The Wright Brothers: How They Invented the Airplane Study Guide

The Wright Brothers: How They Invented the Airplane by Russell Freedman

BOOKRAGS

Contents

Plot Summary

The Wright Brothers: How They Invented the Airplane by Russell Freedman is a young adult book written about the Wright brothers and their quest for inventing and perfecting the world's first flying machine. Freedman is a noted biographer with more than 50 titles to his credit. Unlike many biographers, Freedman manages to interject personal stories and correspondence along with many photographs while not losing the thread of the story. Freedman paints the Wright brothers as genius inventors and heroes yet they are also portrayed as real people.

The book begins Chapter One with the following quote:

"No one had ever seen what Amos Root saw on that September afternoon in 1904."

Chap. 1, p. 1

Amos Root had driven to Huffman Prairie on the outskirts of Dayton, Ohio to witness the Wright brothers in flight. What Root saw was Wilbur's first turn in the sky.

The book tells the life stories of Wilbur and Orville Wright, brothers and co-inventors. Wilbur was born on the outskirts of Millville, Indiana in 1867. Orville was born in Dayton, Ohio in 1871.

As young boys, the Wright brothers became intrigued with mechanical toys and making their own inventions by using those toys as models. As the boys grew older, they continued to tinker and invent various items.

Neither brother had graduated from high school nor attended college. Orville dropped out of school to open a printing company. Wilbur went to work with him. Soon the business was successful and the brothers began to print their own newspaper. When the bicycle craze swept the US, the brothers opened a bicycle shop and eventually began to manufacture a new line of two models.

The brothers learned about Otto Lilienthal, a German who had some success flying model planes. The brothers immediately set out to design and build a full-size flyer, one that would be able to carry a man.

It was not long before the workroom of the bicycle shop became the design center for the Wright brothers' first Flyer. It was a glider, much like the ones used by other inventors. However, the Wright brothers' Flyer had some different features such as the pilot's positioning and control levers.

After many years filled with trials, successes and failures, the brothers made great strides in producing a glider that could stay in the air longer than any other, even the models used by some researchers. The brothers eventually turned their attention to creating a flying machine that would house a motor. After many months of design and testing, the Wright brothers managed to build a motor that could power an airplane. It

was the first practical airplane and it would lead to the production of military aircraft as well as planes for commercial use.

In addition to the text, there are 91 photographs in the book, the vast majority of which were taken by the Wrights who were also accomplished photographers.

Chapters 1-2

Chapters 1-2 Summary and Analysis

Chapter 1: What Amos Root Saw

The Wright Brothers: How They Invented the Airplane by Russell Freedman begins Chapter One with the following quote:

"No one had ever seen what Amos Root saw on that September afternoon in 1904."

Chap. 1, p. 1

Amos Root had heard about a flying machine and drove 200 miles to see it for himself. Root stood in a cow pasture in Dayton, Ohio and watched as Wilbur Wright made a circle in the sky above him. Root watched as a pilot lay face down on the lower wing, steering the aircraft to a landing in the grass.

Wilbur Wright was the pilot. Wilbur and his brother Orville had built the aircraft in the workroom of a bicycle shop. The brothers had permission to try it out on the field called Huffman Prairie. What Root witnessed was a test - the first circling flight made by an airplane. The event lasted one minutes 36 seconds.

Root returned home to Medina, Ohio where he wrote an eyewitness account of the Wrights' flight. Root published his article on January 1, 1905 in "Gleanings in Bee Culture," a trade magazine published by Root for the customers of his supply business.

Root published a piece about the event which began: "'Dear friends,' he wrote. 'I have a wonderful story to tell you - a story that, in some respects, outrivals the Arabian Nights fables.'" (chap.1, p. 2)

Root told the story of two boys, sons of a Bishop, who operated a bicycle shop and began studying flight. Root was proud he had been the first person to see the airplane in flight. Root described in detail what he saw including how the aircraft worked. Root ended the article by comparing the Wright brothers to Christopher Columbus.

Chapter 2: Wilbur and Orville

Wilbur said that from the time the brothers were children they did everything together including living, playing, working and even thinking together. Neither brother drank, smoked, nor married. They lived at home with their father, Bishop Milton Wright, and their younger, unmarried sister Katharine.

Long before building an airplane the Wright brothers operated the Wright Cycle Company, a shop that built, sold and repaired bicycles. Neither of the brothers had any formal education and in fact neither graduated from high school nor attended college.

However both brothers had a mechanical knack and ways of solving problems. Orville and Wilbur's niece, Ivonette, recalled how her uncles used to take apart toys and reassemble them so that they were better than when they were new.

Although the brothers were alike in many ways they did have their differences. Wilbur was four years older than Orville. He tended to be quiet and people often thought of him as living in a world all his own. Orville, on the other hand, was much more gregarious although he often became shy around strangers. Orville was extremely fastidious and was known for being able to work in a bicycle shop without getting dirty. Wilbur had the vision; Orville had the enthusiasm. When Bishop Wright was asked which brother contributed most to the business, the Bishop said that they were equal in their work and neither claimed superiority over the other.

Wilbur was born on the outskirts of Millville, Indiana in 1867. Orville was born in Dayton Ohio in 1871. There were five Wright children - Reuchlin, Lorin, Wilbur, Orville, and Katharine. They were the children of Bishop Milton Wright, who served as a minister at the United Brethren Church, and Susan Koerner Wright.

It was thought that the brothers received their analytical gifts from their mother:

"Wilbur and Orville believed that their mechanical aptitude came from their mother, a shy and retiring woman who enjoyed working with her hands."

Chap. 2, p. 7

The Bishop on the other hand was not handy and had difficulty driving a nail in straight. However the Bishop did encourage Wilbur and Orville and gave them the gift of absolute self-confidence and determination. Orville recalled that they were fortunate to grow up in such an environment where there was so much encouragement to expand their intellectual horizons.

Susan Wright died in 1889 of tuberculosis. Susan never got to see what Wilbur and Orville would accomplish. Wilbur was 22 years old at the time and stayed home to take care of Susan. Orville had just drooped out of high school so that he could open a printing business. Katharine, 14, took over as the lady of the house. Katharine eventually went to Oberlin College where she earned a teaching degree.

Unlike his wife, Bishop Wright lived to take a ride in his sons' airplane. Bishop Wright was 88 years old when he died.

The brothers say they got their first inspiration and fascination for flight when the Bishop brought home a toy when the boys were children. It was a toy helicopter. The boys played with the helicopter until it fell apart and then they built replicas which flew just as well. However when the boys tried to build a helicopter on a larger scale, their efforts were unsuccessful.

Orville was enthusiastic about printing and built his first press from items taken from a junkyard. Orville used a tombstone as the bed for movable type. Orville spent his

summer vacations working for a Dayton printer as an apprentice and eventually became an expert typesetter. Eventually Orville dropped out of school to open a printing shop. Orville built another printing press which was highly efficient. Orville was visited by a veteran printer who was eager to see the piecemeal machine. The veteran examined the machine and was amazed that it worked.

Bishop Wright published and edited a church newspaper which inspired Orville to start the West Side News, a weekly newspaper. Wilbur joined the staff as the editor. The brothers tried publishing a daily newspaper called "The Evening Item." Unfortunately, they could not compete with the larger newspapers in Dayton and the daily newspaper lasted for only three months. Afterward, the brothers opened a new business known as Wright and Wright, Job Printers.

About this time the bicycle craze began to sweep the nation. The brothers bought bicycles and became avid fans of the sport. Before long, people began to take their bikes to the Wright brothers for repairs. In 1892, the brothers promoted Ed Sines to manager of the printing business so they could form the Wright Cycle Company, which grew to four shops in a short time. After a while the shop began to manufacture bicycles. The brothers had a lot of free time during the off-season and spent it by working on the house and developing a love for photography. In 1899 they discovered a new love and began to work on the project of their lives

Chapters 3-4

Chapters 3-4 Summary and Analysis

Chapter 3: The Art of Flying

"While the Wright brothers were building bicycles in Dayton, an engineer named Otto Lilienthal was conducting gliding experiments from the top of a small hill and Germany." (Chap. 3, p. 15)

Lilienthal had pioneered a technique with the gliders whereby he would attach a glider to his back and run down a hill until the wind lifted the glider's wings. Newspapers around the world told stories about Lilienthal referring to him as the "Flying Man." Photos showed Lilienthal flying through the air attached to something that looked like bat wings. Lilienthal was in the heyday of his career when a glider stalled during a flight in 1896. Lilienthal fell and broke his spine. He died the next day.

Lilienthal would not be the first or last man to die trying to fly. The author tells the story of Icarus. The famous Greek myth details the story of Daedalus and his son Icarus. The father and son had escaped from prison on the island of Crete by fashioning wings out of wax and feathers. The men managed to fly away. Icarus became arrogant and flew so high that the sun melted the wax causing Icarus to fall into the sea and drown. The author also tells the tale about an 11th century Benedictine monk named Eilmer who was convinced that he could fly. The monk fashioned wings by using linen and feathers attached to a wooden frame. The monk began to fly but then was sent crashing to the ground by turbulent wind. The man broke his legs and became lame. The monk lamented not using a tail on the back end of the contraption.

Freedman also talks about Leonardo da Vinci. Da Vinci, an Italian artist in the early 1500s, gave a great deal of thought to flying. Da Vinci studied birds and drew detailed sketches of various flying machines. However, da Vinci did not publish his ideas.

Although many people tried to devise a flying machine, the first person to create what most resembles a modern day plane was Sir George Cayley. Cayley was a British baronet who studied the flight of birds and aeronautics in the early 1800s. The contraption Cayley devised had fixed wings, a tail, a fuselage and separate systems that would provide propulsion and control. In 1804, it was Cayley who built the first successful model glider. Although Cayley built two full-size gliders able to complete brief flights, he would never live to see powered flight.

By the late 1800s, scientists were working diligently to progress the field of aeronautics using model airplanes. Other researchers believed that flights would not be accomplished by using models but by using manned gliders. Lilienthal was considered to be the most influential of the latter group. During the 1890s, Lilienthal built 16 versions of a basic hang glider which included monoplanes and biplanes.

Dr. Samuel Pierpoint Langley is by far the best known experimenter who worked with model airplanes. Langley was the head of the Smithsonian Institution located in Washington DC. Langley spent 10 years of his career testing airplane models on an indoor track before deciding on a final design. Langley called the models aerodromes. Langley's first successful launch occurred on May 6, 1896 when one of his aerodromes stayed aloft for 90 seconds. It is estimated that the miniature plane flew for half a mile at approximately 20-25 mph. Six months later, one of Langley's larger models flew three quarters of a mile. The US Army gave Langley $50,000 to continue his work. The Smithsonian added $20,000, quite a fortune in those days. It was thought that if anyone could build a full-size airplane equipped to carry passengers it would be Dr. Langley.

Freedman also talks about the American civil engineer Octave Chanute. Chanute had become famous for building the first bridge to cross the Missouri in 1868. Chanute visited Lilienthal and came home eager to conduct his own experiments. Between 1896 and 1898 Chanute made hundreds of flights on the dunes of Lake Michigan.

At the same time Dr. Langley was working on a gasoline powered, full-size airplane-based on his models. Langley called this aircraft the Great Aerodrome. The first flight took place on October 7, 1903. The trial was not a success. Langley did not give up even though the newspapers poked fun at his attempts. The media said that the feat might be accomplished but it would take 1 - 10 million years. Nine days later Orville Wright made his first successful flight.

Chapter 4: Wind and Sand

"Otto Lilienthal's gliding experiments in Germany, and his dramatic death in 1896, had aroused the Wright brothers' curiosity. They began to read what little they could find published on the subject of flight." (Chap. 4, p. 27)

Wilbur wrote that it should not seem impossible for man to fly if reptiles, insects, birds and mammals did it every day. In 1899, Wilbur wrote a letter to the Smithsonian Institution asking for information regarding flight experiments. The Smithsonian sent several pamphlets and a list of books, among them Samuel Pierpoint Langley's Experiment in Aerodynamics and Octave Chanute's Progress in Flying Machines. Eventually the Wright brothers would contact both men for advice.

The Wright brothers discovered that any flying machine would have three basic requirements. The machine would need wings to gain lift, a power source, and some method of control while in flight. The first two issues had been solved to a degree. The author describes the concept of lift and the advancements that have been made in that area. After studying all of the available information, the Wright brothers were surprised that there had been so little attention paid to the problems of control and balance. Wilbur and Orville believed that an effective control system was imperative for successful flight. The method of control came from observing buzzards in-flight. The brothers noticed that the bird would shift its wings. Wilbur developed a plan to do the same with airplane wings.

The brothers took a biplanes glider that would be tested as if it were a kite. The trial was successful and the brothers began to look for a place where they could test a full-size glider using the same principles. Wilbur contacted the US Weather Bureau to receive a list of the windiest locations in the country. The spot that seemed to be the most ideal was a fishing village named Kitty Hawk. Kitty Hawk was located on the Outer Banks of North Carolina. The winds averaged 10-20 mph which seemed ideal for testing the glider. The Outer Banks also offered stretches of beach which were perfect for a soft landing and also offered solitude. Wilbur wrote a letter to his father explaining the experiments and then left for North Carolina. Wilbur arrived in Kitty Hawk on September 13, 1900, followed by Orville who arrived 10 days later.

The brothers had prepared to camp for as long as it was necessary to complete the experiments. It would turn out that the wind was not always their friend, especially at night when squalls tried to blow the tent away. Despite the conditions, Wilbur and Orville always dressed properly for the occasion. The parts for the new glider were sent via train. The major difference between the Wright brothers' glider and the ones built by Chanute and Lilienthal was the positioning of the pilot. In Chanute and Lilienthal's machines, the pilot was suspended underneath the aircraft. The Wright brothers decided to have the pilot lay face down on the bottom wing where he would be able to move the rudder and control the direction of the glider.

After three weeks the brothers were ready to test the glider. They went to a group of giant sand dunes known as Kill Devil Hills. Wilbur would be the pilot and throughout the day made nearly a dozen flights. The flights were short but successful.

Wilbur said, "We were very much pleased with the general result of the trip, for setting out as we did, with almost revolutionary theories on many points, and an entirely untried form of machine, we considered it quite a point to be able to return without having our pet theories completely knocked in the head... and our own brains dashed out in the bargain." (Chap. 4, p. 38)

The brothers were ready to return to Ohio. They gave the postmaster permission to salvage what was left of the kites, which he did. The postmaster's wife used the sateen to make dresses for their daughters.

The brothers returned to Kitty Hawk in the summer of 1901. That year they would not be alone. Chanute and two of his associates were on hand to observe experiments and test the Chanute's new glider. The weather was not so accommodating and there were troubles controlling the glider. One thing after another went wrong and the brothers eventually returned to Ohio, discouraged.

chapters 5-6

chapters 5-6 Summary and Analysis

Chapter 5: Back to the Drawing Board

Wilbur and Orville returned to Ohio discouraged by the second round of tests at Kitty Hawk. The brothers reflected on the problems and review their calculations. Realizing that they were basically groping in the dark because many of the experiments and information they had been relying on were unreliable, the brothers finally decided to rely entirely on their own data. They returned to the workroom behind the bicycle shop and began to run their own tests to gather more accurate data. In order to test different types of wing surfaces the brothers built a wind tunnel. The next step would be to make model wings known as airfoils. Fortunately, all of the tools needed to create the airfoils were on hand. Using hammers, tin shears, a soldering iron and files, the brothers created 200 miniature wings out of various materials including steel, solder, wax, galvanized iron, and tin. They formed every possible shape and size to test how they would behave in various airstream conditions. Repetitious and tedious, but necessary, testing went on for several weeks. Eventually the brothers completed their lab tests, confident that they had better and far more accurate data than had ever been recorded before.

The brothers built their largest glider to date. Its wings measured 32 feet side to side and 5 feet front to back. It had a tail consisting of two six-foot high vertical fins and weighed just less than 120 pounds. The brothers were ready for their next trip to Kitty Hawk.

Katharine wrote to their father that getting away would be good for the brothers who seemed to be drawn and tired. They worked endlessly building the new glider. It was the end of August when the brothers reached the Outer Banks. Before the experiments could get underway, the brothers had to rebuild their shelter from the previous year. It was the middle of September when the new glider was ready.

Orville wrote about the concurrent successes as well as some issues with the glider. The brothers seemed closer than ever to solving their previous problems. However, approximately one out of 50 flights would go awry for no obvious reason. Lying in bed one night, Orville figured out the problem when he realized that the tail would have to be movable to shift with the wind and airspeed.

Wilbur and Orville made adjustments to great success. By this time many people, including their brother Lorin, came to watch the test flights. By the time the brothers were ready to leave Kitty Hawk they had begun to devise a way to attach the motor to the glider.

Chapter 6: Horsepower and Propellers

The Wright Brothers knew that they could not simply put any motor into one of the gliders. They would need a motor that was powerful yet light. They would also have to design propellers that would give enough thrust to propel the flying machine. Finally, they would have to build the body of an aircraft that would be able to withstand vibrations from the propellers and the motor and also be sturdy enough to carry the weight.

Wilbur decided to write to manufacturers of gasoline engines inquiring if they might be able to supply an engine that could produce 8 horsepower while weighing less than 200 pounds. No one gave a positive response. Wilbur and Orville decided that they would build the motor themselves. Building the propellers was more difficult because there was no reliable data in existence. It took five months of experiments, study and discussion before Wilbur and Orville came up with a usable design. The author goes on to discuss how the propellers were designed and made. The project ended up taking so much room in the bicycle shop that customers had to be waited on outside. In the end the new glider would be assembled at Kill Devil Hills.

The brothers arrived at their camp at Kill Devil Hills in September 1903. On nice days they would fly the 1902 glider; on rainy days they would stay inside the new building to work on the new machine. There were some problems with propeller shafts and transmission sprocket wheels which caused great frustration for the brothers. The propeller shafts caused so much grief that Orville had to return to Dayton to get new ones manufactured. Orville returned to Kill Devil Hills in December.

Eventually the time came to make a test flight. Wilbur and Orville tossed a coin and Wilbur won the chance to pilot the new glider. During the first try the glider stalled and hit the ground. Fortunately Wilbur was not hurt. The second trial took place six days later.

Freedman details the next trial, which was successful.

"This flight lasted only 12 seconds, but it was nevertheless the first in the history of the world in which a machine carrying a man had raised itself by its own power in to the air in full flight, have failed forward without reduction of speed, and it finally landed at a point as high as that from which it had started." (Chap. 6, p. 76)

It had been seven years since Lilienthal's fatal crash.

The next day Wilbur and Orville sent a telegram to their father as promised, telling him about the success.

Chapter 7-8

Chapter 7-8 Summary and Analysis

Chapter 7: The First Practical Airplane

Bishop Wright made a statement to the press immediately after receiving Orville's telegram.

"Wilbur is 36, Orville 32, and they are as inseparable as twins. For several years they have read up on aeronautics as a physician would read his books, and they have studied, discussed, and experimented together. Natural workmen, they have invented, constructed, and operated their gliders, and finally their 'Wright Flyer,' jointly, all of their personal expense. About equal credit is due each." (Chap. 7, p. 81)

Upon returning to Dayton the Wright brothers wrote their own press release. However, it was clear that before the Flyer could be considered to be a practical airplane it would have to be capable of more than brief straight-line flights. In the spring of 1904, the Wright brothers would work on a new plane on the outskirts of Dayton at a place called Huffman Prairie. Unfortunately, Huffman Prairie had a lot of swamps and pit holes which made it difficult to launch and land the plane. In August the brothers were making flights about a quarter of a mile long, limited by the barbed wire fence between Huffman Prairie and an adjacent cornfield. It was on September 20th that Wilbur made his first turn with the new flyer. This was the flight witnessed by Amos Root. The brothers realized even more success on November 9 when Wilbur was able to circle Huffman Prairie four times within five minutes.

In the spring of 1905 Flyer III was built. Wilbur set the new record on October 5 when he managed to circle the field 30 times in 39 minutes, with a total distance covered of 24 1/2 miles. These flights were significant enough to have the Wright Flyer III be declared the world's first practical airplane. Despite these successes, people did not believe that the Wright brothers had achieved flight. On two occasions, reporters traveled to Huffman Prairie only to have the airplane fail to take off. By fall of 1905 people began to take notice of the strange incidents taking place at Huffman Prairie. However the Flyer still did not make national or world news.

Chapter 8: Fliers or Liars?

For the next two and half years the Wright brothers did not fly again.

"Now that they had built a practical airplane, they wanted to put it on the market. Until their patent rights were secure, they felt that secrecy was important so that no one can steal their invention." (Chap. 8, p. 89)

The Flyer was first offered to the US War Department where the Wrights were turned down flat. The military had already spent a great deal of money on Samuel Pierpoint

Langley's aerodrome experiments and was wary of similar claims. Wilbur did not take it well. Wilbur told Chanute that they had given the American government first chance at the Flyer. If others wanted to support the expense of manufacturing the Flyer, the brothers' consciences were clear.

The brothers would continue to look for financial backers and eventually approached the War Department once again. The War Department said they want to see demonstrations before they would issue a contract. The Wrights would not accept. Chanute tried to talk the brothers into flying publicly. Wilbur and Orville argued with Chanute because they were worried that other inventors would try to steal their ideas. Eventually the War Department would offer a contract to the Wright brothers. In February 1908, the Wright brothers made a contract with the US Signal Corps for a two man machine that could fly 125 miles at a minimum speed of 40 mph.

Feeling that they're flying skills were rusty the brothers returned to Kill Devil Hills. On May 14, 1908, the Wright brothers made history with the first two passenger flights. At the end of the month, Wilbur and Orville separated for the first time. Orville went home to Dayton to work on a new Type A Flyer and Wilbur sailed for France where they would have Flyers manufactured. Wilbur was worried about leaving Orville alone and asked Katherine to report any problems.

Wilbur ran into some problems while in France including disbelief of the French as well as damaged parts. Eventually, Wilbur staged a public flight at a small racetrack near Le Mans. The Flyer stayed in the air for one minute 45 seconds. Despite the short flight time, the Flyer made the French planes seem awkward and crude. Wilbur was given permission to use Camp d'Auvours, a large military base near Le Mans. While there, Wilbur made over 100 successful flights. Wilbur took many people on the test flights including Madam Hart O. Berg, the first woman to fly. Wilbur became an international celebrity.

Back in the United States Orville was preparing for acceptance tests of the new Wright Signal Corps Flyer. Rivals began to make public flights. However, it was Orville's flight in September that convinced the American public that the age of flight had arrived.

Chapters 9-10

Chapters 9-10 Summary and Analysis

Chapter 9: the Conquering Heroes

On September 3, 1908, Orville began the demonstration flights from the parade grounds at Fort Myer, Virginia. Thousands of people began to gather to watch Orville fly. Each day Orville broke records and regularly made flights lasting an hour or more.

Orville received a letter from Wilbur:

"'The newspapers for several days have been full of stories of your dandy flights,' wrote Wilbur from France, 'and whereas a week ago I was a marvel of skill, now they do not hesitate to tell me I am nothing but a 'dud' and that you are the only genuine skyscraper. Such is fame! Your flights have naturally created an immense sensation in Europe and I suppose that America is nearly wild.'" (Chap. 9, p. 99)

Disaster struck on September 17 when Orville and Lieutenant Thomas Selfridge were involved in a crash. Orville was injured with a fractured thigh, back injuries, several broken ribs, and serious scalp wounds. Lt. Selfridge received a skull fracture; he died later that evening. Later Wilbur wrote to Katharine taking blame for Orville's accident, saying that if he had been there the accident would not have happened.

The Wrights began to tour Europe and were lauded for their accomplishments. The US government began to realize the value of the Flyers and contracts were created between the brothers and the government. Wilbur began to make public flights in the US. One flight was watched by nearly 1,000,000 New Yorkers, almost all of which had never seen an airplane before.

Chapter 10: the Age of Flight

Despite all of these successes by the Wright brothers, flying was still a tricky and difficult thing. Pilots could only fly in the daytime and only if conditions were right. Planes could not yet carry enough cargo or passengers to make flights profitable. Yet to the Wright brothers it seemed that the possibilities were limitless.

"'I firmly believe in the future of the airplane for commerce, to carry mail, to carry passengers, perhaps express,' Orville declared. 'I cannot but believe that we stand at the beginning of a new era, the Age of Flight.'" (Chap. 10, p. 110)

In 1909, the Wright brothers established a manufacturing company called Wright Flyers. Orville was in charge of the day-to-day operations while Wilbur spent a great deal of time in court fighting lawsuits involving patent infringement from their rivals.

The Wright brothers continued to improve their Flyers. Landing wheels were added in place of skids and adjustments were made to improve control. Some of the Flyers were designed for competitions and aerial exhibitions. The Wright Baby Grand Racer, a single-seater, was debuted at the 1910 Belmont Park flying meet in New York. The meet was the first international air show. Another Wright Flyer was the first to complete a coast-to-coast flight across the US in 1911.

That autumn Orville returned to Kitty Hawk. Although the brothers were producing new advanced models of their Flyers, Orville wanted to glide once more. Wilbur stayed in Dayton. Orville's new glider broke a world record by staying in the air for 9 minutes, 45 seconds.

In 1912 Wilbur fell ill with a case of typhoid fever. After four weeks Wilbur went in to a coma and died at the age of 45. Orville was consumed with grief. Some say that when Wilbur died a piece of Orville died with him.

In 1915, Orville sold his interest in the business and retired. In 1918 he gave up piloting although he continued aeronautical research. Orville lived to see the birth of airmail service in 1918, the first nonstop transcontinental flight in 1923, the first round the world flight in 1924, and so on. He lived through two world wars and saw the airplane play a vital role.

Orville Wright died of a heart attack on January 30, 1948. He was 76 years old.

Characters

Wilbur Wright

Wilbur Wright was born in the outskirts of Millville, Indiana on April 16, 1867. Wilbur was the third son of Bishop Milton and Susan Koerner Wright. Four years later Orville would be born and history would change forever.

As children and into adulthood, the brothers were inseparable. Although Wilbur and Orville were a lot alike, Wilbur was older by four years. He was also taller and thinner by a miniscule amount. Physically, he had a long nose and high, domed forehead that gave him the appearance of a hawk. Wilbur was also bald on top.

People never knew what to make of Wilbur since he often seemed aloof. It was simply that Wilbur tended to live in a world of his own, to observe rather than participate. Unlike Orville, Wilbur did not pay close attention to his attire or the small details of things. Wilbur was more of a visionary than a detail man.

Freedman writes, "Often he had to be reminded by his sister that his suit needed pressing or that something didn't match. Once she insisted that he borrow a shirt, cuff links, and an overcoat from Orville before going off to deliver an important speech." (Chap. 2, p. 5)

As the Wright brothers built and went on to improve on their inventions, Wilbur became less involved in the day to day operations as he spent a lot of time in court defending patents. In 1912 Wilbur contracted typhoid fever and died at the age of 45.

Orville Wright

Orville Wright was born in Dayton, Ohio on August 19, 1871. Orville was born in the family home on Hawthorn Street. Orville was the fourth son of Bishop Milton and Susan Koerner Wright. Neither brother smoked, drank nor married.

As children and into adulthood, the brothers were inseparable. Although Wilbur and Orville were a lot alike, Orville was the more gregarious of the two. Orville was extremely fastidious, always fashionable and was known for being able to work in a bicycle shop without getting dirty. Wilbur had the vision; Orville had the enthusiasm.

While both brothers flew on many test flights, it was Orville who was once badly injured with a fractured thigh, broken ribs and other injuries. Orville's co-pilot was not so lucky.

As the Wright brothers built and went on to improve on their inventions, Orville took over the day to day operations because Wilbur was required to spend a lot of time in court defending patents. It is said that when Wilbur died, part of Orville died, too. In 1948, Orville died from a heart attack. He was 76 years old.

Bishop Milton Wright

Bishop Milton Wright was the father of Wilbur and Orville Wright. The Bishop worked as pastor of the United Brethren Church in Dayton, Ohio. The Bishop was the one credited with giving Wilbur and Orville solid self-confidence, determination and belief that one can accomplish anything.

Susan Koerner Wright

Susan Koerner Wright was the mother of Wilbur and Orville Wright. It was thought that the brothers received their analytical gifts from their mother:

"Wilbur and Orville believed that their mechanical aptitude came from their mother, a shy and retiring woman who enjoyed working with her hands."

Chap. 2, p. 7

Otto Lilienthal

Otto Lilienthal was a German who was working on putting model airplanes into flight in Germany when the Wright brothers became inspired to study flight. Otto Lilienthal flew over 2000 times. Lilienthal was the first man to successfully operate a glider.

Sir George Cayley

Sir George Cayley was a British baronet who studied the flight of birds and aeronautics in the early 1800s. The contraption Cayley devised had fixed wings, a tale, a fuselage and separate systems that would provide propulsion, lift, and control. In 1904, it was Cayley who built the first successful model glider.

Octave Chanute

American civil engineer Octave Chanute had become famous for building the first bridge to cross the Missouri in 1868. Chanute had visited Lilienthal and came home eager to conduct his own experiments. Between 1896 and 1898 Chanute made hundreds of flights on the dunes of Lake Michigan.

Dr. Samuel Pierpoint Langley

Dr. Samuel Pierpoint Langley was by far the best known experimenter who worked with model airplanes. Langley was the head of the Smithsonian Institution located in Washington DC.

Bill Tate

Bill Tate was the postmaster at Kitty Hawk and helped the Wright brothers with their experimental flights.

Dan Tate

Dan Tate was Bill Tate's brother. He was taken on as an assistant by the Wright brothers during their field tests at Kill Devils Hill.

Objects/Places

Flying Machines

As young boys the Wright brothers became intrigued with mechanical toys and making their own inventions by using those toys as models. As the boys grew older, they continued to tinker and invent various items. Orville made his first printing press using scrap metal and a tombstone. The invention should not have worked. Not only did it work but it was highly efficient.

Wilbur and Orville would soon begin to sell, manufacture and repair bicycles. However, it was hearing about Otto Lilienthal's experiments, successes and failures that guided the brothers in a new direction.

"Otto Lilienthal's gliding experiments in Germany, and his dramatic death in 1896, had aroused the Wright brothers' curiosity. They began to read what little they could find published on the subject of flight." (Chap. 4, p. 27)

It was not long before the workroom of the bicycle shop became the design center for the Wright brothers' first Flyer. It was a glider, much like the ones used by other inventors. The Flyer had some different features such as the pilot's positioning and control levers.

After many trials, successes and failures, the brothers made great strides in producing a glider that could stay in the air longer than any other, even the models used by some researchers. The brothers turned their attention to creating a flying machine that would house a motor. After many months of design and testing, the Wright brothers managed to build a motor that could power an airplane. It was the first practical airplane and it would lead to the production of military aircraft as well as planes for commercial use.

The Wright Cycle Company

The Wright Cycle Company was formed by Wilbur and Orville Wright in 1892. The bicycle craze had hit America and as mechanical minded men, the Wright brothers were immediately interested in the new contraptions. Wilbur and Orville bought bicycles and soon became devoted cyclists. It was not long before people began to ask the brothers to do repair services on the bikes. The Wright Cycle Company was born. Wilbur and Orville already had Wright and Wright, Job Printers and decided to promote Ed Sines to manage the business so that they could open the new company across the street. The brothers began to sell and repair bicycles.

Within a couple of years the Wrights began to manufacture their own line of bicycles, including the Van Cleve and St. Claire brands.

There was a lot of down time on the off season so the brothers used their free time to work on the family home. They also became photography buffs and opened their own darkroom. After learning about Otto Lilienthal's work with model airplanes, the brothers decided to start working on a plan to create a flying machine. The initial plans would be worked out in the workshop at the bicycle shop.

Dayton, Ohio

Dayton, Ohio is the city in which the Wright brothers lived. It is also the location of their two businesses as well as where they developed and tested the first airplane.

Kitty Hawk, North Carolina

Kitty Hawk, North Carolina is a small fishing village on the Outer Banks. As one of the windiest locations in the US, the Wright brothers chose it for a test sight. It was at Kitty Hawk that the Wright Brothers had their first successes in flight.

Kill Devils Hill

Kill Devils Hill is the name of the cluster of sand dunes from which the Wright brothers launched their various Flyers.

Wright and Wright, Job Printers

Wright and Wright, Job Printers was the name of the printing shop opened by Orville Wright. It was later turned over to an employee to manage while the brothers opened their bicycle shop.

Mechanical Toys

The Wright brothers became intrigued with mechanics after Bishop Wright brought home mechanical toys for the boys to play with and take apart. The brothers would soon create replicas of the toys which were better than the originals.

Wright Flyers

The Wright brothers developed their own line of Flyers, including the Van Cleve and St. Claire brands. They went on to create many powered Flyers as well, including the Wright US Signal Corps Flyer, an aircraft manufactured for the government.

Hawthorne Street

The Wright family home was located on Hawthorne Street in Dayton, Ohio. It was also the site where Orville was born.

France

Wilbur sailed to France to oversee the manufacture of the Wright Flyers. Wilbur also launched more than 100 flights while in Europe, taking the first civilians into the air.

Themes

Flying Machines

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Determination

There have been few inventors, aside from Thomas Edison, who have been so devoted to their creations. The Wright brothers fall into this category. It took many years of study, design, trials and experiments before the Wright brothers invented the first successful glider and the first practical airplane.

The brothers complemented each other perfectly. They had always been close, as inseparable as twins, according to Bishop Wright. Both men had foresight and the ability to solve complex problems, build almost anything from items at hand, and to create things that had never been created before or if they had been created, were not successful. One example is the ongoing relatively unsuccessful aerodrome experiments conducted by Otto Lilienthal. The brothers were fascinated by Lilienthal and later Chanute, knowing that they could prevail where others had not.

It took about 9 years from the time the brothers began to design their first Flyer in the bicycle shop until the first practical airplane was built and ready for military and public use.

Determination is also what made it possible for Wilbur to keep focus on the big picture and for Orville to remain optimistic throughout the long process.

Vision

It took a great deal of vision for the Wright brothers to be able to create, design and fly the first successful Flyer. For almost 100 years man attempted to fly with little to no success. The men knew about the tragedy of Icarus. There is a famous Greek myth that details the story of Daedalus and his son Icarus. The father and son had escaped from prison on the island of Crete by fashioning wings out of wax and feathers. The men managed to fly away. Icarus became arrogant and flew so high that the sun melted the wax causing Icarus to fall into the sea and drown. The brothers were determined not to drown.

The calculations and tests at the workshop seemed to be endless but that did not discourage the brothers or their vision.

Freedman says that people never knew what to make of Wilbur since he often seemed aloof. It was simply that Wilbur tended to live in a world of his own, to observe rather than participate. Unlike Orville, Wilbur did not pay close attention to his attire or the small details of things. Wilbur was more of a visionary than a detail man. Orville backed up his brother's vision with hard work in the day to day operations and superior mechanical ability.

The brothers were completely in tune with their vision and always wanted to do more. A success on the Outer Banks helped to found a new idea, that of the first practical airplane that would contain a motor and be able to be used for commercial ventures.

Style

Perspective

Russell Freedman (1929-present)

The Wright Brothers: How They Invented the Airplane was written by noted author Russell Freedman. Freedman is known for having published 50 biographies as well as two dozen books on animal behaviors. According to Freedman's publisher, he prefers to be referred to as a "factual writer" as opposed to a non-fiction author. In Freedman's mind, non-fiction is made out to be boring and less interesting and entertaining than fiction. Freedman disagrees.

As with all of his books, Freedman wrote The Wright Brothers: How They Invented the Airplane because he was interested in the topic. Freedman is keen on picking topics and people that fascinate him. Freedman also believes in using photography to help tell a story. This technique is used liberally throughout the book.

Freedman manages to interject personal stories and correspondence along with many photographs while not losing the thread of the story. Freedman paints the Wright brothers as genius inventors and heroes yet they are also portrayed as real people.

The Wright Brothers, along with Lincoln: A Photobiography, was the recipient of a Newbery Honor Award.

Freedman's other books include: Franklin Delano Roosevelt (1990); Eleanor Roosevelt: A Life of Discovery (1993); The Life and Death of Crazy Horse (1996); Out of Darkness: The Story of Louis Braille (1997); Martha Graham: A Dancer's Life (1998); Washington at Valley Forge (2008); and Lafayette and the American Revolution (2010).

Tone

The tone used in The Wright Brothers: How They Invented the Airplane by Russell Freedman is most definitely partisan in nature. There is an undercurrent of admiration and perhaps even awe on the part of the author although the facts are present in a precise and accurate fashion.

Freedman manages to explain the background of the Wright brothers' lives without sentimentality although it is clear that there was a great bond in the family. It can be seen in the aftermath of Susan Wright's death, the close knit fashion in which Wilbur, Orville and Katharine never left the family home, and the fact that Wilbur made Katharine promise to watch over Orville while he was in France.

Freedman manages to do what many biographers cannot - take a great deal of information and weave it into a format that is insightful and factual while maintaining entertainment value. Even the technical aspects of the book are interesting.

Overall, Freedman's tone is pleasant and informative, imparting nothing but fact while giving the readers a glimpse into the lives of two of the world's greatest inventors.

Structure

The Wright Brothers: How They Invented the Airplane by Russell Freedman is a work of non-fiction comprised of 129 pages, broken down into 10 chapters. Freedman also includes 3 additional sections: "About the Photographs;" "Places to Visit;" and "For Further Reading." There is also an index for easy reference.

The shortest chapter is 2 pages in length; the longest chapter is 18 pages in length. The average length of the chapters is 13 pages.

Aside from Amos Root's story, the book is presented in chronological order from the births of the Wright brothers, following them throughout their stellar careers, and ending with their deaths and further flight advancements.

There are 91 photographs in the book, the vast majority of which were taken by the Wrights who were also accomplished photographers. The first shows the 1904 flight over Huffman Prairie, the sight witnessed by Amos Root. Every chapter begins with a corresponding photograph to complement the following titles:

Chapter 1: What Amos Root Saw

Chapter 2: Wilbur and Orville

Chapter 3: The Art of Flying

Chapter 4: Wind and Sand

Chapter 5: Back to the Drawing Board

Chapter 6: Horsepower and Propellers

Chapter 7: The First Practical Airplane

Chapter 8: Fliers or Liars?

Chapter 9: The Conquering Heroes

Chapter 10: The Age of Flight

The photographs included in the book are specifically credited to the copyright holders. Additional photos are credited to Wright State University; Library of Congress; and Smithsonian Institution.

Quotes

"No one had ever seen what Amos Root saw on that September afternoon in 1904."
Chap. 1, p. 1

"People often remarked that Wilbur and Orville were as inseparable as twins."
Chap. 2, p. 3

"Wilbur and Orville believed that their mechanical aptitude came from their mother, a shy and retiring woman who enjoyed working with her hands."
Chap. 2, p. 7

"When the bicycling season ended each year, Wilbur and Orville had plenty of spare time."
Chap. 2, p. 13

"While the Wright brothers were building bicycles in Dayton, an engineer named Otto Lilienthal was conducting gliding experiments from the top of a small hill in Germany."
Chap. 3, p. 15

"Cayley built and flew the world's first successful model glider in 1804."
Chap. 3, p. 17

"Otto Lilienthal's gliding experiments in Germany, and his dramatic death in 1896, had aroused the Wright brothers' curiosity. They began to read what little they could find published on the subject of flight."
Chap. 4, p. 27

""We cannot understand that there was anything about a bird that could not be built on a larger scale and used by man,' Orville wrote later."
Chap. 4, p. 30

"The Wrights knew that they were exploring uncharted territory with their wind tunnel tests."
Chap. 5, p. 48

"Before their Flyer could be considered a practical invention, the Wrights had to prove that it was capable of more than brief, straight-line flights."
Chap. 7, p. 81

"Now that they had built a practical airplane, they wanted to put it on the market. Until their patent rights were secure, they felt that secrecy was important so that no one can steal their invention."
Chap. 8, p. 89

"There were moments when he looked back wistfully to those long-ago days when flying was still a dream that he shared with his brother."
Chap. 10, p. 116

Topics for Discussion

Otto Lilienthal was a major inspiration to the Wright brothers. Who was Otto Lilienthal? What did he invent? What was special about his work? What was the name of Lilienthal's book? How did Lilienthal inspire the brothers? What happened to Lilienthal?

Another inspiration to the Wright brothers was Octave Chanute. Who was Octave Chanute? What did he invent? What was special about his work? What was the name of Chanute's book? How did Chanute inspire the brothers? How did Chanute become an important part of the tests at Kitty Hawk? Explain.

As the Wright brothers' success grew, so did their business. While the thriving business presented many opportunities, it also presented many problems. List each of the opportunities presented to the Wright brothers after the success at Kitty Hawk and then again after inventing the first powered airplane. Also list the legal and other problems faced.

Explain the Wright family relationships, including the relationships between parents and children as well as the relationships between the siblings. Was the family collectively supportive of the quest to build the first successful glider and flying machines? Explain.

Wilbur Wright died at age 45 from a bout with typhoid fever. Explain how Wilbur's death changed the face of the business. Also explain how it affected Katharine and Orville. How did Orville change after Wilbur's death? What happened to the companies? When did Orville retire?

During the years in which the brothers operated the bicycle shop, both became avid photographers. This would be especially important during the test flights as the brothers documented a great number of trials. Choose at least four photos from the book and explain why they are important.

Discuss how the Wright Brothers' business may have progressed if they had not made their foray into flight. Do you think the brothers would have continued to repair and sell bicycles? Do you think they would have gone into other businesses? What happened to the brothers' printing business? Who might have accomplished the feats undertaken by the Wright Brothers if they had not made that first trip to Kitty Hawk?