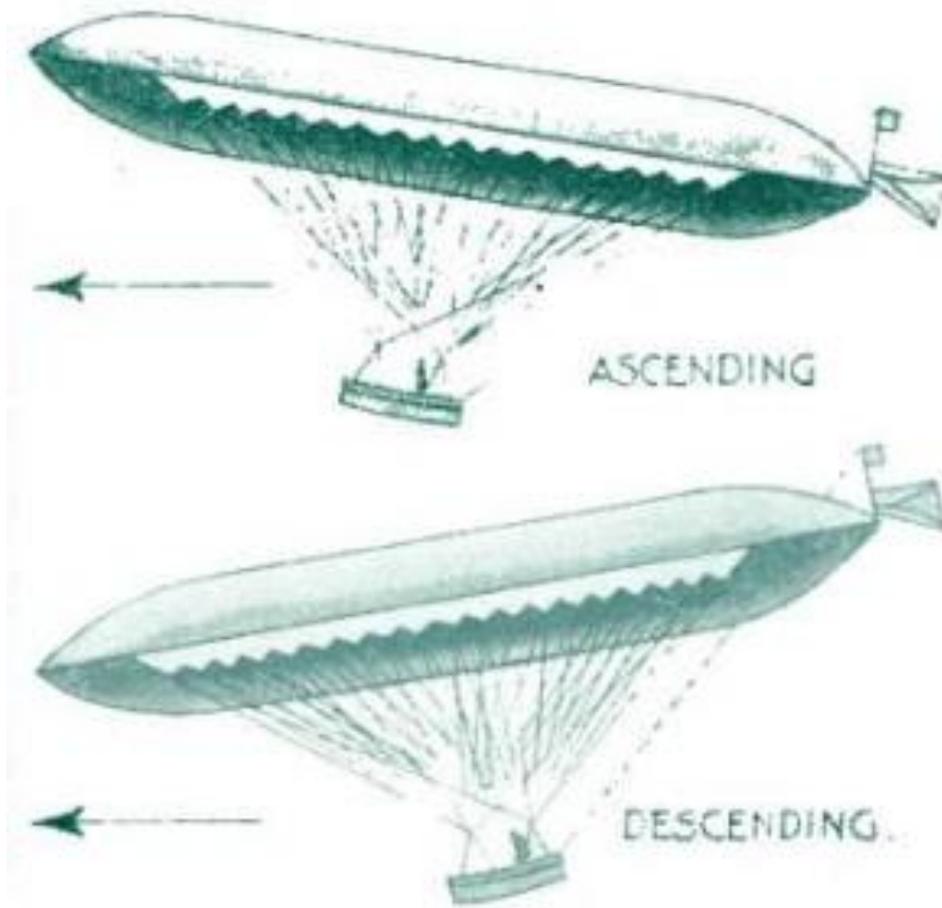


Solomon Andrews' *Aereon 1 & 2*

Peter Lobner, Updated 3 April 2021

Back in the 1860s, Dr. Solomon Andrews invented the directionally maneuverable, hydrogen-filled airship named *Aereon* that used variable buoyancy and airflow around the airship's gas envelope to provide propulsion without an engine. The gas envelope on the original *Aereon* airship consisted of three side-by-side, cigar-shaped balloons, each with seven internal cells containing the hydrogen lifting gas. The balloons formed a gas envelope measuring 80 feet (24.4 meters) long and 13 feet (4 meters) wide.

- Buoyancy of the airship was controlled by venting some hydrogen lift gas or dropping some sand ballast.
- The angle-of-attack (pitch angle) of the gas envelope was controlled by moving the center of gravity of the gondola (i.e., by moving people in the gondola fore and aft as needed)
- Propulsive force was generated by alternating between positive buoyancy (lighter-than-air) flight and negative buoyancy (heavier-than-air) flight, and by coordinating the pitch angle of the gas envelope.
 - During a buoyant ascent, the pitch angle was adjusted to as much as 15 degrees up. Airflow along the top surface of the envelope moved from bow to stern and drove the airship forward. The airship can continue to ascend until it reaches its "pressure altitude" where the decreasing atmospheric air density reduces airship buoyancy from positive to neutral.
 - During a semi-buoyant descent, the pitch angle was adjusted to as much as 15 degrees down. Airflow along the bottom surface of the envelope moved from bow to stern and continued to drive the airship forward.
- Direction was controlled by a rudder at the stern of the airship

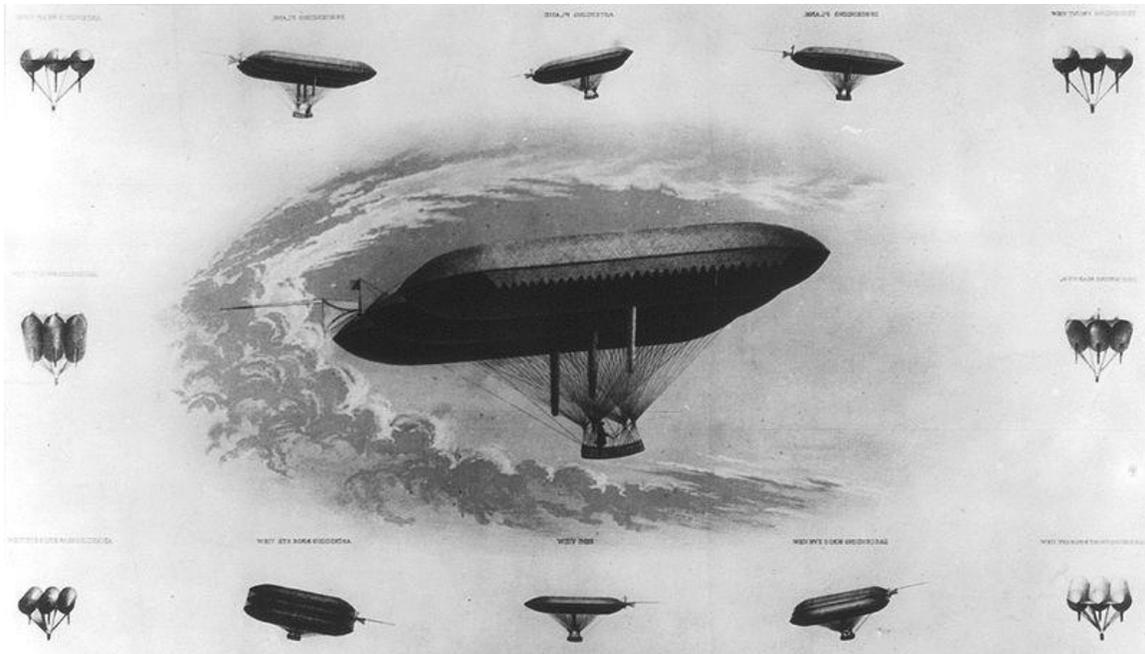


Source: Popular Science Monthly, January 1932

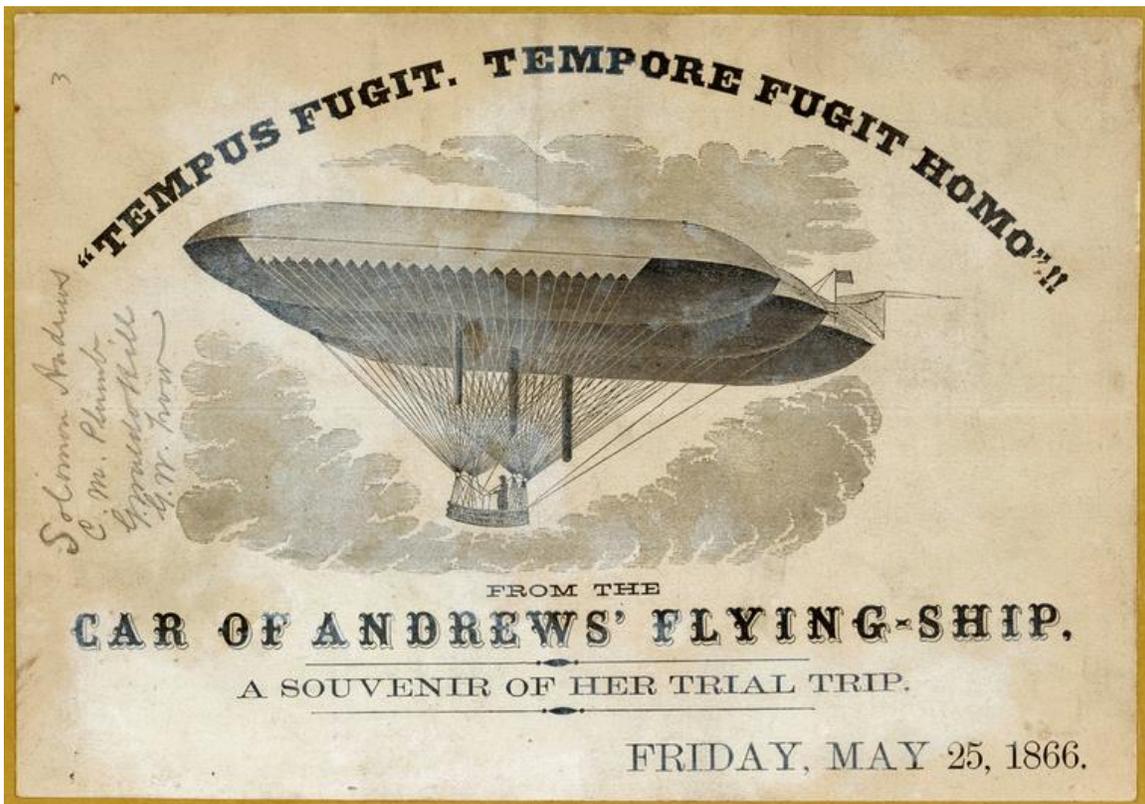
Andrews first flew Aereon over Perth Amboy, NJ on 1 June 1863 and flew at least three times more. With Aereon, he demonstrated the ability to fly in any direction, including against the wind, make broad 360-degree turns, and navigate back to and land at his starting point. Aereon's gondola could carry the pilot and three passengers.

On 5 July 1864, the US Patent Office issued Patent # 43,449 to Solomon Andrews for his invention of a balloon that was capable of directed flight and could even be flown against the wind. You can read the patent here:

<https://patents.google.com/patent/US43449>



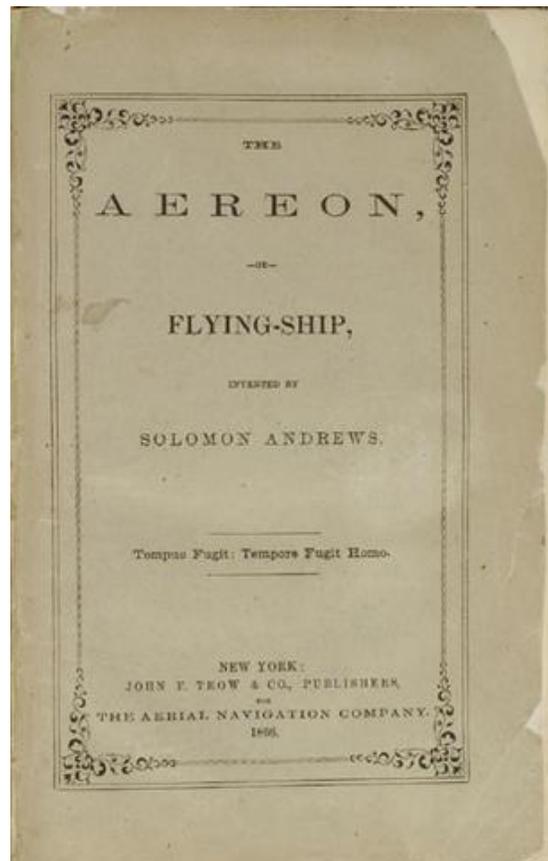
Lithograph of Solomon Andrews's first airship "Aereon"
 Source: United States Library of Congress's Prints and Photographs
 division, digital ID cph.3b01438.



Source: Skinner Auctioneers

Andrews' second airship, *Aereon 2*, had a different gas envelope design, described as "a flattened lemon, sharply pointed at both ends." *Aereon 2* also used a different approach for controlling buoyancy. The new approach used a complex set of ropes and pulleys to squeeze or release external pressure on the hydrogen gasbags, thereby changing their volume and how much air was being displaced. *Aereon 2* flew over New York City on 25 May and 5 June 1866. The second trip ended up about 30 miles away with a landing in Oyster Bay, Long Island. This was Andrews' last flight.

Andrews organized the Aerial Navigation Company, which was chartered in November 1865 for "the transportation of passengers, merchandise and other matter from place to place." The firm intended to build commercial airships and establish regular airship service between New York and Philadelphia. During the post-Civil War economic crisis, many banks failed and Aerial Navigation Co. went bankrupt, ending the plans for the first commercial passenger and freight air service in the world.



Source: Worthpoint

Variable buoyancy propulsion was not demonstrated again for almost 140 years, when, in the early 2000s, New Mexico State University conducted an indoor test flight of their subscale Advanced High-Altitude Aerobody (AHAB) variable buoyancy propulsion prototype airship. Almost two decades later, in 2019, the UK Phoenix team demonstrated variable buoyancy propulsion during an indoor test flight of their Phoenix unmanned aerial vehicle (UAV) airship. In contrast to these two modern-era test flights, Solomon Andrews flew *Aereon 1* and its successor, *Aereon 2*, from 1863 to 1866, and demonstrated the ability to fly with passengers against the wind, covering considerable distances in an intended direction and landing safely.

For additional information

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- Rare Pioneering Aviation Pamphlet, *Aereon*, Aerial Navigation Co, 1866; <https://www.worthpoint.com/worthopedia/1866-pioneering-aviation-pamphlet-111762012>