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DOUBLE PULITZER PRIZE WINNER

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THE WRIGHT BROTHERS

The Dramatic Story behind the Legend



CHAPTER FIVE

December 17, 1903

When we got up a wind of between 20 and 25 miles was blowing from the north. We got the machine out early and put up the signal for the men at the station. ORVILLE WRIGHT'S DIARY, DECEMBER 17, 1903 I. With the arrival of the New Year 1903, the outlook in Dayton was more promising than ever. The local population had reached nearly 100,000 and according to the Evening News, an equal number were now finding their way there to do business. It was no town for a pessimist, said the paper, "but if there is any hope for him, here he may breathe the glorious air of prosperity and imbibe the spirit of optimism and be cured." To Americans throughout most of the country, the future was full of promise. A New Year's Day editorial in the Chicago Tribune said one would have to be of "dull comprehension" not to realize things were better than they had ever been and would be "better still when new science and new methods, and new educations have done their perfect work." The tempo of popular tunes was appropriately upbeat. Pianists north and south were playing ragtime, people singing and dancing to hits like "Bill Bailey, Won't You Please Come Home?" and "In the Good Old Summer Time."

Employment was up nearly everywhere. In the state of New York practically the entire labor force was working. Wages were

rising, the national wealth increasing. Instead of a national debt, there was a surplus of \$45 million. In Washington one sensed “a new velocity” under the leadership of Theodore Roosevelt. The country was about to take on the building of the Panama Canal, picking up where the French had failed. No new year had “ever brought the people of the United States a more encouraging outlook,” said the Albuquerque Journal-Democrat. Further, as noted in numerous editorials, Sunday sermons, and at many a family dinner table, the world was at peace. One of the few puzzling questions to be considered, said the Philadelphia Inquirer, was why, so far, after so much attention had been paid to “aerial navigation,” had there been so few results? It was shortly before the New Year when the Wright brothers sent out letters to manufacturers of automobile engines in seven states asking if they could supply an off-the-shelf engine light enough in weight but with sufficient power for their purposes. There was only one response, and in that case the motor was much too heavy. So again they had some original work to do and they had had no experience building engines. In time to come the brothers would be widely portrayed as a couple of clever, hometown bicycle mechanics who managed to succeed where so many others had failed because of their good old-fashioned American knack for solving seemingly impossible mechanical problems. This was true only in part. For Charlie Taylor, however, the description applied almost perfectly, except that he was more than a clever mechanic, he was a brilliant mechanic and for the brothers a

godsend. If sister Katharine found Charlie's claim to know all the answers unbearable, Wilbur and Orville never lost sight of his ability and enormous value to their efforts. And he himself well understood how far beyond him they were in so many ways. As he later said, boasting about them, "Those two sure knew their physics. I guess that's why they always knew what they were doing and hardly ever guessed at anything." As for building the engine: While the boys were handy with tools, they had never done much machinework and anyway they were busy on the air frame. It was up to me. . . . We didn't make any drawings. One of us would sketch out the part we were talking about on a piece of scratch paper and I'd spike the sketch over my bench. His only prior experience with a gasoline engine had been trying to repair one in an automobile a few years before. But that January, working in the back shop with the same metal lathe and drill press used for building bicycles, he went to work and six weeks later had it finished. The motor had four cylinders with a 4-inch bore and a 4-inch stroke. It was intended to deliver 8 horsepower and weigh no more than 200 pounds, to carry a total of 675 pounds, the estimated combined weight of the flying machine and an operator. As it turned out, the motor Charlie built weighed only 152 pounds, for the reason that the engine block was of cast aluminum provided by the up-and-coming Aluminum Company of America based in Pittsburgh. Other materials came from Dayton manufacturers and suppliers, but the work of boring out the aluminum for the independent cylinders and making the cast iron piston rings

was all done by one man with a drooping walrus mustache working in the back room at the bicycle shop. The fuel system was simple [he would later explain]. A one gallon fuel tank was [to be] suspended from a wing strut, and the gasoline fed by gravity down a tube to the engine. . . . There was no carburetor. . . . The fuel was fed into a shallow chamber in the manifold. Raw gas blended with air in this chamber, which was next to the cylinders and heated up rather quickly, thus helping to vaporize the mixture. The engine was started by priming each cylinder with a few drops of raw gas. Compared to later engines all was amazingly simple and crude. The ignition was of the “make-and-break type” in Charlie’s expression, probably meaning that if broken it could be quickly fixed. There were no spark plugs. The spark was made by the opening and closing of two contact points inside the combustion chamber. These were operated by shafts and cams geared to the main camshaft. The ignition switch was an ordinary singlethrow knife switch we bought at a hardware store. The “little gas motor,” as Bishop Wright called it, was finished by midFebruary, and when started up in the shop the first time the racket and clouds of smoke were nearly unbearable. When further tested the next day, the engine block cracked. Dripping gasoline had frozen the bearings, breaking the engine body and frame. Another two months went by before a second block would be delivered from Pittsburgh. This engine worked fine and as a bonus delivered an unexpected 12 horsepower. Meantime, the design of the propellers had become a still bigger challenge. “I think the

hardest job Will and Orv had was with the propellers,” Charlie later said. “I don’t believe they ever were given enough credit for that development.” The problem became more complex the more the brothers studied it. Much to their surprise, they could find no existing data on air propellers. They had assumed they could go by whatever rule-of-thumb marine engineers used for the propellers on boats, and accordingly drew on the resources of the Dayton library only to find that after a hundred years in use the exact action of a screw propeller was still obscure. Once more they were left no choice but to solve the problem themselves. “Our minds,” said Orville, “became so obsessed with it that we could do little other work.” They began to see the propeller as an airplane wing traveling in a spiral course, and that if they could calculate the effect of a wing traveling a straight course, why could they not calculate the effect of one traveling in a spiral course? But on further consideration [Orville would explain], it is hard to find even a point from which to make a start; for nothing about a propeller, or the medium in which it acts, stands still for a moment. The thrust depends upon the speed and the angle at which the blade strikes the air; the angle at which the blade strikes the air depends on the speed at which the propeller is turning, the speed the machine is traveling forward, and the speed at which the air is slipping backward; the slip of the air backward depends on the thrust exerted by the propeller, and the amount of air acted upon. When any one of these change, it changes all the rest, as they are all interdependent on one

another. After several months of study and discussion they had come to understand that the thrust generated by a standing propeller was no indication of the thrust when in motion, and that the only realistic way to test the efficiency of a propeller would be to try it out on the flying machine. During these months their "discussions" became as intense as they had ever been. Heated words flew, filling hours of their days and nights, often at the tops of their voices. "If you don't stop arguing, I'll leave home," a nearly hysterical Katharine cried out at one point. According to Charlie Taylor, they were never really mad at each other. One morning after one of their "hottest" exchanges, he had only just opened the shop at seven o'clock as usual when Orville came in saying he "guessed he'd been wrong and they ought to do it Will's way." Shortly after, Wilbur arrived to announce he had been thinking it over and "perhaps Orv was right." The point was, said Charlie, "when they were through . . . they knew where they were and could go ahead with the job." The new Flyer, as they called it, would have two propellers positioned between the two wings just to the rear of the operator. One would turn clockwise, the other, counterclockwise, so the spinning, or gyroscopic action, of the one would balance that of the other. Making the propellers with the proper diameter, pitch, and surface area proved no great problem. Each had a diameter of 8 and a half feet and were made of three spruce laminations glued together and shaped by hand with a hatchet and spoke shaver, or "drawknife," as used by wheelwrights. That they were different

from any propellers ever built before was certain, and the last major problem had been resolved. Again, the machine would ride on skids, not wheels. The operator would again lie prone at the controls in the middle of the lower wing. The motor and a radiator would be positioned directly beside him on the right. A little one-gallon gas tank hung overhead on a strut to his left. The drive chains for the propellers were specially made by the Indianapolis Chain Company, and Roebling wire would be used for the trusses between the wings—wire made by the Roeblings who built the Brooklyn Bridge. On March 23, the brothers applied for a patent on their flying machine, its wing-warping system, and rudder. In late April came a letter postmarked Paris from Octave Chanute, who, to help recover from the death of his wife, had been on an extended vacation in Europe. Their experiments were attracting much attention in Paris, he reported to the brothers, adding, “It seems very queer that after having ignored all this series of gliding experiments for several years, the French should now be overenthusiastic about them.” While in Paris he had given several talks on the subject, including one at a formal dinner conference at the Aéro-Club de France. What the genial Chanute did not relate was how, in these talks, he had portrayed his part in the experiments, referring repeatedly to the Wrights as his “devoted collaborators.” Perhaps it was his pride in les frères, or the glow he undoubtedly felt being a center of attention in his native France where interest in aviation was great. However, the impression he conveyed was that he was their

teacher, and they, his daring pupils, were carrying “his” work to fulfillment. This was not only untrue but grossly unfair. Great as had been Chanute’s interest and encouragement, the brothers had never in any way been his pupils or collaborators. All they had achieved was their own doing, gained by their own original study and effort. Exactly when and how they learned of what Chanute had said in Paris is unclear, but it was not something they were happy about or would forget. Of far greater consequence, however, was Chanute’s admirable emphasis on the importance of their glider flights, all of which was a revelation for the French and “even a little disagreeable,” as said one of the Aéro-Club’s leaders, Comte Henri de La Vaulx. It was time for French aviation experimenters “to get seriously to work if they did not wish to be left behind.” In his speech and in numerous conversations while in France, Chanute had also provided a great deal of information on the details of the Wright glider, and this would indeed have a profound impact on French aviation. Chanute had agreed to write something for the influential publication *L’Aérophile*, he informed Wilbur, and would need pictures of him and Orville without delay. After allowing a few weeks to slip by, Wilbur replied goodnaturedly that they did not know how to refuse when Chanute had put the matter so nicely, but on the other hand they had not the courage to face a camera. By mid-May, Chanute was back home and wanted to set a date for Wilbur to come again to Chicago and again address the Western Society of Engineers. He also wished to visit the brothers in Dayton quite soon as he had

information he wished to deliver in person. He arrived the morning of June 6 and returned to Chicago that same night. In the course of the day's conversation he told the brothers he was giving up his own experiments. From here on, he said, it was all up to them. Wilbur spoke before the gathering in Chicago the evening of June 24, and with considerably more confidence and spirit than he had two years earlier. He described in some detail the breakthrough he and Orville had achieved with the glider they tested at Kitty Hawk the previous fall. He said much about the part the study of birds had played in their work, and of the glides they were able to achieve, putting particular emphasis, as he had before, on the necessity of skill at the controls. More than machinery skill was needed. "A thousand glides is equivalent to about four hours of steady practice," he told the audience, and this was "far too little to give anyone a complete mastery of the art of flying. Since soaring is merely gliding in a rising current, it would be easy to soar in front of any hill of suitable slope, whenever the wind blew with sufficient force to furnish support, provided the wind were steady. But by reason of changes in wind velocity there is more support at times than is needed, while at others there is too little, so that a considerable degree of skill, experience, and sound judgment is required in order to keep the machine exactly in the rising current. . . . Before trying to rise to any dangerous height a man ought to know that in an emergency his mind and muscles will work by instinct rather than conscious effort. There is no time to think. A continuing study

of soaring birds had convinced him that man could build wings that had as little or less resistance than even the best of birds. But that was not the point, or the lesson from birds. "The birds' wings are undoubtedly very well designed indeed, but it is not any extraordinary efficiency that strikes with astonishment but rather the marvelous skill with which they are used." At the close Wilbur declared still again, "The soaring problem is apparently not so much one of better wings as of better operators." Asked during a brief discussion period what he thought of experiments being conducted by Alexander Graham Bell to hoist a man into the air with a giant kite, Wilbur replied, "It is very bad policy to ask one flying machine man about the experiments of another, because every flying machine man thinks that his method is the only correct one." Asked by another in the audience what he thought of the dihedral angle of the wings used by Samuel Langley, Wilbur did not hesitate to point out that Langley's machine was tested only in dead calms when there were no side gusts to contend with and that it must be remembered "the wind usually blows." Nowhere in the talk had he said a word about the gasoline engine sitting in the back room of the bicycle shop at Dayton; or of his and Orville's intense, often maddening work on propellers; or of what they would be up to at Kitty Hawk in only a matter of months. When the subject of motors came into discussion, he simply kept to the past tense. "As none of our experiments has been with power machines, my judgment . . . may be of little value." Day after day that June the weather in Dayton remained, as Bishop

Wright recorded, “fair and mild.” For him all was much as usual.

He went to the library, he wrote letters, attended church, accompanied Katharine at a high school commencement. When she headed off to Oberlin for another commencement, the house on Hawthorn Street grew quieter still. At the shop on West Third Street it was a different story. With the help of Charlie Taylor, the brothers were on the home stretch and working harder than ever to get everything right with every piece and part of the new machine. From Kitty Hawk Bill Tate sent word that he had installed a gasoline tank at the camp and asked how soon he could expect to see them. On July 14 came the news that in a matter of days, Samuel Langley was to test his “latest contrivance” on the mosquito-infested banks of the Potomac River near Quantico, Virginia, thirty miles south of Washington. This time it was to be a motor-powered “full-fledged airship” called “The Great Aerodrome,” capable of carrying one operator. It had cost \$50,000 in public money—in Smithsonian resources and the largest appropriation yet granted by the U.S. War Department. Professor Langley and several of his friends, including Alexander Graham Bell, contributed another \$20,000. Reporters rushed to the scene, and in a flotilla of watercraft comprised of everything from catboats to steam launches converged on the giant houseboat, “the ark” as they called it, on top of which perched Langley’s machine, “the buzzard,” poised to go. Langley himself arrived from Washington and went aboard the houseboat only to disappear inside, refusing to show himself, despite earnest

pleas for interviews. When a storm struck, he and his party of mechanics and scientists went back to Washington. Then, with the storm over, the young man who was expected to fly the machine, Charles Manly, hurried off to Washington, but on returning the next day refused to say anything. At last, on the morning of August 8, the air perfectly still, an unmanned, quarter-scale model of the Langley machine was launched and traveled some 1,000 feet before crashing into the river.

“AIRSHIP AS A SUBMARINE” ran the mocking headline in the New York Times. Manly went before reporters to declare the flight entirely successful, but beyond that would say no more.

How Wilbur and Orville felt about all this, just as they were about to attempt the most important step in their own work, what comments were exchanged in the privacy of the workshop or at home, there is no telling. The only comment on record, in a letter Wilbur wrote to Octave Chanute, was largely an expression of sympathy for Langley: Professor Langley seems to be having rather more than his fair share of trouble just now with the pestiferous reporters and windstorms. But as the mosquitoes are reported to be very bad along the banks where the reporters are encamped he has some consolation. Work on their “whopper flying machine,” as they had come to call it, continued through the mounting heat of summer, the brothers and Charlie seeing to the final touches on every component, every small detail, before departure for Kitty Hawk, where, they knew, still more work would be required for the assembly of it all. “We never did assemble the whole

machine at Dayton. There wasn't room enough," Charlie would explain. Just the center section alone when set up in the shop, so blocked passage between the front and back rooms that to wait on customers he or one or the other of the brothers had to slip out a side door and go around to the street entrance in front. Packing everything for shipment so there would be no damage en route became in itself a major task—motor, frame, and parts adding up to an estimated 675 pounds. By September 18, all was crated and on the train. There was no ceremony about it or anxiousness, according to Charlie. "If there was any worry about the flying machine not working, they never showed it and I never felt it." Five days later Wilbur and Orville themselves were packed and on board an eastbound train. II. The change from the crowded, stifling hot, noisy confines of the workspace at Dayton to the open reaches of sea and sky on the Outer Banks could hardly have been greater or more welcome. They loved Kitty Hawk. "Every year adds to our comprehension of the wonders of this place," wrote Orville to Katharine soon after arrival. The previous winter on the Banks had been especially severe, one continuing succession of storms, the brothers were told, the rain coming down in such torrents as to make a lake that reached for miles near their camp. Ninety-mile-an-hour winds had lifted their building from its foundation and set it down several feet closer to the ocean. Mosquitoes were said to have been so thick they turned day into night, the lightning so terrible it turned night into day. But the winds had also sculpted the sand hills into the best shape for gliding the

brothers had seen, and the September days now were so glorious, conditions so ideal, that instead of turning at once to setting up camp, they put the glider from the year before back in shape and spent what Wilbur called “the finest day we ever had in practice.” They made seventy-five glides and with some practice at soaring found it easier than expected. All was looking highly favorable. With the help of Dan Tate, a new 16 × 44-foot building in which to assemble and store the new Flyer went up in little more than a week’s time, its doors hung and hinged just as a terrific storm struck, the wind at one point blowing 75 miles per hour. Progress on the new machine had to go forward, of course, though indoors. “Worked all day in making connections of sections of upper [wing] surface, putting in wires at rear edge and putting on some hinges,” Orville recorded on October 12 the same day Dan Tate reported that five boats had already been driven ashore between Kitty Hawk and Cape Henry. On October 18, as Wilbur wrote to Katharine, “a storm hove to view” that made “the prayers of Elijah look small in comparison. The wind suddenly whirled around to the north and increased to something like 40 miles an hour and was accompanied by a regular cloudburst. In this country the winds usually blow from the north, then from the east, next the south, and then from the west, and on to the north again. But when the wind begins to “back up,” that is, veer from south to east and north, etc., then look out, for it means a cyclone is coming. . . . Maybe it got so in love with backing up that it went forward a little sometimes just to have the fun of “backing up”

again. It repeated this process seven times in four days. . . . The second day opened with the gale still continuing. . . . The climax came about 4 o'clock when the wind reached 75 miles an hour.

Suddenly a corner of our tar-paper roof gave way under the pressure and we saw that if the trouble were not stopped the whole roof would probably go. Orville put on Wilbur's heavy overcoat, grabbed a ladder, and went out to see what could be done. Wilbur, coatless, followed after and, fighting the wind, found Orville at the north end of the building, having succeeded in climbing the ladder only to have the wind blow the coat over his head. As the hammer and nails were in his pocket and up over his head [Wilbur continued, delighting in telling the story for those at home once the storm had passed], he was unable to get his hands on them or to pull his coattails down, so he was compelled to descend again. The next time he put the nails in his mouth and took the hammer in his hand and I followed him up the ladder hanging on to his coattails. He swatted around a good little while trying to get a few nails in. . . . He explained afterward that the wind kept blowing the hammer around so that three licks out of four [he] hit the roof or his fingers instead of the nail. Finally the job was done and we rushed for cover. The driving wind and rain continued through the night, Wilbur wrote, "but we took the advice of the Oberlin coach, 'Cheer up, boys, there is no hope.'" By mail, on October 18, came a newspaper clipping sent by their Hawthorn Street neighbor George Feight reporting the failure of another Langley test flight on October 7, and this time it was the full-sized Great

Aerodrome with Charles Manly at what constituted the controls. No sooner had the “buzzard” with a wingspan of 48 feet been launched than it dove straight into the water. Manly, though thoroughly drenched, suffered no injury. “I see that Langley has had his fling, and failed,” Wilbur wrote to Octave Chanute. “It seems to be our turn to throw now, and I wonder what our luck will be.” In the same letter, Wilbur left no doubt that their confidence was at a new high. “We are expecting the most interesting results of any of our seasons of experiment, and are sure that, barring exasperating little accidents or some mishaps, we will have done something before we break camp.”

Scratching off a postcard to Charlie Taylor, Orville expressed the same spirit in a lighter vein. Flying machine market has been very unsteady the past two days. Opened yesterday morning at about 208 (100% means even chance of success) but by noon had dropped to 110. These fluctuations would have produced a panic, I think, in Wall Street, but in this quiet place it only put us to thinking and figuring a little. They proceeded on the Flyer much as if they were building a truss bridge, only with the attention to detail of watchmakers, Orville keeping a day-by-day record in his diary. Thursday, October 22 We worked all day on lower surface and tail. Friday, October 23 Worked on skids during morning, and after dinner finished putting on hinges. Saturday, October 24 We put in the uprights between surfaces and trussed the center section. Had much trouble with wires. On Monday the 26th, they worked again on the truss wires until the afternoon, when the wind veered to

the north, and they spent two hours at Kill Devil Hills flying the glider and succeeded in breaking their previous record for time five times and covering distances of as much as 500 feet.

George Spratt had rejoined them, and on October 27 he and Dan Tate started up the engine on the machine. Monday, November 2 Began work of placing engine on machine. . . . Wednesday, November 4 Have machine now within half day of completion. But when the next day they started up the motor, the magneto—a small generator utilizing magnets—failed to deliver a spark to ignite the gas and the vibrations of the misfiring engine tore loose and badly twisted the propeller shafts. With little chance of more flight tests anytime soon, George Spratt chose to go home, taking with him the damaged shafts as far as Norfolk to be shipped back to Charlie Taylor in Dayton. Two days later Octave Chanute appeared. The weather turned miserably cold and rainy, and there was little to do but sit around the stoves and talk. Chanute told the brothers it was as if they were “pursued by a blind fate” from which they were unable to escape. “He doesn’t seem to think our machines are so much superior as the manner in which we handle them,” Orville wrote to Katharine and their father after Chanute had left. “We are of just the reverse opinion.” Days passed still too cold to work. Puddles about the camp turned to ice. All the same, the brothers were entirely comfortable and had no trouble keeping warm, as Wilbur wrote reassuringly in another letter home, cheerful as ever and off on another of his wry renditions of coping with the travails of camp life. In addition to

the classifications of last year, to wit, 1, 2, 3 and 4 blanket nights, we now have 5 blanket nights, and 5 blankets and 2 quilts. Next come 5 blankets, 2 quilts and fire; then 5, 2, fire, & hot-water jug. This is as far as we've got so far. Next comes the addition of sleeping without undressing, then shoes & hats, and finally overcoats. We intend to be comfortable while we are here. In the last days of November, snow fell, something they had not seen before on the Outer Banks. Water in their washbasin froze solid. Cold or not, they succeeded meantime in getting the engine to run with practically no vibration even at high speed. The Flyer would be launched on a single wooden track, to serve like a railroad track 60 feet in length on which it would slide. The total cost for materials for this innovation was all of \$4. By all evidence the brothers had suffered in spirit not in the least. "After a loaf of 15 days, we are down to work again," Orville wrote to Charlie on November 23. "We will not be ready for a trial for several days yet on account of having decided on some changes in the machine. Unless something breaks in the meantime we feel confident in success." New propeller shafts made of larger, heavier steel tubing arrived from Charlie, only to crack during an indoor test. With no delay, Orville, the better mechanic of the two, packed his bag and on November 30 left for Dayton to see what could be done, with Wilbur remaining behind "to keep house alone," in his words. In Washington, by the morning of December 8, the cold wind eased off, and to Charles Manly and the Smithsonian technicians working with him, conditions for another test of

Samuel Langley's much publicized, much derided aerodrome looked as favorable as could be hoped for given the time of year. Cakes of ice could be seen riding with the current on the Potomac, but the day was bright, the air calm, and given that money for the project was nearly gone by now, any further postponement seemed out of the question. The brave Manly was again to be the "steersman," the only one to risk his life, and it was he who made the final decision to proceed. As he saw it, it was "now or never." The giant airship, with its wings again set at a pronounced dihedral angle, was to be launched as before by catapult from atop the same monstrous houseboat, tied up this time just four miles below the city at Arsenal Point. Some five hours of frantic effort went into the final preparations. Not until four in the afternoon did everything appear ready, and by then it was nearly dark and the wind was rising. Professor Langley and a few of his associates were watching from small boats. Other boats of every sort were filled with reporters, and crowds of spectators lined the length of the Arsenal seawall. Having stripped down to a union suit, Manly put on a jacket lined with buoyant cork, climbed aboard the aircraft, and fired up the gasoline engine. At exactly 4:45 he gave the signal to release the catapult. Instantly the machine roared down the track and leaped 60 feet straight up into the air, only to stop and with a grinding, whirring sound, hang suspended momentarily, nose up, then, its wings crumbling, flipped backward and plunged into the river no more than 20 feet from the houseboat. Manly, who had

disappeared into the river, found himself trapped underwater, his jacket snared by part of the wreckage. Tearing free, he fought his way up through tangled wires only to hit a sheet of ice before at last breaking through to the surface. He was pulled from the water, uninjured but nearly frozen. After being quickly wrapped in blankets and administered a shot of whiskey, he broke into what one of the Smithsonian staff would describe as “the most voluble series of blasphemies” he had ever heard in his life. As the newspapers reported, the failure was worse by far than that of October 7, as was the humiliation for Langley and nearly everyone connected with the costly, long-drawn-out project. Halfhearted and unconvincing explanations were offered by Langley and others, fixing the blame on flaws in the launching apparatus. Few were convinced. Langley was compared to Darius Green, the comic fool of the famous poem whose ludicrous machine flew in one direction only, downward. The government, said the Washington Post, should promptly sever its relations with the experiment that had covered eight to ten years and involved a very large outlay of public money without disclosing a single ground for hope. The whole thing had been a colossal failure, to be sure, but as the Chicago Tribune said, it was impossible not to feel some sympathy for Langley. He has constructed his aerodrome on scientific principles so far as he understands them. He has spent much money, he has shown great patience and perseverance, and he has labored hard. . . . Evidently something is wrong with the scientific principles or the

professor's application of them. The only one whose reputation did not suffer was Charles Manly. Langley, who would die three years later, in 1906, never got over the defeat and humiliation. Word of what had happened was brought back to Kitty Hawk by Orville. The news had broken on December 9, the morning he was leaving Dayton with a set of new solid steel propeller shafts. It was while waiting at the station that he had picked up the papers with all the details. Neither brother was ever to make critical or belittling comments about Langley. Rather, they expressed respect and gratitude for the part he had played in their efforts. Just knowing that the head of the Smithsonian, the most prominent scientific institution in America, believed in the possibility of human flight was one of the influences that led them to proceed with their work, Wilbur told Octave Chanute in a letter written some years later. As for Langley's actual work, his successes and failures, Wilbur thought it "perhaps too soon to make an accurate estimate, but entirely aside from this he advanced the art greatly by his missionary work and by the inspiration of his example. He possessed mental and moral qualities of the kind that influence history. When scientists in general considered it discreditable to work in the field of aeronautics he possessed both the discernment to discover possibilities there and the moral courage to subject himself to the ridicule of the public and the apologies of his friends. He deserves more credit for this than he has yet received. The treatment Langley had been subjected to by the press and some of his professional friends had been

“shameful,” Wilbur said. “His work deserved neither abuse nor apology.” III. Orville reached Kitty Hawk at midday, December 11, a Friday, and spent that afternoon with Wilbur unpacking “the goods.” Saturday the wind was too light to make a start on level ground. Sunday, as always a day off, they passed the time much as they might have at home, reading and visiting with neighbors, in this case, Adam Etheridge from the Life-Saving Station, who with his wife and children came by to say hello and see the new machine so many were talking about. On the afternoon of Monday the 14th, all final repairs attended to, the brothers were ready. With the help of John T. Daniels, a robust man who looked as though he could lift a house, and two other men from the station, they hauled the 605-pound Flyer the quarter mile over to the Big Hill to the face of the slope where they had positioned the 60-foot launching track. When the engine was started up with a roar, several small boys who had been tagging along were so startled they took off over the hill as fast as they could go. Everything was set. There was no debate or extended discussion over which of them should go first. They simply flipped a coin. Wilbur won and worked his way between the propellers and in among the truss wires to stretch flat on his stomach beside the engine, his hips in the padded wing-warping cradle, whereby he could control the wing-warping wires by shifting his body, and head up, looking forward out through the horizontal rudder or elevator that controlled the up or down pitch of the craft. Orville took hold of an upright bar at the end of the right wings, ready to help

balance the whole affair when it started forward on the track. Then off they went, Orville running as fast as he could, holding on until no longer able to keep up. But at the end of the track, Wilbur made a mistake. Pulling too hard on the rudder, he sent the Flyer surging upward at too steep an angle. To compensate, he nosed it downward, but again too abruptly and the machine hit the sand a hundred feet from the end of the track. The brothers were elated. Motor, launching device, everything had proven reliable. Damage was minor. Wilbur's error in judgment, from lack of experience with this kind of apparatus, had been the only cause of trouble, as he told the others and explained in a letter to Katharine and the Bishop. The repairs took two days. Not until late the afternoon of the 16th was the machine ready.

While they were setting it up on the track in front of the building, seeing to final adjustments, a stranger wandered by and after looking the machine over, asked what it was. When we told him it was a flying machine, he asked whether we intended to fly it [Orville would write later]. We said we did, as soon as we had a suitable wind. He looked at it several minutes longer and then, wishing to be courteous, remarked that it looked as if it would fly, if it had a "suitable wind." The brothers were much amused, certain that by "suitable wind," the man had in mind something on the order of the recent 75-mile-an-hour gale. Only five men showed up the morning of Thursday the 17th, after the brothers hung a white bedsheet on the side of the shed, the signal to the men at the LifeSaving Station that their help was needed. Many, as Orville later explained, were

apparently unwilling to face the “rigors of a cold December wind in order to see, as they no doubt thought, another flying machine not fly.” Those who did turn out felt differently. “We had seen the glider fly without an engine,” remembered John T.

Daniels, “and when these boys put an engine in it, we knew that they knew exactly what they were doing.” Adam Etheridge

and Will Dough had come with Daniels from the Life-Saving Station. W. C. Brinkley was a dairy farmer from Manteo, and the fifth, Johnny Moore, was a boy of about eighteen who had

happened by and was curious to know about the strange-looking machine. Daniels, known to be “a joker,” told him it was a “duck-snarer” and explained how any minute Orville would be going up and out over the bay, where there were ducks by the hundreds, and how he would drop a giant net and catch every

one. The boy decided to stay and watch. Bill Tate, to his subsequent regret, was away at the time in Elizabeth City. The

day was freezing cold. Skims of ice covered several nearby ponds. A gusty wind was blowing hard out of the north. “The wind usually blows,” Wilbur had reminded his Chicago audience in June. It was blowing at nearly a gale force of 20 to 27 miles per hour, far from ideal. The difficulty in a high wind was not in

making headway in it but maintaining balance. Reflecting on the moment long afterward, Orville would express utter amazement over “our audacity in attempting flights in a new and untried machine under such circumstances.” Working together they and the men hauled the Flyer to the launching track, four 15-foot-long two-by-fours sheathed with a metal

strip, and laid down this time on a flat, level stretch about 100 feet west of the camp, the track running north-northeast straight into the freezing wind. With everything in place and ready to go, Wilbur and Orville walked off a short way from the others and stood close talking low for some time under an immense overcast sky. Dressed in their dark caps and dark winter jackets beneath which they wore their customary white shirts, starched white collars, and dark ties, they could as well have been back in Dayton on a winter morning chatting on a street corner. The other five watched and waited together in silence. They had become “a serious lot,” John T. Daniels remembered. “Nobody felt like talking.” Because Wilbur had won the toss three days before, it was now Orville’s turn. The two shook hands as if saying goodbye. Then Wilbur went over to the others and told them not to look so glum, but to cheer Orville on his way. “We tried,” Daniels said, “but it was mighty weak shouting with no heart in it.” In the time since 1900, when Wilbur had gone off on his first trip to Kitty Hawk bringing a camera as part of his equipment, the brothers had become increasingly interested in photography as essential to their flying experiments. They had even begun selling photographic equipment at the bicycle shop. In 1902 they had made what for them was a major investment of \$55.55 in as fine an American-made camera to be had, a large Gundlach Korona V, which used 5 × 7-inch glass plates and had a pneumatic shutter. Early that morning of December 17, Orville had positioned the Korona on its wooden tripod about 30 feet from the end of the starting rail

and assigned Daniels to squeeze the rubber bulb to trip the shutter as the Flyer passed that point. Orville now positioned himself on his stomach at the controls, as Wilbur had, while Wilbur stood to the right at the tip of the lower wing ready to help keep the machine in balance as it started down the track. Minutes passed while the engine warmed up. As they would later emphasize neither had had any “previous acquaintance” with the conduct of the machine and its controlling mechanisms. At exactly 10:35, Orville slipped the rope restraining the Flyer and it headed forward, but not very fast, because of the fierce headwind, and Wilbur, his left hand on the wing, had no trouble keeping up. At the end of the track the Flyer lifted into the air and Daniels, who had never operated a camera until now, snapped the shutter to take what would be one of the most historic photographs of the century. The course of the flight, in Orville’s words, was “extremely erratic.” The Flyer rose, dipped down, rose again, bounced and dipped again like a bucking bronco when one wing struck the sand. The distance flown had been 120 feet, less than half the length of a football field. The total time airborne was approximately 12 seconds. “Were you scared?” Orville would be asked. “Scared?” he said with a smile. “There wasn’t time.” “It was only a flight of twelve seconds,” he would also stress later, “and it was an uncertain, wavy, creeping sort of a flight at best, but it was a real flight at last.” The machine was picked up and carried back to the starting point, after which they all took a short break to warm up inside the camp. At about eleven o’clock, the wind

having eased off somewhat, Wilbur took a turn and “went off like a bird” for 175 feet. Orville went again, flying 200 feet. Then, near noon, on the fourth test, Wilbur flew a little over half a mile through the air and a distance of 852 feet over the ground in 59 seconds. It had taken four years. They had endured violent storms, accidents, one disappointment after another, public indifference or ridicule, and clouds of demon mosquitoes. To get to and from their remote sand dune testing ground they had made five round-trips from Dayton (counting Orville’s return home to see about stronger propeller shafts), a total of seven thousand miles by train, all to fly little more than half a mile. No matter. They had done it. There was talk of going again, of even attempting a flight down the beach to the weather station. But a sudden gust caught the Flyer and tossed it along the sand “just like you’ve seen an umbrella turned inside out and loose in the wind,” remembered John T. Daniels. Daniels had been standing holding an upright of one of the wings and suddenly found himself caught in the wires and the machine “blowing across the beach, heading for the ocean, landing first on one end and then on the other, rolling over and over, and me getting more tangled up in it all the time” —all 600-plus pounds of the machine, plus Daniels, who weighed over 200 pounds, swept up by the wind as though they weighed nothing at all. When the machine stopped momentarily, Daniels succeeded in breaking loose. (“His escape was miraculous,” Orville later wrote, “as he was in the engine and chains.”) “I wasn’t hurt much. I got a good many bruises and scratches and

was so scared I couldn't walk straight for a few minutes," Daniels would say. The brothers "ran up to me, pulled my legs and arms, felt of my ribs and told me there were no bones broken. They looked scared, too." From that day on Daniels could proudly claim to have survived the first ever airplane accident. The Flyer was a total wreck, nearly all the ribs of the wings broken, the chain guides badly bent, uprights splintered. Any thought of another flight had vanished. Daniels and the others said their goodbyes and walked back to the Life-Saving Station. For their part Wilbur and Orville fixed and ate some lunch, then washed the dishes before walking four miles to the Kitty Hawk weather station to send a telegram home. The day in Dayton had been cloudy and freezing cold with snow on the ground. It was past dark when Carrie Kayler, preparing supper in the kitchen at 7 Hawthorn Street, stopped to answer the doorbell. The Western Union man handed her a telegram, which she signed for and carried upstairs to the Bishop. A few minutes later he came down looking pleased, but with no excitement in his voice, told her, "Well, they've made a flight."

The telegram read: SUCCESS FOUR FLIGHTS THURSDAY MORNING ALL AGAINST TWENTY ONE MILE WIND STARTED FROM LEVEL WITH ENGINE POWER ALONE AVERAGE SPEED THROUGH AIR THIRTY ONE MILES LONGEST 57 SECONDS INFORM PRESS HOME FOR CHRISTMAS. OREVELLE WRIGHT (Mistakes in the transmission had caused 59 seconds to become 57 and Orville's name to be misspelled.) Katharine came in from school, looked at the telegram, and told Carrie to

delay supper while she went to tell Lorin. Success it most certainly was. And more. What had transpired that day in 1903, in the stiff winds and cold of the Outer Banks in less than two hours time, was one of the turning points in history, the beginning of change for the world far greater than any of those present could possibly have imagined. With their homemade machine, Wilbur and Orville Wright had shown without a doubt that man could fly and if the world did not yet know it, they did. Their flights that morning were the first ever in which a piloted machine took off under its own power into the air in full flight, sailed forward with no loss of speed, and landed at a point as high as that from which it started. Being the kind of men they were, neither ever said the stunning contrast between their success and Samuel Langley's full-scale failure just days before made what they had done on their own all the more remarkable. Not incidentally, the Langley project had cost nearly \$70,000, the greater part of it public money, whereas the brothers' total expenses for everything from 1900 to 1903, including materials and travel to and from Kitty Hawk, came to a little less than \$1,000, a sum paid entirely from the modest profits of their bicycle business. Of those who had been eyewitnesses at Kill Devil Hills the morning of the 17th, John T. Daniels was much the most effusive about what he had felt. "I like to think about it now," he would say in an interview years later. "I like to think about that first airplane the way it sailed off in the air . . . as pretty as any bird you ever laid your eyes on. I don't think I ever saw a prettier sight in my life." But it would

never have happened, Daniels also stressed, had it not been for the two “workingest boys” he ever knew. It wasn’t luck that made them fly; it was hard work and common sense; they put their whole heart and soul and all their energy into an idea and they had the faith. As they crated up the damaged Flyer to ship home, the brothers were “absolutely sure” in their own minds that they had mastered the problem of mechanical flying. But they also understood as no one else could have how much they had still to do, how many improvements were needed, how much more they themselves needed to learn about flying so different a machine, and that this would come only with a great deal more experience. The Flyer would go into storage in Dayton. It would never be flown again.