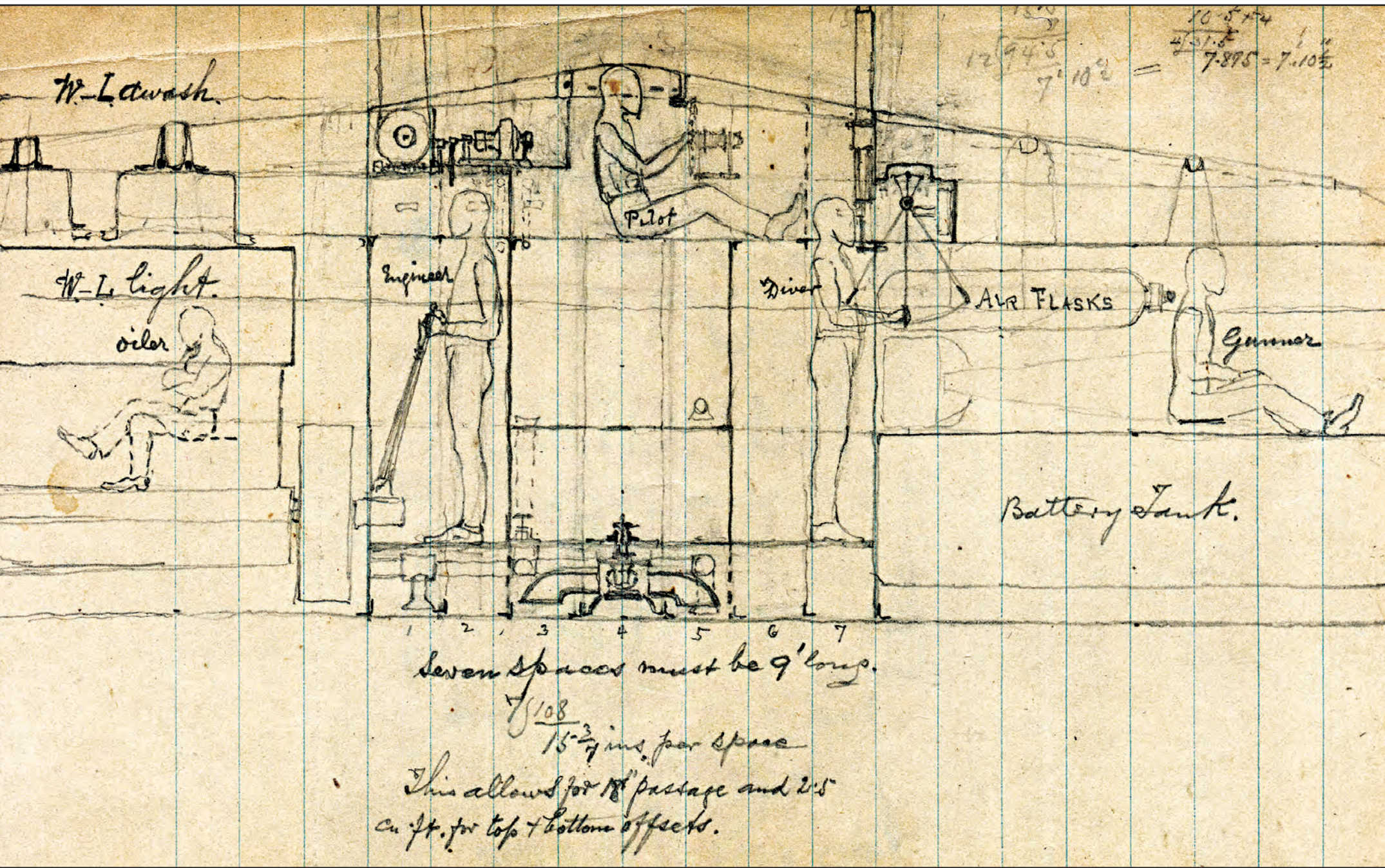


Holland's work on the submarine spanned nations and borders.
The Paterson Museum, Edward M. Graf Collection

Science and Technology



In the 1870s, the idea of a submersible vessel seemed pure science fiction. That is not to say that inventors and engineers before Holland had not been grappling with the idea. Among the most famous attempts were two American vessels, the *Turtle* (1775) and the *H.L. Hunley* (1863). Both of these vessels can be considered successes and failures. The *Turtle*, traveled underwater several times, but failed to successfully sink a British ship in New York Harbor. In contrast, the *H.L. Hunley* succeeded in sinking the USS Housatonic outside Charleston Harbor. However, the ship never returned to dock, sinking with its crew.



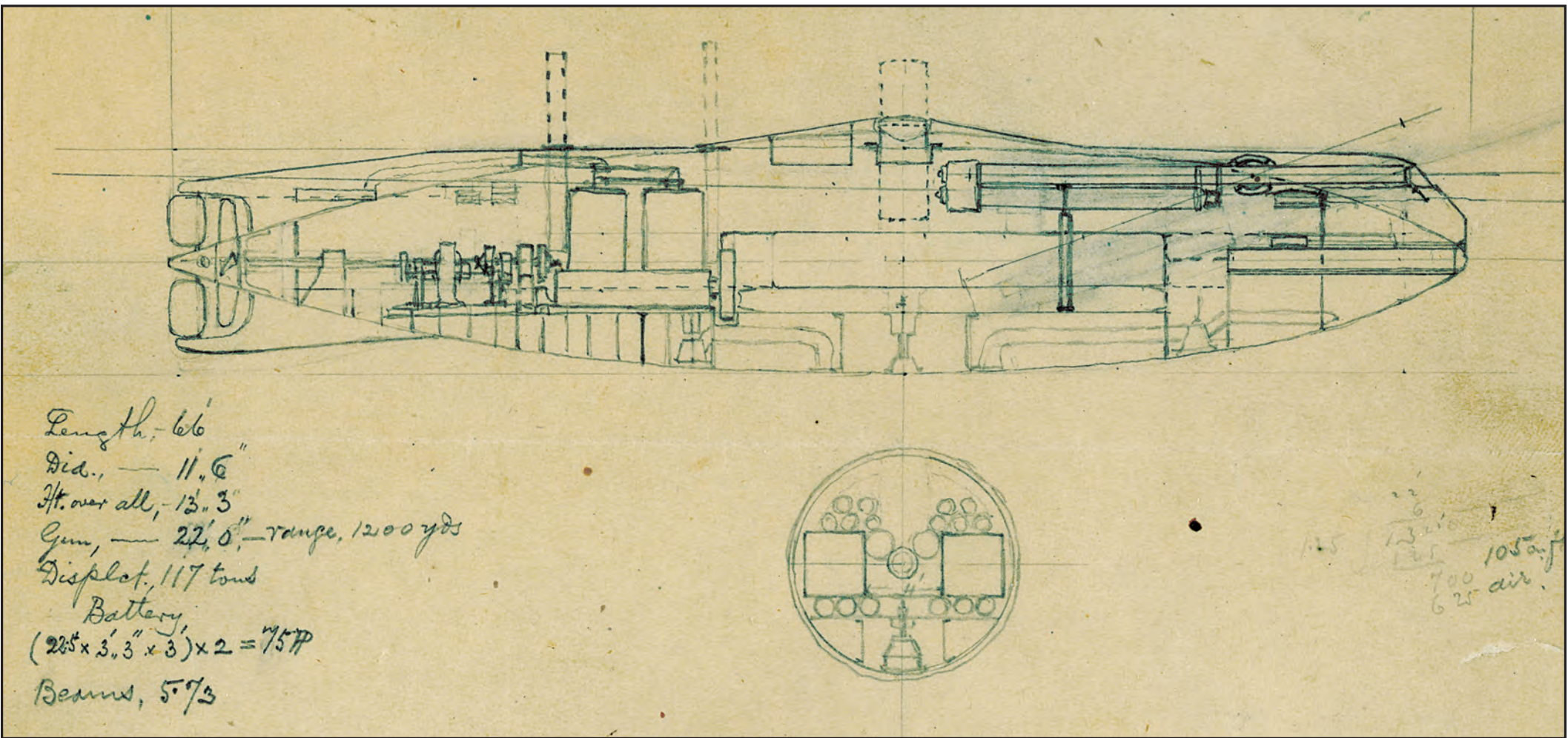
Two of Holland's sketches. The inventor generated thousands more like these in his efforts to perfect his design. *The Paterson Museum, Edward M. Graf Collection*



Holland's US Patent for "Submarine Boats," issued March, 1906. *The Paterson Museum, Edward M. Graf Collection*

“I started to consider what physical difficulties stood in the way.”

John Holland (*Washington Evening Star*, January 6, 1900)



Holland determined four major hurdles to a successful submarine:

1 Carrying Sufficient Air

When Holland designed his submarine in the 1860s and 1870s, no technology existed to filter air for reuse. Therefore, any underwater vessel had a limited amount of oxygen, based on its size. What Holland's design did was maximize the usable air by circulating it through the vessel with an air compressor. This allowed Holland's prototypes to remain underwater longer than their predecessors.

2 Preventing the Boat from Sinking

Holland needed to submerge his vessel, but more importantly, he needed to find a way to have it return to the surface. To do this, the ship would need to be in a state of near neutral buoyancy. Rather than the vessel taking on water to lower it deeper into the water, Holland's design maintained a slight positive buoyancy, which would help it to rise to the surface. To counter this positive buoyancy Holland used machines to sink the ship, which took the submarine down in a porpoise style dive rather than vertically lowering and raising the ship.

3 Handling the Vessel Underwater

Previous submarine designs had used human power, either with foot pedals or hand cranks. Holland approached the problem differently by installing an engine. As he developed his prototypes, he experimented with several different kinds of engines including electric, steam and internal combustion, as well as batteries. His final solution to the problem on *Holland VI* was a combination of different power sources.

4 Designing an outer shell that could resist the pressure of the water

All of Holland's prototypes were made of boiler iron. This type of iron was designed to withstand heat and pressure, making it the best available material for his submarine. When designing his second vessel, Holland also incorporated a second hull. In the double hull design, the outer hull prevented water from entering the vessel, while the inner hull (sometimes called the pressure hull) resisted the water pressure.

John Philip Holland & the Modern Submarine



John Philip Holland (1841-1914).
The Paterson Museum, General Photograph Collection

The story of the first modern submarine and its inventor John Holland is the story of invention, innovation, immigration and foreign relations.

John Philip Holland stepped off the gangway in Boston, in 1873. A thirty-two year old mathematics and music teacher, Holland left his native Ireland to join his brothers and mother in the Land of Opportunity. Shortly after he arrived, Holland slipped on the ice and broke his leg. While he spent three months convalescing, John kept busy reviewing some math and designs he had laid out years before, designs for a boat that traveled underwater.

“I loved the children because they were the only ones who didn’t think I was crazy.”

John P. Holland.

In 1874, John Holland was offered a teaching job at St. John’s Parochial School in Paterson. However, as he returned to the classroom, he did not forget his idea of a submarine. He continued to theorize and refine his design, finally submitting it to the United States Navy for review in February, 1875. His plans were reviewed and rejected. Many, including those in charge of the Navy, felt that underwater travel was best left to science fiction.

“A Fantastic Scheme of a Civilian Landsman.”

George M. Robeson, US Secretary of the Navy

Holland did not let rejection stop him from developing his designs. By 1878, he had secured funding through the Fenian Brotherhood and by May he was testing a prototype of his design in the Passaic River. The *Holland I*, was small and basic compared to his later designs, but it proved one very important point, Holland’s design worked.

Following the launch of *Holland I* in 1878, John would spend the rest of his life developing and refining and re-imagining his submarine. In 1900, all of his hard work was rewarded when the United States Navy commissioned the *Holland VI* (renamed *USS Holland*) to be the first submarine in the fleet. Soon, many other navies around the world followed suit. Just like that, the face of naval warfare had changed forever. And it all started with an Irish-American teacher in a 14 ft. 6 in. vessel, in the Passaic River.



Holland exiting the conning tower of the Holland VI.
The Paterson Museum, General Photograph Collection



The base of operations for the Electric Boat Company and Holland Torpedo Boat Company, New Suffolk, Long Island circa 1900.
Courtesy of Dr. Richard Morris

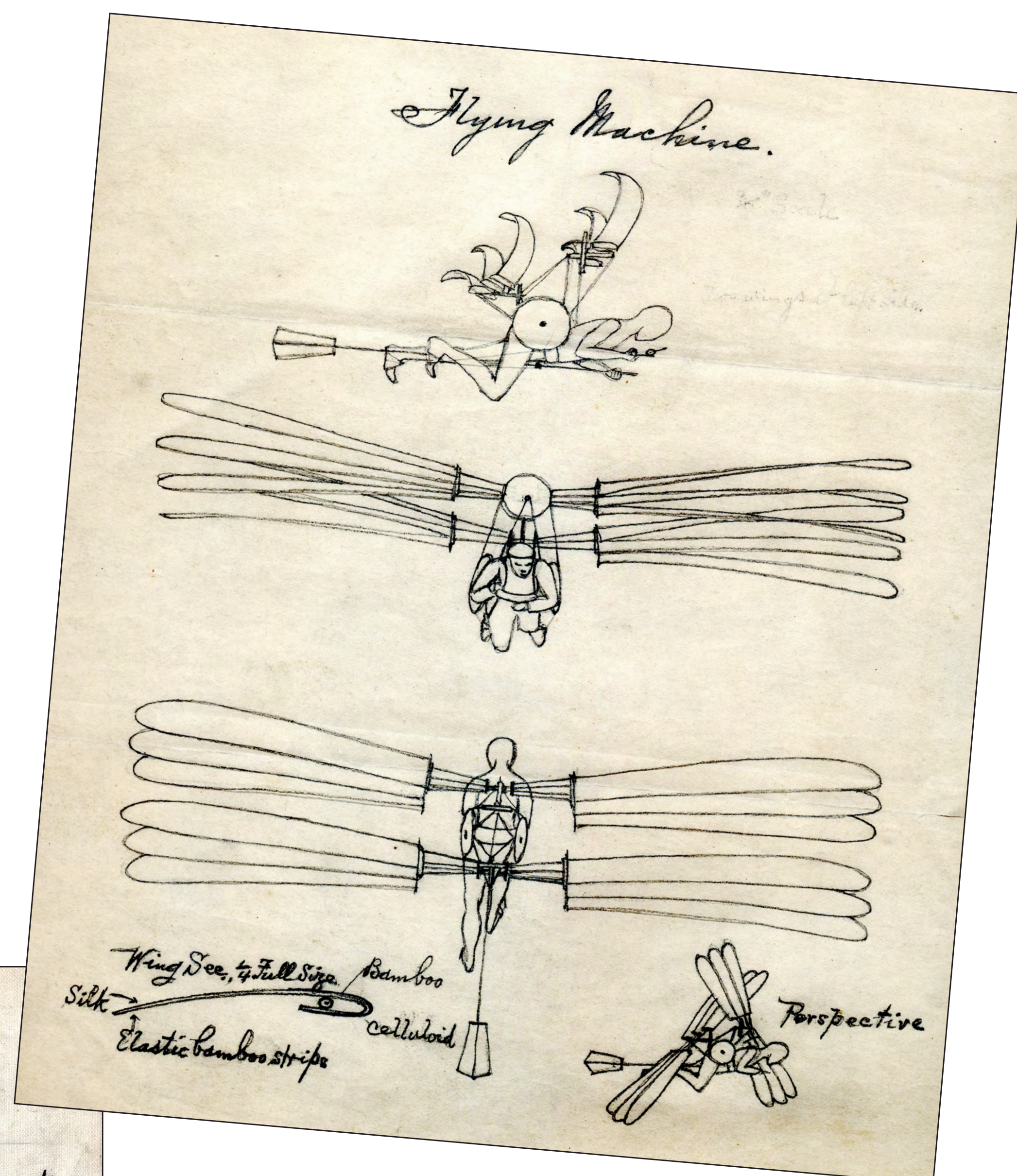
Thoughts Take Flight



Today, John Holland is known for inventing the modern submarine. However, some of his first designs and plans were for machines that would travel in the air. John Holland began studying flight as early as 1862, while he was still a teacher in Ireland. He completed his first design for a flying machine in 1863, long before he concentrated his focus on underwater travel.

While Holland's flying machines never made it off the page, his study of flight would influence his later work. Unlike other inventors of the time, Holland focused his attention on nature. He studied bird flight extensively. By observing nature, he developed an understanding of aerodynamics that was far ahead of his time. He would later apply this knowledge of currents and air flow to his work on the submarine.

Even after he became deeply involved in developing his submarine, flight continued to be of interest to Holland and he returned to its study throughout his life. In 1891, Holland wrote *The Practicality of Mechanical Flight*, which included twenty-one drawings. His designs included propellers on springs that adjusted their own pitch, based on wind pressure. This arrangement is seen in both helicopters and airplanes today.



Samples of some of Holland's flight designs.
The Paterson Museum, Edward M. Graf Collection

