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Marc Mercado

Southern Illinois University Carbondale

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Marc Mercado

The Rise and Fall of Lighter-Than-Air Aircraft, 1783 – 1937

When one thinks about military aircraft, they rarely think about anything other than jets or helicopters, both of which are heavier-than-air aircraft. From the perspective of the twenty-first century, it is almost humorous to imagine a fragile, slow paced, and highly flammable gas-filled balloon gliding over a battlefield and a hailstorm of bullets. However, hot air balloons and zeppelins, which are both lighter-than-air aircraft, saw a great deal of military use until the end of the First World War. It is perhaps even stranger to think that experts considered lighter-than-air aircraft, which in retrospect seem little more than flying fire hazards, the safest and most effective form of military and commercial air travel. Though lighter-than-air aircraft have existed over twice as long as their currently more widely used heavier-than-air counterparts, due to a perceived lack of usefulness and safety, they saw a sharp decline in both military and commercial use in the early twentieth century.

How did lighter-than-air aircraft rise to such popularity for both military and commercial use, only to fall out of use so quickly in both arenas? Heavier-than-air aircraft eventually surpassed lighter-than-air aircraft. Ultimately, the preference for heavier-than-air aircraft led to their further development, as well as the obsolescence of lighter-than-air aircraft in most applications. Despite their long history of functionality, in terms of flight range, safety, and flight control, their ultimate demise came from a relatively small number of specific catastrophic events that ruined their reputation in the public's eyes. I argue that these specific events had a

great deal to do with the ultimate termination of the large-scale use of lighter-than-air aircraft. By analyzing the birth, development, and failures of lighter-than-air aircraft in its various military and commercial applications from the eighteenth to twentieth century, one can see the events that caused their rise and eventual fall.

One way to study this topic is by analyzing France's development of the hot air balloon and Germany's development of the Zeppelin. Hot air balloons and Zeppelins exemplify lighter-than-air aircraft used for military and commercial applications. Germany and France emerged as respected leaders in the development of lighter-than-air aircraft before America and the Wright Brothers revolutionized the use of heavier-than-air aircraft. In addition, both hot air balloons and Zeppelins saw a drastic decline in use for military and commercial purposes after France and Germany adopted heavier than air aircraft. This analysis of the birth and decline of the lighter-than-air aircraft begins with the earliest example of a lighter-than-air aircraft—the hot air balloon.

Credited with the creation of the first hot air balloons, brothers Joseph-Michel and Jacques-Étienne Montgolfier's success came using a large globe shaped burlap sheet and three thin layers of paper lining the inside of the sack. On June 4, 1783, the brothers demonstrated their first successful public balloon launch, in Annonay, France. The Balloon had a volume of 28,000 cubic feet, and traveled a distance of 1.3 miles, reaching an estimated altitude of 5,200 – 6,600 feet.¹ The creation of the balloon came as a way to test what they believed to be the discovery of a new gas. Theorist thought that this gas, known as “Montgolfier Gas,” formed above fire, and had the ability to give objects lift when enclosed in an envelope shaped apparatus. They observed this principle in several ways, such as watching air pockets form in their cloth laundry as it dried by a fire, and by watching paper rise as it burned.² We now know

that the “Montgolfier Gas,” which they claimed was lighter than air, is merely normal air that becomes more buoyant when it is heated. The brothers’ principal for lighter-than-air gas became one of the most important contributions to the development of lighter-than-air aircraft.

Although unmanned, the first successful balloon flight of the Montgolfier brothers drew a great deal of attention. This attention came not only from the public, but also from academics, nobles, and the king and queen of France: Louis XVI and Marie Antoinette. One of their most notable flights occurred over the Palace of Versailles on September 19, 1783, in the presence of France’s royal family.³ A wallpaper manufacturer by the name of Jean-Baptiste Réveillon collaborated with the Montgolfier brothers to create an elaborate version of their balloon. The balloon elegantly adorned with golden zodiac signs and a light blue background attracted crowds of onlookers to their creation.⁴ The new balloon, slightly larger than its predecessor at 37,500 cubic feet and seventy-five feet tall, was able to soar for about two miles reaching heights of 1,500 feet with the capacity to land safely.⁵

Impressed by the subsequent showcases that many members of the French nobility and elite sponsored, the public became hot air balloon enthusiasts. This brought hot air balloons further into the realm of commercial use, and led to their further development. For instance, many of the balloons in use by hot air balloon enthusiasts displayed similar characteristics to that of Jean-Baptiste Réveillon’s balloon. Réveillon’s balloon replaced the burlap and paper sack with an envelope of taffeta coated with alum to prevent fire damage. Balloons grew in size and elegance as hot air balloons increasingly became a public spectacle.⁶

One of the most significant developments concerning hot air balloons occurred on December 1, 1783. The first manned hydrogen balloon, piloted by Professor Jaquis Charles and brothers Anne-Jenne and Nicolas-Louis Robert, ensued less than five months after the

Montgolfier brothers publicly launched their first unmanned balloon. Many remember Charles, a renowned physicist and aeronaut in his time, for his principal the “Charles Law,” which explains how gas expands when heated. His December flight became a milestone in aviation particularly because it lasted two hours and five minutes, achieving a flying distance of over 22 miles. However, in terms of elevation, Charles limited the balloon’s range at 1,500 feet due to his employment of “chancers,” which were men riding horses with the balloons ropes tied to them thus ensuring the balloon did not ascend uncontrollably. By offering the general public a close up view of the balloon’s launch, the men financed the spectacle with a fee of one crown per person. The experiment became not only a milestone for aviation, but also set an example of commercial aviation, as such.⁷

The launch drew a reported crowd of over 400,000 people, including Benjamin Franklin, who served as the American diplomat in France at the time.⁸ Franklin remained skeptical about the practicality of hot air balloons in their state at that time. In a letter written in 1783 to Sir Joseph Banks (the president of the Royal Society of London), he noted that hot air balloons seemed difficult to control and maneuver. He wrote: “These Machines must always . . . be driven by the Winds. Perhaps Mechanic Art may find easy means to give them progressive Motion.”⁹ Charles initially created his balloon to test his theory about gas density. English physicist Robert Boyle determined the absolute pressure and density of gas, given a constant temperature, now known as Boyle’s Law. That concept formed the basis for Charles’ theory.¹⁰ Another English physicist, by the name of Henry Cavendish, also influenced Charles. In 1766, Cavendish found that hydrogen was seven times lighter than air. That fact also helped inspire Charles’ theory that a hydrogen filled balloon could produce a greater amount of lift than one filled with heated air.¹¹

Little more than a decade after Jaquis Charles's first flight using a hydrogen filled hot air balloon, armies already used hot air balloons in battle. On April 2, 1794, the First French Republic founded the French Aerostatic Corps as a branch of the Army of the North.¹² Created during the French Revolution, the branch's use of hot air balloons provided France an advantage over the encroaching Austrian, Dutch, and British forces. In 1793, the First French Republic's Committee of Public Safety experimented with the use of military hot air balloons, and had undergone several unsuccessful attempts to create an air ship. One of the main issues that the Committee of Public Safety faced when attempting to create both hydrogen filled hot air balloons and air ships, was a cost effective and steady supply of hydrogen. When Jaquis Charles created his balloon, he required nearly a quarter ton of sulfuric acid and nearly a half ton of scrap iron to create the hydrogen necessary to lift a balloon large enough to carry himself and the Robert brothers.¹³

Alternative means of hydrogen production that did not require sulfuric acid developed in late 1793. As a result, it became feasible for France to create military hot air balloons, in 1794. However, they abandoned the creation of a French airship. Producing large enough quantities of hydrogen to fill the substantially larger air ships, and the utter lack of ability to control a large-scale air ship, proved cost inefficient.

The French Aerostatic Corps first employed hot air balloons during the Battle of Fleurus, on June 22, 1794. Due to the desperation of the French forces, who at the time were conscription based and facing larger professional armies, the French forces attempted to use any equipment that might provide an advantage over the enemy, including their modified hot air balloon. Made up of skilled carpenters and chemists, the French Aerostatic Corps created a hot air balloon with the capacity to stay in the air for over nine hours at a time, enabling extensive reconnaissance

missions.¹⁴ It is significant that the modifications made for battle use created hot air balloons that could stay in the air nearly five times longer than the model created by Jaquis Charles, a little more than a decade prior to the battle. During the battle the French forces employed only one balloon, named *L'Entreprenant* or “the enterprising one.”¹⁵ The balloon gave the French forces a distinct advantage over the encroaching armies, by allowing them to gain vital information on enemy troop movements in a matter of minutes. These operations would have taken scouts on horseback hours or even days to gather and relay.¹⁶ The French scored an overwhelming victory at the Battle of Fleurus, and gave a great deal of credit to the Aerostatic Corps for their use of the hot air balloon. One officer compared fighting without hot air balloons to “dueling while blindfolded.”¹⁷

Though the French had one successful military application of a hot air balloon, subsequent failures permanently lowered the prestige of hot air balloons for military use. One of the most damaging factors to the reputation of military hot air balloons occurred at the Battle of Würzburg, in 1796. The use of three hot air balloons provided no tactical advantage during the battle. The army of the Reine suffered a distinct loss to Austrian forces despite using three hot air balloons. During the battle, the Austrians captured the Second Aerostatic Company and their balloons. Upon their release, the army transferred the company from Moreau’s army of the Reine to the Army of Sambre-et-Meuse, which was under the command of General Lazare Hoche. Hoche refused to use hot air balloons in his army. Writing to France’s minister of war, he requested the removal of the balloons from his service, claiming that they were useless. After the loss of the Battle of Würzburg, additional French commanders protested the use of military hot air balloons. For example, this occurred during the Napoleonic campaign in Egypt, which was from 1798-1799. The French sent two hot air balloons to aid their forces, but none ever saw use

in battle. Following the Battle of the Nile, the elimination of one came via fire, while officers used the other purely for entertainment. With commanders refusing to use the hot air balloons in combat, the French Aerostatic Corps disbanded in 1799.¹⁸

There is an argument that France's reluctance to use hot air balloons in the military had more to do with the reputation of hot air balloons, rather than their practical use. However, while the use of hot air balloons for commercial entertainment continued in France, the military did not use hot air balloons in battle again, until 1859. At that time they used the balloons to deliver mail, which was during the Franco-Prussian War.¹⁹ Even after the reintroduction of hot air balloons into the French military, they never regained their prestige as perspective battle winning military technology, nor as a viable ways to efficiently transport people or goods. Hot air balloons would forever remain little more than a novelty in the eyes of both the military and commercial industry. Organizations perceived the balloons as slow, hard to control, and ultimately impractical for most tasks outside of entertainment. However, the decline of hot air balloons did not mark the end of interest in lighter-than-air aircraft.

By the end of the nineteenth Century, France's dominance over the development of lighter-than-air aircraft ended when a German, Count Ferdinand Von Zeppelin, set out to improve upon the hydrogen based lighter-than-air aircraft. In 1863, Von Zeppelin served as an observer in the Union Army during the Peninsula Campaign of the American Civil War.²⁰ Von Zeppelin's connections enabled this position via a German-born general in the Union army, General Carl Schurz. President Abraham Lincoln approved Von Zeppelin's endorsement, allowing Von Zeppelin to serve under General Schurz.²¹ Von Zeppelin's objective consisted of observing the various military advancements of the American military, thus further enabling and

influencing the creation of German technology. The Union Army's use of hot air balloons as scouting devices sparked his interest.²²

Von Zeppelin began his fascination by observing the practical uses of the hot air balloons used by the Balloon Corps, which was the Union Army's military hot air balloon division. Unfortunately, Von Zeppelin arrived at their division while the Corps was in the process of shutting down. The Balloon Corps Chief Aeronaut, Thaddeus S.C. Lowe, had recently resigned due to disputes over his wages, and the entire division was without effective leadership. Wanting to learn more about the various uses of hot air balloons Von Zeppelin left the service of General Schurz and traveled to Saint Paul, Minnesota, where he received knowledge of safer and more in depth use of hot air balloons.²³ Von Zeppelin observed a former Union Army balloonist, by the name of John Stiner. This connection and observation enabled Von Zeppelin's first ascent in a 41,000 cubic foot coal gas powered balloon. The balloon ascended roughly 600-700 feet, and gave Von Zeppelin the inspiration for his greatest contribution to lighter-than-air technology.²⁴

Lack of steering and lifting capabilities proved the most significant obstacle Von Zeppelins encountered with the balloons. In 1874, he sought to solve the problem of lift by having a frame enclose multiple balloon cells, which would allow for both steering and use of several balloons worth of lifting power. The key to his design was the ridged structure that allowed for a stable and fully controllable flight.²⁵ In 1884, French engineers Charles Renard and Arthur C. Krebs created the first fully controllable free flying Airship, named *La France*.²⁶ The one hundred and seventy-foot-long, battery powered airship beat Von Zeppelin to the market by several years, yet it inspired him to seek further means to get his airship into production.²⁷

In 1887, Von Zeppelin wrote a letter to King Charles I of Württemberg requesting a military contract to build airships for the Kingdom of Württemberg's military. Von Zeppelin

argued that Germans should not fall behind the French in technology, and that there was a lack of German innovation in the field of aviation. Skeptical, the King of Württemberg indicated that he wanted to see a proof of concept before he approved Von Zeppelin for a military contract. In 1891, Von Zeppelin secured investors into his enterprise and informed the King of Württemberg that the construction of his airship began. One of his first revisions to his original plans included the addition of four propellers on the belly of the airship to help add lift and control to the vehicle. He also secured a far more efficient motor to power his airship from Daimler Motors Corporation (*Daimler-Motoren-Gesellschaft*). The addition of Daimler's motor allowed Von Zeppelin's airship to fly for several hours. This technology drew a comparison between airships and cars. The latter, another innovation in transportation technology that transpired at about the same time.²⁸

By 1894, Von Zeppelin submitted his plans to construct a controllable airship-train, with several carrier structures arranged one behind another, to the Prussian Airship Service. The capabilities of the airship included manual steering, the capacity to carry nearly six thousand pounds, and the ability to stay in the air for several hours. The government lacked faith in the airship's ability to sustain flight long enough for any use. Initially, they approved the minimum requested funds, but withdrew their offer shortly afterwards, in 1895. The loss of the prospect for a military contract in 1895 drove away many investors, and caused public opinion of Von Zeppelin's airship to decline. However, that same year Von Zeppelin secured an important investment from industrialist Carl Berg, as well as an updated schematic from famed airship constructor David Schwarz. To fund the endeavor Von Zeppelin, Berg, and another investor, Philipp Holzman, formed a joint stock company in 1898: the Society for the Promotion of Airships (*Gesellschaft zur Förderung der Luftschiffart*). With an eight hundred thousand mark

cost to construct, Von Zeppelin used a large portion of his personal wealth to cover half of the cost to build his airship.²⁹

With a solid plan and funds secured, the construction of the LZ1 (*Luftschiff Zeppelin 1*) began in 1895. In 1900, the company completed the LZ1. It measured four hundred twenty feet in length, and had a hydrogen capacity of over four hundred thousand cubic feet. The LZ1 had two fifteen horsepower Daimler engines, each powering a pair of propellers on the front and the back of the airship's belly. The LZ1's completion reignited public interest, and began attracting crowds at its events.³⁰ The events that followed, however, further sowed the seeds of public distaste for Zeppelins.

On July 2, 1900, the first Zeppelin flight took place over Lake Constance. Although the ship displayed no notable problems during the launch or flight, landing the ship badly damaged it. Two more flights took place that same year on the seventeenth and twenty-fourth of October. On its final flight, the LZ1 attained a speed of 13.4 miles per hour, which was significantly better than the previous record holder, *La France*. Despite this fact, investors focused on its inability to land without crashing and remained unimpressed.³¹ This caused shareholders to abandon the company and funding came to a grinding halt. The liquidation of the company's assets accompanied the dismantling of the LZ1. Von Zeppelin, not willing to give up on his dream, salvaged most of the parts from the LZ1, which he intended to use in the creation of an improved airship.³²

Von Zeppelin, in a desperate effort to keep his dreams of a successful airship alive, managed to find the funds to create his second Zeppelin, the LZ2. He did this by investing one hundred thousand marks of his own money (the remainder of his fortune) and mortgaging his wife's estate. Von Zeppelin's perseverance attracted a great deal of attention. This drew in

several important investments, including a fifty thousand-mark investment from the Kingdom of Prussia. The King of Württemberg raised and donated one hundred twenty-four thousand marks to Von Zeppelin, through the arrangement of a special state lottery.³³

On January 17, 1906, the LZ2 attempted a cross-country flight. The first hours of the flight were smooth and peaceful, setting new records for length spent in the air. However, fortune was not with Von Zeppelin that day; engine failure in both the engines caused the LZ2 to make an emergency landing. While on the ground, a storm tore the LZ2 to pieces, damaging the grounded Zeppelin beyond repair.³⁴ After salvaging what little he could from the LZ2, Von Zeppelin managed to find enough public support to fund the creation of the LZ3. The LZ3's successes lied in its ability to traverse Switzerland. By that time, the Prussian military had found a new interest in Von Zeppelin's work, and offered him a military contract. The caveat was that he had to demonstrate the Zeppelin's air sustainability for at least twenty-four hours before the Prussian military would purchase any of his airships. Von Zeppelin agreed and created the LZ4 before securing any funds from the government. This decision proved a near career-ending flaw.³⁵

The LZ4's traveling distance of over two hundred forty miles, and a cruising altitude of twenty six hundred feet, made it one of the greatest airships ever built.³⁶ On August 5, 1908, the LZ4 began its twenty-four hour endurance test. Roughly, eighteen hours into the test a storm caused mechanical problems. Von Zeppelin decided to anchor the airship and break for a meal. When he returned to the airship, he found it loose from its anchor. It crashed and burned in a tree. Falling short of its twenty-four hour mark, the government refused to buy either of his two remaining Zeppelins.³⁷

Von Zeppelin found himself deeply in debt and in possession of two expensive airships not fit for sale. Von Zeppelin's seemingly imminent doom to a life of poverty reversed due to the newspapers picking up his story. Von Zeppelin's harrowing tale of business venture and financial risk in the name of technological innovation resonated with the public. Von Zeppelin's story attracted investment into his company in the form of large investors, as well as small donations from regular citizens inspired by his bravery and sacrifice. The donations he received totaled over six million marks.³⁸ In response to such large public interest, Von Zeppelin founded DELAG, or *Deutsche Luftschiffahrts-Aktiengesellschaft* (German Airship Travel Corporation). DELAG became known as the first commercial airline company. DELAG saw a fair amount of success, transporting 34,028 passengers on 1,588 commercial flights without a single death or injury before the start of the first world war and the Zeppelin's military career.³⁹ Despite the commercial success, Zeppelin travel, in reality, was little more than a novelty even at its height.⁴⁰

Standard airship tickets for a four-hour flight between Dusseldorf, Prussia to Lucerne, Switzerland cost nearly \$1,900 (USD) in today's currency.⁴¹ In comparison, travel via railroads was as fast, yet far more economical. In addition, the unpressurized cabin smelled strongly of fuel due to a lack of air filtration. With little to no turbulence control, the ride was also far from smooth.⁴² By 1939, even with the refinement of commercial Zeppelins, the specs of the LZ10 were far from favorable, especially when compared to the first commercial airplanes. The speed of the LZ10 peaked at mere forty-four miles per hour, with a cruise range of nine hundred miles, and a maximum passenger capacity of twenty.⁴³ This was especially troubling when it came to its use as a military vehicle during the First World War.

On January 15, 1915, Imperial German forces began Zeppelin bombing raids over London, which began the Zeppelin's military career.⁴⁴ Zeppelins had the prospect of being

extremely useful during combat due to their ability to fly at high enough altitudes to avoid enemy anti-aircraft guns. Anti-aircraft guns lacked the ability to fire shells at the altitude in which Zeppelins flew. However, the guns prevented Zeppelins from flying at low altitudes disabling their accurately. During the early stages of the war, Imperial German Zeppelins had a distinct advantage over British airplanes, as weaponized airplanes did not yet exist. Though Royal Airforce pilots had used pistols, rifles, and grenades during aerial combat, since 1914, the British did not acquire effective fighter planes until the creation of the Royal Aircraft Factory, in July 1915, which manufactured a biplane, the F.B. 5, with a front facing Lewis machine gun.⁴⁵ During the first Zeppelin bombing raid of London, the English sent unarmed airplanes into the sky to chase the Zeppelin away, in hope that the Zeppelin would drop low enough that an anti-aircraft gun could hit it. This was England's only defense against the Imperial Zeppelins.

On November 1, 1915, *The New York Times* produced a column concerning the ongoing Zeppelin bombing raids. They cited a *London Globe* reporter who stated, "The public knows now that the Zeppelin, choosing its own time and circumstances for attack, is particularly immune against the ordinary weapons of aerial warfare. The only way to hit the enemy is to strike at him as he strikes at us. ..." ⁴⁶ Despite the Zeppelins seemingly impenetrable nature early in the war, the *New York Times* listed the number of casualties from each Zeppelin bombing raid, which appeared to be surprisingly low. Each raid tended to only kill or injure a few dozen people, causing minimal damage to London.⁴⁷ Considering the extreme expense of each Zeppelin produced, the ability for use only in ideal weather conditions, and their capacity to cause little damage to the enemy other than fostering fear, it is easy to see why Zeppelins began to decline in military use. These factors caused the Zeppelin's unsustainable growth when compared to the

development of airplanes, or heavier-than-air aircraft, which proved cheaper to develop and provided better weapons options.

The first incident of a Zeppelin shot down by allied forces occurred on November 28, 1916. First-Lieutenant Egbert Cadbury and his team of four five Royal Flying Corps pilots shot down the Imperial Zeppelin L21 (LZ 61) with incendiary rounds over the North Sea near Lowestoft, England. Cadbury and his squadron attacked the Zeppelin's hydrogen-filled hull causing it to combust. This ambush occurred as the Zeppelin returned to Germany to refuel after a bombing raid. The ultimate downfall of the Zeppelin was not its ability to carry out long distance air raids, but its inability to effectively maneuver when it came under attack.⁴⁸ Cadbury himself would in fact go on to shoot down a second Zeppelin (L70 or LZ112), on August 6, 1918 over the North Sea, using the very same strategy.⁴⁹

As the First World War dragged on, airplanes became a far less expensive, and more versatile, piece of military technology. In turn, the Zeppelin became increasingly more difficult to fund and more susceptible to attacks from airplanes, both when in the air and on the ground. On January 5, 1918, an allied air raid on an Imperial airbase in Ahlhorn, Germany caused a fire, which eventually destroyed four Imperial Zeppelins.⁵⁰ This event not only financially damaged the Imperial military, but also proved that the 1915 view of the Zeppelin as an invincible and unstoppable war machine was false. Its heavier-than-air counterpart, the airplane, had fundamentally outmatched the Zeppelin. The various events where airplanes destroyed Zeppelins in the air and on the ground were a turning point. They diminished the reputation of lighter-than-air aircraft, resulting in a military shift away from their use.

Following the signing of the "Treaties of Versailles" on October 21, 1919, the age of the slow paced, barely effective, and wildly expensive military Zeppelins ended.⁵¹ Though Germany

restricted military use of Zeppelins, construction of transportation Zeppelins continued. Despite this, the Zeppelin never—at any point—proved a viable transportation vehicle for the general public. It was seemingly doomed as a novelty item for the elite since its inception into the commercial market. However, in terms of the Zeppelins' complete failure, it is widely accepted that one event above all others caused the rapid abandonment of commercial Zeppelin travel: the Hindenburg disaster. With the accumulation of disastrous events creating distrust in aeronautics, the failure of the Hindenburg became synonymous with the end of commercial Zeppelin travel.⁵²

In 1913, twenty-four years before the Hindenburg disaster, another catastrophic Zeppelin crash occurred off the coast of Heligoland, during the First World War. Known as the “The Heligoland Disaster,” the L-1 (LZ – 14) flew through a storm over the North Sea causing immediate engine failure. The Zeppelin crashed into the frigid sea killing fourteen of its twenty crew members. The L-1 was the first Zeppelin purchased by the Imperial German army, its failure created an immediate stigma. On September 13, 1913, *The New York Times* reported the Heligoland disaster, claiming the L-1 as the eighth Zeppelin destroyed by the elements in seven years. Harsh criticism from international news sources attested to the significance of its crash. A *New York Times* reporter stated, “All of these wrecks are dismissed by the Germans as *kinderkrankheiten* – their idiom for experimental difficulties.”⁵³

That report framed the dismissal as a German excuse for the failure of their airship. Additionally, the report indicated that the Germans suggested the failure of the airship as akin to the trial and error process of the railroad, and that the Germans had already built a direct successor the L-2, in which they claimed would be more durable and weather resistant. The overall response from the article showed the growing skepticism of the Zeppelin being a viable military vehicle. In a follow up article, *The New York Times* clarified that in fact fifteen of the

twenty crewmen perished, and that amongst the fifteen Captain Friedrich Metzger (the chief of the Admiralty Aviation Department) and Baron von Moltzahn (a nobleman from Mecklenburg) had died.⁵⁴ The report went on to state, “The North Sea Disaster is one in a long series in Germany’s attempt to master travel in the air. Probably no inventor has met with more discouragements and setbacks than has the persistent Count Zeppelin.” The article listed many of the problems that Von Zeppelin had while attempting to finance his airship company, and the timeline of his airship crashes.⁵⁵ In this second *New York Times* article, the clarity of the Zeppelin’s long chain of failures since its creation provided another link in the chain with the L-1 disaster. Consequently, the article indicated a growing skepticism toward the future of the Zeppelin, criticizing claims that the L-2 would be weather resistant and would not suffer from the same problems as the L-1.

The New York Times had good reason for its skepticism concerning the use of Zeppelins. On October 17, 1913, the L-2 suffered an in-flight engine malfunction igniting the airship’s hydrogen, causing the entire airship to combust. All twenty-eight crewmen died either in the fire or as a result of the two thousand-foot crash. Among the dead was Captain Felix Pietzker, the newly appointed chief of the Admiralty Aviation Department, and one of the main naval architects who designed airships for use as bombers. Within thirty-four days, the totality of deaths related to the Admiralty Aviation Department consisted of two chiefs and forty-three crewmen.⁵⁶ Following the death of Pietzker, Peter Strasser took over as the chief of the Admiralty Aviation Department, serving until his death, in 1917. He died in a fatal Zeppelin crash during the last bombing raid of London.⁵⁷ Though Zeppelins continued to function for military purposes until the end of the First World War, the disasters of the L-1 and L-2,

compounded with the deaths of three Chiefs of the Admiralty Aviation Department within a four-year span, caused a waning faith in the use of Zeppelins for military purposes.

On May 6, 1937, one of the largest airships ever constructed, the LZ129 *Hindenburg*, burst into flames during a scheduled trans-Atlantic journey from Frankfurt, Germany to Rio de Janeiro, Brazil. The event occurred while the *Hindenburg* attempted to dock at Naval Air Station Lakehurst, in Manchester Township, New Jersey. Several witnessed the disaster, most notably Chicago news reporter Herb Morrison, who provided a live broadcast exclaiming:

It's fire and it's crashing! ... This is the worst of the worst catastrophes in the world! Oh, it's crashing ... oh, four or five hundred feet into the sky, and it's a terrific crash, ladies and gentlemen. There's smoke, and there's flames, now, and the frame is crashing to the ground, not quite to the mooring mast. Oh, the humanity, and all the passengers screaming around here! ... I can't talk, ladies and gentlemen. Honest, it's just lying there, a mass of smoking wreckage, and everybody can hardly breathe and talk ... Honest, I can hardly breathe. I'm going to step inside where I cannot see it. ... ⁵⁸

News outlets worldwide repeated Morrison's recording of the *Hindenburg* disaster associating his coverage with all airship travel. This event gained significant media attention prompting an immediate decline in Zeppelin travel.⁵⁹ To this day, the cause of the fire is unclear. Theories range from electrical failure to intentional sabotage. No matter the cause, the resulting death of the thirteen passengers and twenty-two crewmen who burned in the inferno intensified the Zeppelin's demise.

The question of why lighter-than-air aircraft rose to such popularity in commercial use, only to fall out of use so quickly, warrants further investigation beyond the scope of this work. Germany and France truly led the world in the field of early aviation with their contributions of lighter-than-air aircraft, including the creation of Zeppelins and hot air balloons respectively. By the twentieth century, use of both the Zeppelin and hot air balloons declined as the use of heavier-than-air aircraft, such as the airplane, increased. Lighter-than-air aircraft existed in both

military and commercial use for nearly two centuries. The rise of the lighter-than-air aircraft for commercial use fueled the amazement of manmade flight. The hot air balloon drew crowds of onlookers from its bright colors and graceful (yet highly uncontrollable) movement.

However, despite its hypnotic appeal while up in the air, the hot air balloon was little more than a novelty, for it served no commercial purpose other than for show. Until the creation of the Zeppelin airline company DELAG, that particular lighter-than-air aircraft would not serve a practical commercial use. In the early twentieth century, the expense of the Zeppelin offset its usefulness. They could only carry a modest amount of weight, and could only hold approximately twenty passengers. As the railway system gained popularity, flight via Zeppelin proved no more than a novelty, similar to its predecessor the hot air balloon.

The downfall of the commercial use of the hot air balloon did not surface due to notable disasters. It was widely known that there was a risk of death from falling or crashing due to the fact that hot air balloons were largely uncontrollable, and deflation was always a risk. However, casualties in balloon crashes were few, and damage remained minimal. If anything, danger became a part of the appeal of ballooning to some adventurous balloonists. Unlike hot air balloons, disaster marked the end of the commercial use of the Zeppelin, specifically, the Hindenburg. Combined with the well-publicized military crashes of the Zeppelin, the Hindenburg disaster marked the end of the commercial use of the Zeppelin. The Zeppelin not only defined the dangers of aeronautics, but also its inferior method of air transit. By 1937, the airplane's use of transporting both people and cargo became more efficient and cost effective than the Zeppelin. After the Hindenburg disaster, the use of Zeppelins for commercial purposes left the public eye. In 1937, both the commercial and military use of lighter-than-air aircraft largely ended.

The Zeppelin truly epitomized the full realization of the dream of a military balloon. France's military use of the hot air balloon, much like Germany's Zeppelin, was short lived. Hot air balloons, even though expensive and ineffective, existed for military use by the French a century before Germany created the Zeppelin. Although expensive and often seen as unfavorable by commanders, lighter-than-air aircraft's potentiality made them better scouts than cavalry. Though credited with winning the Battle of Fleurus, the hot air balloon's reputation, damaged by the loss at the Battle of Würzburg, called their use into question by high-ranking French Military officials. Due to their immense cost, their perceived inferiority in comparison to the traditional scout cavalry, and their lack of weapons, militarized lighter-than-air aircraft saw little use between the time France ended its Aerostatic Corps, in 1799, and the military hot air balloons of the American Civil War, which inspired the creation of the Zeppelin.

By the end of the First World War, heavier-than-air aircraft surpassed lighter-than-air aircraft in speed, maneuverability, cost efficiency, and most importantly versatility. The Zeppelin's practicality to the Imperial German military came due to its capacity to fly at an altitude that anti-air weapons could not reach during the beginning of World War I. By the end of the war, however, airplanes equipped with guns had the capacity to shoot down Zeppelins. Zeppelins, even when they were impervious to enemy fire, did not serve a sufficient purpose in battle to justify their cost. Zeppelin's reputation came in a variety of forms including their inability to hit targets at their specified altitude and speed. Zeppelins lacked what airplanes provided in scouting missions. The crashes of the L-1 and L-2 and the deaths associated with the Imperial Admiralty Aviation Department attested to the ineffectiveness of their military use, resulting in the fact that other countries chose not to invest in them.

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