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The Wright Ingenuity

On Monday, December 17, 2003, the world will celebrate the centennial of man's ability to fly. For that ability, we must thank Wilbur and Orville Wright, the first humans on earth to have sustained powered flight in a heavier than air flying machine. Throughout the course of their experiments, they did an abundant amount of preliminary and ongoing research, as well as take careful notes and details of their experiments, further discussing their findings and trying to solve any problems that they faced, and were not afraid to experiment with new ideas. Their curious, ambitious, and dedicated nature was very much responsible for them having achieved "first flight."

The Wright Brothers, from early on in their childhood were intrigued by all kinds of mechanical toys.[1] But it would take Wilbur eleven years and Orville seven years to develop an interest in flying. The reason being is that those were the respective ages of the Wrights when in 1878 their father gave them a toy helicopter as a present. [2] Soon after, Orville with childlike ambition started building small model replicas of that "flying machine" from pieces of wood that he was able to get a hold of. He stayed focused on building them and would not even let school stand in the way of his hobby. He had persisted in his work in constructing one while in school instead of doing the work that he as a second grader was supposed to have been doing.[3] But Orville was always be eager for a greater challenge. That eagerness led him to try his hand at building larger model

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[1] Wendie C. Old, *The Wright Brothers: Inventors of the Airplane* (Berkeley Heights: Enslow Publishers, Inc., 2000) 16.
[2] Orville Wright, *How We Invented the Airplane: An Illustrated History* (New York: Dover Publications, 1989), 2.
[3] Old, 18.

helicopters, with each successive model being a little larger than the preceding one.[4] But the larger he made them, the less they worked. This was because, as a young boy, he did not yet have any scientific knowledge and thus was unaware that when the size of the toy was twice as big, he had to proportionally make the motor eight times more powerful than he had for the smaller toy in order for it to fly.[5] But Orville's helicopter making days would not last.

Soon after, Orville and Wilbur turned their attention to more grown up toys and started flying kites like other kids their age. Their hobby soon turned into a nice entrepreneurial venture, as they began making kites for other kids their age.[6] While making these kites Orville learned a very valuable lesson that would come in handy years later. In an effort to cut his business costs and earn a bigger profit, or in Orville's case, earn a little more spending money, he used thinner strips of wood to shape the kite's form. Inadvertently, he learned that these thinner strips, while in flight, curved unlike the more solid pieces of wood that were traditionally used in kite making. The curve in the kites that he made allowed them to fly better because the curve helped to fight off the wind resistance. The lesson that he learned would have to wait to be applied though because when his and Wilbur's adolescent years came around, they once again changed hobbies, and subsequently started other business, printing and bicycle making, which were again based on their interests.[7]

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[4] Wilbur Wright and Orville Wright, "The Wright Brothers' Aeroplane," in *The Published Writings of Wilbur and Orville* Wright, ed. Peter L. Jakab and Rick Young (Washington D.C.: Smithsonian Institution Press, 2000), 24.
[5] Ibid., 24.
[6] Ibid., 24.
[7] Wright and Wright, "The Wright Brothers' Aeroplane," 24.

It would take the death of an aviation pioneer to rekindle the passion for flying that the brothers had shared as boys. In August 1896, Wilbur Wright learned that Otto Lilienthal had been fatally wounded in a glider accident because he had trouble balancing it properly.[8] But at the time of this fatal accident, Orville was so sick with typhoid fever from contaminated water that he drank that Wilbur did not want to burden him with the bad news.[9] When Orville recovered, Wilbur told his brother about Lilienthal's death and instantaneously the news spurred and immediately reinvigorated his interest in flying,[10] an enthusiasm that was equally shared by Wilbur.[11] But they would not have much time to pursue their interest because they were preoccupied with running their bicycle business. Although, their business was good to them because it afforded them the ability to use the profits that they had earned from the shop to fund their future experiments.[12]

By May 30, 1899, Wilbur finally took the time to write to the Smithsonian Institution in Washington D.C. to request some reading materials. In response, the Smithsonian sent him some literature and a list of books on the subject of flight.[13] At the time, while Orville was in his late twenties and Wilbur in his early thirties, they took the time to read numerous pieces of literature on the subject of flight, including works by Otto Lilienthal, Samuel Pierpont Langley, Octave Chanute, Louis Mouillard, along with copies of the Aeronautical Annuals of 1895, 1896, 1897.[14] From the larger works that they read, Wilbur and Orville started to get a general and historical understanding of the

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[8] Wright, *How We Invented the Airplane: An Illustrated History*, 12.
[9] Fred Howard, *Wilbur and Orville: A Biography of the Wright Brothers* (New York: A Borzoi Book, 1987), 13.
[10] Old 117.
[11] Orville Wright, "How We Made the First Flight," in *The Published Writings of Wilbur and Orville* Wright, ed. Peter L. Jakab and Rick Young, 40-41.
[12] Old, 30.
[13] Peter L. Jakab and Rick Young, *The Published Writings of Wilbur and Orville* Wright, ed. 11.
[14] Wright, *How We Invented the Airplane: An Illustrated History*, 11-12

many flying attempts that had been tried and of problems that those pioneers faced.[15] But it was really the works of Lilienthal and Mouillard that inspired and drove the two brothers to try and find a cure for man's ailment of not being able to fly.[16] They were overwhelmed to learn of the many famous people and inventors who had tried to create a flying machine but had failed, including Leonardo da Vinci, Sir George Cayley, Alexander Graham Bell, Thomas Alva Edison, and Dr. Samuel Pierpont Langley, among a line of others. None of them were brilliant enough to figure out the secret of flying.[17] And so, Wilbur and Orville facing reality were pessimistic and thought that they would not fare much better. [18] But that did not stop them from trying to analyze the problems of flight and at the same time have fun in experimenting. They still had the ambition and desire to leave a lasting contribution to the progress of developing a heavier than air flying machine.

During this period in time, the Gilded Age in the last decade of the nineteenth century, countless numbers of individuals tried their hand at building a flying machine. But they had no luck.[19] Their failures prompted many artists to draw comic pieces for newspapers in which they mocked all of the failed experiments that were conducted, with the intent to finally instill the belief in the general public that man would never have the ability to fly. [20] Not only newspapers, but many scholars and scientists as well held those same beliefs. Since the general public respected and relied on the beliefs and knowledge of the almighty science community, the public at large was pushed to finally accept the

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[15] Wright and Wright, "The Wright Brothers' Aeroplane," 25.
[16] Ibid.
[17] Wright, *How We Invented the Airplane: An Illustrated History*, 12.
[18] Jakab and Young, 11.
[19] Wright and Wright, "The Wright Brothers' Aeroplane," 26.
[20] Tom D. Crouch, *The Bishop's Boys: A Life of Wilbur and Orville Wright* (New York: W.W. Norton and Company, 1989), 137.

idea that flying was impossible and would always remain nothing but a dream.[21] But encouragement from Alexander Graham Bell who had made "wire communication" possible through the use of his telephone, put perspective and hope into the quest for flight, claiming that powered flight would be achieved in the near future. His words inspired new people to become interested in and continue the pursuit of man's destiny.[22] But some still held firm to their beliefs that if man were intended to fly that God would have given him the wings to do so.[23]

Orville Wright kept believing that man would one day fly because he did not believe and could not stand for the fact that a mere bird could have the ability to do something that man could not. After all, as he learned, birds do not use their muscles to fly; they use their wings, and he believed that the bird's wings could be substituted.[24] The Wrights believed that for a heavier than air flying machine to be functional, it had to have wings to lift it into the air, a motor or energy source to propel it through the air, and a means to control the airplane while in flight.[25] Wilbur and Orville, through their research, came to believe that the key to successful powered flight lay in the development of a practical means of controlling the plane.[26] However, they could not figure out a practical means of accomplishing that task.

Through discussions, Wilbur and Orville deliberated on the cause of the crash that had taken the life of Otto Lilienthal. They concluded that the reason that his glider failed to work and the reason why all of the prior flying experiments had failed was because

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[21] Old, 34.
[22] Crouch, 128.
[23] Ibid., 137.
[24] Ibid., 160.
[25] Freedman, Russell, *The Wright Brothers: How They Invented the Airplane* (New York: Holiday House, 1991), 28.
[26] Freedman, 29.

they relied on the unreliable tactic of shifting body weight left and right to maintain the balance of the gliders in the air.[27] Shifting body weight was an inadequate way to maintain balance because wind can push the body in a certain direction and depending on how strong the wind is, could make it hard to resist the strength of that wind to shift body weight against the wind's force. On August 2, 1896, a week before Lilienthal died, Robert Wood, a newspaper correspondent for a Boston-area paper witnessed ten gliding flights by the master glider.[28] After that time, the journalist was allowed by Lilienthal to take the gliding journey for himself. Wood, in the report of his experience, noted that he had a difficult time in trying to balance the glider, which Lilienthal had been using and expressed the notion that he felt helpless while he was suspended in flight. But interestingly enough, he concluded that the experience was wonderful and breathtaking.[29] From studying Lilienthal's gliding flights, as well as from observing birds, the Wrights believed that to maintain balance, there had to be one wing curved upward and the other curved downward.[30] This would serve to counteract the wind resistance, serving to keep the glider equally balanced. However, they came upon a problem. They could not figure out how they could turn one wing upward and the other one downward.

But then, all of a sudden, on a day when Wilbur was restlessly having a conversation with a customer in their bicycle shop, he started fiddling with the ends of a box, twisting each end of the box in opposite directions.[31] As he looked down at his fiddling, which seemed to be more interesting than his conversation, he was suddenly struck with an idea that he believed could provide for the means of control that he and his

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[27] Wright, *How We Invented the Airplane: An Illustrated History*, 12.
[28] Crouch, 144.
[29] Ibid., 144-45
[30] Wright, *How We Invented the Airplane: An Illustrated History*, 12-13.

brother were looking for. He visualized a similarity between his movements with the box, twisting the ends back and forth to his observation of birds where they changed the shape and position of the tips of their wings while in flight.[32] He believed he could apply this same technique by using a spiral twist and running it along the wings of the airplane and that simulation to birds would possibly enable one wing to tilt upward, while the other wing tilted downward and thus create a more controllable glider.[33] After conferring with his brother, he and Orville ventured to create their first experimental aircraft, which wound up being a throwback to their childhood days, when in August 1899 they applied the idea on a kite. The brothers held on to the wires, which were connected to the wings in order to obtain the desired effect that they were looking for. Just as they believed, the idea worked stupendously, causing the Wrights to believe that they were on the right track to solving one of the problems of flight.[34]

After having successfully conducted their kite experiment in 1899, shortly after beginning with their experiments, Wilbur became increasingly motivated and started to believe that it was possible to eventually create powered flight.[35] The next year, proceeding in their next obvious step, Wilbur and Orville built their first full-size glider to test the success that had achieved with the kite.[36] At the time, Wilbur explained to his father that he had started experimenting as a hobby for fun and was not looking to profit from it, but he just as well understood that if his and Orville's experiments were successful that they would indeed profit from their hobby and become famous in the

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[31] Old, 33
[32] Freedman, 30.
[33] Old, 33.
[34] Ibid.
[35] Freedman, 32.
[36] Old, 39.

process.[37] For their next step, they would turn to a place that would take them far away from their home in Dayton, Ohio to a small fishing town named Kitty Hawk on the outer banks of North Carolina.[38]

They found the location of Kitty Hawk through information that they received from the United States Weather Bureau. They had requested the daily wind speeds of different cities in the country, but what they received was the average year-round wind speeds of different cities in America. At the time they received the information they did not realize the mistake, otherwise they probably would have chosen another town that would have been more conducive to their experiments.[39] The Wrights believed that Kitty Hawk with the desirable wind speed of sixteen miles per hour would be the perfect setting for their experiments. But some days, in this small, isolated town, the wind blew furiously at over sixty miles per hour, while at other times the wind reverted to the opposite extreme of only blowing at ten miles per hour. Both extremes proved to be frustrating for their experimental process.[40] Most of the experiments that they conducted were on the beaches at Kitty Hawk, but they also attempted flights at Kill Devil Hills, a location only a couple of miles south of Kitty Hawk which had nice sand dunes that the glider could take off from.

The first glider that the Wrights created for their experiments cost them a total of fifteen dollars, an expensive amount for 1900, but well worth the money for the enjoyment that they received and the lessons that they would take away.[41] Wilbur began the journey to Kitty Hawk before his brother, at the beginning of September 1900 so that

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[37] Freedman, 32.
[38] Howard, 45.
[39] Old, 39.
[40] Ibid.

he could reconstruct the glider that the brothers had created. They had dismantled and shipped most of the glider's parts because it was the easiest way to get them to Kitty Hawk. Near the end of September, Orville joined his brother, at which time the glider was finished being built. During the construction of the glider, Wilbur had suffered a setback in the creative plans for the glider. The design called for the wings to be created from eighteen feet long pieces of wood, but in the town he was in, he was only able to secure pieces that were sixteen feet long.[42] As a result, he also had to reduce the size of the sateen fabric wing covering that the brothers had created by cutting a section out of the middle of the fabric covering. But since they were only amateurs, it was not a great setback.[43]

The Wrights had only intended for their glider to be a fun project by which they could test and try to improve the control and balance of gliders, and as such they mostly flew it as a kite.[44] But on the few occasions that the wind was at a workable speed, they did fly their invention with a manned pilot. The glider was designed so that the pilot could lie facedown on the lower wing, with the pilot's hands' gripping the glider's forward rudder or elevator, and his feet were planted in a pivoted T-bar. The T-bar was connected by wires and pulleys to the wings so that if the pilot pushed down on the T-bar with one of his feet, it would allow the pilot to twist the wings at opposite angles to better sustain flight, as had been tested on the 1899 kite. In addition, to increase or decrease the pilot's altitude, he would only have to tilt an elevator on the glider up or down.[45]

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[41] Freedman, 36.
[42] Old, 37.
[43] Ibid.
[44] Freedman, 36-37.
[45] Ibid.

The Wrights created their 1900 model according to flying specifications that Lilienthal had developed and which had been independently verified by Octave Chanute. But even with all of their preparation, the glider did not work the way that they had planned.[46] As such, being amateurs at the time, they believed that they had to have made a mistake somewhere. But since they could not find the mistake, they left the problem in the air until the following year.[47] Becoming increasingly intrigued by their experiments, they planned to spend their vacations every year on working to find a solution to the problems of flight. They had initially started flying for the fun of the sport, but now, as with their incessant dedication to all their ventures, they decided to do increasing research for the answers that would get man into the air and so they began stumbling into the science end of flying.[48]

After their failed experiment in 1900, they started to review and investigate the calculations that they had relied on and also came up with more ideas that they believed they could use to make flying more practical.[49] In an effort to gain further enlightenment, Wilbur contacted gliding expert Octave Chanute.[50] Wilbur told Chanute that he had been "afflicted with the belief that flight is possible to man" and mentioned that that he felt that his obsession would "soon cost him an increased amount of money," and quite possibly his life.[51] Chanute was impressed with Wilbur's dedication and decided to join the brothers the next summer in North Carolina.

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[46] Orville Wright, "How I Learned to Fly," in *The Published Writings of Wilbur and Orville* Wright, ed. Peter L. Jakab and Rick Young, 51.
[47] Ibid.
[48] Wright and Wright, "The Wright Brothers' Aeroplane," 28.
[49] Orville Wright, "Wilbur Wright," in *The Published Writings of Wilbur and Orville* Wright, ed. Peter L. Jakab and Rick Young Jakab and Young, 80.
[50] Crouch, 181.
[51] Ibid.

When the summer of 1901 came around, Chanute was indeed at their side, and was there to witness several more variations and alterations that the brothers had come up with.[52] However, they had no better luck than they had in 1900.[53] But one thing did change this time around, because with the Wrights becoming increasingly dedicated to their work, they started documenting their experiments better. Already having an avid interest in photography, they decided to take pictures of each step in their experiments, noting the subject, date, place, camera setting, type of negative, and any other distinguishing characteristics available, alongside the picture.[54] The Wrights studied each of these pictures to analyze and evaluate the mistakes that they made.[55] After long discussions and after carefully analyzing the photographs, the trio of Wilbur, Orville, and Octave Chanute came to the conclusion that there were no faults in their glider's construction. They came to believe that the problem was in the accuracy of the tables of air pressure that they had relied on from Otto Lilienthal's findings.[56] Chanute kept encouraging the brothers, who had become discouraged, to continue working on the problems of flight, because he felt that only through experimentation would flying one day be possible.[57] After their failed experiment, the Wrights went back to Dayton. Soon after arriving back in Dayton they started to believe that another reason that the glider failed was because it did not have a vertical tail.[58]

In Dayton, they continued their quest for answers and they made results happen. The two brothers built a small wind tunnel, which they used to create new air pressure

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[52] Wright and Wright, "The Wright Brothers' Aeroplane," 26.
[53] Ibid.
[54] Freedman, 118.
[55] Ibid.
[56] Wright and Wright, "The Wright Brothers' Aeroplane," 27.
[57] Ibid., 26-27.
[58] Moolman, 128.

tables for forty-eight different miniature wings.[59] From the wind tunnel tests, they came away with the knowledge that narrower wings would work better against air pressure. They also tinkered with and made a few more innovative changes in their design before returning to Kitty Hawk the next summer.[60]

In the summer of 1902, the brothers arrived at Kitty Hawk a little bit more optimistically.[61] By this time, they believed that they had successfully investigated the design features necessary for them to sustain flight.[62] But soon after they started using their newly constructed glider, Orville crashed, and at which point they realized that the glider still had control problems. Orville, continuing to ponder the subject while in bed one night, arrived at an idea that he believed would better control the glider. He thought that if they changed the tail on the glider from a fixed tail to a moveable tail, that it would have better success. After conferring with his brother the next morning, they adapted the design and to their satisfaction, it worked.[63] The brothers at the site of Kill Devils Hills, NC, nearby to Kitty Hawk had accomplished something that had never been done before. They had successfully created a glider that could be controlled in flight.[64]

After returning to Dayton in 1902, the brothers reinvigorated with high hopes acquired the services of mechanic Charlie Taylor. Under guidance and direction from the Wright Brothers, Taylor built them a one hundred and forty pound, twelve horsepower, gasoline engine. The brothers were happy with the engine, because it was lighter and had more horsepower than they had initially asked for.[65] But the brothers did not stop with

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[59] Ibid., 125.
[60] Ibid., 128.
[61] Jakab and Young, 11.
[62] Peter L. Jakab, *Visions of a Flying Machine: The Wright Brothers and the Process of Invention*, 1.
[63] Moolman, 131.
[64] Howard, 90.
[65] Moolman, 138.

the engine; they had also been looking for theories, which they could use to develop propellers for their flyer, but they soon discovered that no theories on how they really work existed.[66] But they did not let that stop them, as they had already been successful in developing new theories of air pressure.

Within three months time, Wilbur and Orville, after having countless numbers of heated arguments, believed that they had found success. At times, Wilbur and Orville would even switch arguments and start to argue from the opposite perspective to better find answers to their questions.[67] Their technique may have been the reason for their success. Through their research, deliberations, and trials, they believed that they had successfully found all the aspects that would be necessary for man to fly. Wilbur then subsequently filed a patent for their flying machine on March 23, 1903 with the United States Patent Office. However, the Patent Office rejected it, claiming that the drawings of the plane were inadequate, had a vague description, and that they had given six prior patents for flying machines to people who were unsuccessful in flying their inventions. Just like the general population, the Patent Office did not believe that the Wright flyer was any different than the others; they believed it would fail.[68] As a result, the Wrights were forced to protect their creation on their own by trying to hide the design features of their improved plane from anyone who they feared might try to take credit away from them.[69]

Rough weather in Kitty Hawk during the fall of 1903 gave the brothers trouble in assembling their glider. To quickly finish the assembly, they needed a large, wide-open

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[66] Ibid., 140.
[67] Old, 36.
[68] Ibid., 51.
[69] Jakab and Young, 11.

space on the outside where part of the work could be done and then they finalized the rest on the inside of a building that they had constructed for the plane.[70] Chanute believed that the Wright's 1903 flyer had a better chance to successfully fly than had any of the other flying experiments that he had observed or read about. The Wrights tried to live up to his praise and expectation.[71] By November 5, 1903, they finished building their flyer, but when they tested it, things did not go as planned; the engine backfired and the propellers would not spin correctly, eventually popping off, which caused damage to the propeller's shafts.[72] But even after they fixed those problems, new problems arose. With each new mishap that they had to fix, time was quickly passing and with that the chance to accomplish the first flight in 1903 was diminishing, as the brothers wanted to spend Christmas with their family back home.[73]

Finally by Monday, December 14, 1903, the flyer was fixed and ready to try once more. As with all their ventures, Wilbur and Orville were equal partners.[74] As such, they flipped a coin to see who would attempt the first flight and Wilbur won. But when Wilbur was up in the air, being inexperienced at piloting the powered flyer, he quickly crashed. This time though, it only took two days to make repairs, but on the sixteenth, heavy winds would not permit flying.[75] They had to wait till Thursday, December 17, 1903. On that historic day, at 10:35 a.m., Orville successfully accomplished the first flight at Kitty Hawk, North Carolina.[76] The flyer reached one hundred and twenty feet in

[70] Moolman, 146.
[71] Ibid., 147.
[72] Howard, 146.
[73] Moolman, 150.
[74] Freedman, 119.
[75] Howard, 134-35.
[76] Moolman, 152.

the air and stayed aloft for twelve seconds. It was not a very long time, but it was the beginning of man's ability to fly in a controlled powered flyer.[77]

Years later, after countless more flights, Orville claimed that his first flight had to have been his most hazardous experience in the air because the plane had been weaving up and down tremendously.[78] But he also admitted that the real thrill was not mainly achieving flight, but was the dream that made it possible, the dream that made him wonder how exciting it would be to fly.[79] Orville, an excited pioneer, claimed that "learning the secret of flight from a bird was a good deal like learning the secret of magic from a magician."[80] But unlike a magician, all their tricks would later be clearly demonstrated to the public, as they had kept good records and photographed every step of their journey.[81] Their invention became the first great invention to be fully documented in pictures.[82] With their success in proving flight, the United States government, on May 23, 1906, finally awarded the Wrights' a patent for their flyer, which included most of the control elements that they had developed. It was the first patent for a successful powered flyer.[83]

Wilbur and Orville's persevering efforts contributed to the world an invention that changed modern culture and the future of world history forever and the world is indebted to them for it. Their invention has brought people closer together and has transformed the world into a more interdependent community. Airplane technology may have progressed greatly since the first flight, but the airplanes in use today, still rely on the

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[77] Howard, 137.
[78] Jakab and Young, 49.
[79] Wright, *How We Invented the Airplane: An Illustrated History*, 55.
[80] Ibid., 5.
[81] Old, 41.
[82] Freedman, 118.
[83] Old, 64.

same fundamental principles that the Wrights innovated a hundred years ago.[84] To pay tribute to their long lasting accomplishment, at the site of "First Flight", in Kitty Hawk, North Carolina, there stands a sixty-foot granite monument "in commemoration of the conquest of the air by the brothers Wilbur and Orville Wright. Conceived by genius, achieved by dauntless resolution and unconquerable faith" as is etched on their monument. Also, the United States is planning on releasing a commemorative coin in honor of the Brothers Wright starting on August 1, 2003 and producing them through July 31, 2004 in the denomination of ten-dollar gold eagle coins, silver one-dollar coins, and copper-nickel half dollar coins.[85] Both the 2001 North Carolina and 2002 Ohio quarters from the United States' fifty-state quarter program, which honors the history and heritage of each state, as well, reflect depictions commemorating the accomplishments of the two brothers. The story of the Wright Brothers should be an inspiration to millions of Americans to show them that if one has a dream, they should follow it because as the Wrights proved, anything is possible. The Wright Brothers not only fulfilled their dream, but they changed the dynamics of modern culture forever.

[84] Jakab and Young, 107.
[85] Paul Gilkes. "Snow OKs Wright Commem Designs," in *Coin World* (Sidney: Amos Press, 24 March 2003), 2.

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