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DOUBLE PULITZER PRIZE WINNER

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# THE WRIGHT BROTHERS

The Dramatic Story behind the Legend



## CHAPTER THREE

### Where the Winds Blow

One ship drives east and another drives west With the self-same winds that blow. 'Tis the set of the sails And not the gales Which tells us the way to go. ELLA WHEELER WILCOX, "WINDS OF FATE" I. The legendary Outer Banks, a narrow chain of sandbars and islands shielding the North Carolina coastline from the full force of the Atlantic Ocean, reach more than 175 miles from Norfolk, Virginia, south to Cape Lookout. In 1900 few lived there other than fishermen and their families, and those with the LifeSaving Service. No bridges as yet crossed from the mainland. One got to the Outer Banks by boat and about the only signs of civilization at Kitty Hawk were four Life-Saving Stations, one every six miles, and the Weather Bureau Station. There were no real roads. The one conspicuous structure on the skyline was a rambling summer hotel at Nags Head. Wilbur reached Norfolk by train on September 7, 1900, roughly twenty-four hours after leaving Dayton, and checked in overnight at a hotel. The temperature in Norfolk the next day hit 100 degrees, and dressed in his customary dark suit, high collar, and necktie, he nearly collapsed. He needed still to find the long spruce strips necessary for his "machine" and so set off to several lumberyards only to be told they had none. Settling for white pine, he gathered up everything and boarded a 4:30

train to Elizabeth City, sixty miles to the south, where the Pasquotank River flows to meet Albemarle Sound. When, at Elizabeth City, he inquired about the best way to get over to Kitty Hawk, he received nothing but blank stares. No one he talked to seemed to know anything about the place or have the least idea how to get there. It was another four days before he found a boatman on the waterfront, one Israel Perry, who said he had been born and raised at Kitty Hawk and agreed to take Wilbur across. Perry also had a friend to help him. Wilbur's heavy trunk and the pine strips would go over on the weekly freight boat. To get to Perry's schooner required going by a small skiff much the worse for wear and leaking badly. When Wilbur asked if it was safe, Perry, to assure him, said, "Oh, it's safer than the big boat." With constant bailing the whole three miles, they managed to reach the schooner, which was indeed in sadder shape. "The sails were rotten," wrote Wilbur, "the ropes badly worn and the rudder-post half rotted off, and the cabin so dirty and vermin-infested that I kept out of it from first to last." The weather had been fine all day, but by the time they started out of the wide Pasquotank River and down the sound, it was nearly dark and the water much rougher than the light wind had led them to expect, as Israel Perry pointed out several times, clearly "a little uneasy." The voyage ahead was forty miles. The wind shifted and grew increasingly stronger. The waves, now running quite high, "struck the boat from below with a heavy shock and threw it back about as fast as it went forward," Wilbur would write. He had had no experience with

sailing, let alone rough water, but plainly the flat-bottom craft was woefully unsuited for such conditions. In the strain of rolling and pitching, the boat sprang a leak, and with water crashing over the bow required still more bailing. At 11 o'clock the wind had increased to a gale and the boat was gradually being driven nearer and nearer the north shore, but as an attempt to turn round would probably have resulted in an upset, there seemed nothing else to do but attempt to round the North River Light and take refuge behind the point. The situation suddenly became more dramatic still. In a severe gust the foresail was blown loose from the boom and fluttered to leeward with a terrible roar. . . . By the time we had reached a position even with the end of the point, it became doubtful whether we would be able to round the light. . . . The suspense was ended by another roaring of the canvas as the mainsail also tore loose from the boom, and shook fiercely in the gale. By now their only chance was to take in the mainsail, let the boat swing stern to the wind, and, under the jib only, make a straight run over the sandbar. This, as Wilbur wrote, was a highly dangerous maneuver in such a sea, but somehow Perry managed without capsizing. He would not land on sandbars for a thousand dollars, Perry told Wilbur. So they lay at anchor in the North River the remainder of the night. Having no stomach for any food Perry might have below, Wilbur dipped into a jar of jelly Katharine had packed in his bag and stretched out on deck. Setting the boat in order as best they could took half the next day. It was afternoon before they got under way again and

not until nine that night were they anchored at Kitty Hawk, where again Wilbur slept on deck. He finally went ashore the next morning, September 13, two days after leaving Elizabeth City. He headed first to the home of William Tate, the former Kitty Hawk postmaster with whom he had corresponded. In all,

Kitty Hawk comprised perhaps fifty houses, nearly all the homes of fishermen, and Tate, too, made most of his living that way three months of the year, beginning in October when the fish were running. As he would later write, "The community of Kitty Hawk at that time was a hardy race, chiefly descendants of shipwrecked sailors whom storm and misfortune had cast upon the shores of the North Carolina coast." He himself was the son of a shipwrecked Scotsman. The life there, Tate stressed, was one of "doublebarreled ISOLATION." Houses had little in the way of furniture. Their bare floors were kept clean by scrubbing with white sand. Families raised most of what they ate in small vegetable gardens while the "men-folk" hunted all they could.

Clothes were hand-sewn and most everyone got by with just two or three changes of clothes — "one for special occasions," it was said, "and then one on one day and one on the next." Mail came about three times a week. Children went to school about three months a year, and no one, it seemed, knew what a vacation was. Tate and his wife, Addie, gave the visitor the warm greeting he had promised, and Wilbur, as Tate remembered, "proceeded to unfold a tale of hardship" about his trip from Elizabeth City. "He was a tenderfoot and of course had a tale of woe to tell. His graphic description of the rolling of

the boat and his story that the muscles of his arms ached from holding on, were interesting, but when he said he had fasted for 48 hours that was a condition that called for a remedy at once. Therefore we soon had him seated to a good breakfast of fresh eggs, ham and coffee, and I assure you he did his duty by them. When Wilbur asked if he might board there temporarily until his brother arrived, the Tates excused themselves to confer in the next room, but without closing the door. Hearing Addie say she was not sure their home would do for such a nicely dressed visitor, Wilbur stepped to the door to tell them he would be quite happy with whatever accommodations they could provide. In a long letter to his father, Wilbur described the Tate home as an unpainted, two-story frame house with no plaster on the walls, “no carpets at all, very little furniture, no books or pictures.” For Kitty Hawk, this was above the average. A few men have saved a thousand dollars, but this is the saving of a long life. . . . I suppose a few of them see two hundred dollars a year. They are friendly and neighborly and I think there is rarely any real suffering among them. Beside fishing, they tried to grow their own beans and corn. As there appeared to be nothing but sand, Wilbur thought it a wonder they could grow anything. Until Orville’s arrival, Wilbur worked at setting up camp on a good-sized hill half a mile from the Tate house, overlooking the water. That done, he began preparing their glider, most of his efforts taken up with a change in the wingspan from 18 to 17 feet, because of his failure to find the spruce spars needed and having to be satisfied with the pine

substitutes that were two feet shorter. As a result the fabric for the wings—a beautiful white French sateen—had also to be cut back in size and re sewn. To accomplish this he borrowed Addie Tate’s sewing machine of the kind one pumped by foot. In another letter to the Bishop, he tried to describe what the glider amounted to, stressing that it was to have no motor but depend on the wind only, that the central objective was to solve the problem of balance, and that he knew exactly what he was about, both in building the glider and what he expected to achieve with the tests to come. All this was remarkably clear and concise, and, as time would show, a stunning example of extraordinary prescience. I have my machine nearly finished. It is not to have a motor and is not expected to fly in any true sense of the word. My idea is merely to experiment and practice with a view to solving the problem of equilibrium. I have plans which I hope to find much in advance of the methods tried by previous experimenters. When once a machine is under proper control under all conditions, the motor problem will be quickly solved. A failure of a motor will then mean simply a slow descent and safe landing instead of a disastrous fall. Equilibrium—balance—was exactly what riding a bicycle required and of that he and Orville knew a great deal. Well aware of how his father worried about his safety, Wilbur stressed that he did not intend to rise many feet from the ground, and on the chance that he were “upset,” there was nothing but soft sand on which to land. He was there to learn, not to take chances for thrills. “The man who wishes to keep at

the problem long enough to really learn anything positively must not take dangerous risks. Carelessness and overconfidence are usually more dangerous than deliberately accepted risks.” As time would show, caution and close attention to all advance preparations were to be the rule for the brothers. They would take risks when necessary, but they were no daredevils out to perform stunts and they never would be. Wilbur also assured his father he was taking “every precaution” about his drinking water. As Bill Tate would later recall, the local people grew increasingly curious about the visitor and the “darn fool contraption” he was sewing, gluing, and tying together. In the meantime, it had been drawn out of him by adroit questioning that his brother would be down in a couple of weeks. They were going to live in a tent and were going to make some experiments with their contraption in the art of flying. Outer Banks people were still pretty “set in their ways,” Tate added. “We believed in a good God, a bad Devil, and a hot Hell, and more than anything else we believed that same God did not intend man should ever fly.” II. Orville reached Elizabeth City on September 26, having traveled from Dayton without incident or inconvenience. The little delay he had reaching Kitty Hawk was only from lack of wind, and on arrival, again without any inconvenience, he found Wilbur had the “soaring machine” nearly ready. With everything in place, it consisted of two fixed wings, one above the other, each measuring 5 by 17 feet. In addition it had warping controls and a movable, forward rudder—the “horizontal” rudder or



elevator—of 12 square feet. There were no wheels for takeoffs or landings. Instead the machine had wooden skids, far better suited for sand. The whole apparatus weighed slightly less than 50 pounds. With Wilbur aboard as “operator,” it would total approximately 190 pounds. He would lie flat on his stomach, head first, in the middle of the lower wing and maintain foreand-aft balance by means of the forward rudder. Wind would be all-important and contrary to the old Irish wish—“May the wind be ever at your back”—a good wind had to be head-on. As would be said, for the Wrights the winds were never the enemy. New to such experimental work as they were, the brothers had yet to realize the need for keeping records of all they did. But from their letters home, it appears the experiments began on October 3. “We’ve been having a fine time,” Orville wrote to Katharine on October 14, “altogether we have had the machine out three different days, from 2 to 4 hours each time.” When, at the start of their experiments, a “terrific wind” was blowing at more than 30 miles an hour, “too strong and unsteady for us to attempt an ascent in it,” they flew their machine like a kite, with lines hanging down to the ground by which they could work the steering apparatus. The greatest difficulty was keeping the glider at a height of no more than 20 feet or so. Even with an ideal wind of 15 to 20 miles an hour, the pull of the kite could be fierce. “It naturally wants to go higher and higher,” Orville explained. “When it begins to get too high, we give it a pretty strong pull . . . to which it responds by making a terrific dart to the ground.” If nothing had been

broken, they sent it flying again and photographed it in the air.

Once, after they set the glider on the ground to make “adjustments,” a sudden gust caught one corner and, “quicker than thought,” threw it 20 feet, smashing it to pieces. Orville, who had been standing at a rear corner holding one of the upright spars, was yanked off his feet and landed in a heap 20 feet away, shaken but unharmed. They photographed the wreckage, then dragged it all back to camp and talked of heading home. But after a night’s sleep, they decided there was hope. Repairing the damage took three days. As word of what they were up to continued to spread among the local populace, increasing numbers of them could be seen watching from a respectful distance. Bill Tate and several Tate family men and boys were also glad to lend a hand when needed. The whole time Wilbur and Orville worked together side by side, no less than at home, with the exception of those days when the conditions seemed right to try a manned flight, and then it was Wilbur only who took to the air, if ever so briefly. He would stand inside an opening in the lower wing, as Orville and Bill Tate stood ready at the wing tips. On signal, all three would take hold and start trotting forward, down the sand slope straight into the wind. Wilbur would hoist himself into position, stretch flat, and grasp the controls. Orville and Tate grabbed hold of the lines attached to the wing to keep the glider from sailing higher than wished. Making themselves reasonably comfortable when not working took considerable time and effort. They had moved from the Tate home to Wilbur’s good-

sized tent with room enough for tools, supplies, and themselves. All was very different from back home, as Orville described for Katharine: The site of our tent was formerly a fertile valley, cultivated by some ancient Kitty Hawker. Now only a few rotten limbs, the topmost branches of trees that then grew in this valley, protrude from the sand. The sea has washed and the wind blown millions and millions of loads of sand up in heaps along the coast, completely covering houses and forest. Except for an occasional meal with the Tates, they got by on their own rations and their own cooking. The water around teemed with fish—"you see dozens of them whenever you look down into the water"—and Kitty Hawk fishermen shipped tons of fish to Baltimore and other cities. But the only way the brothers could get fish was to catch it themselves. "It's just like in the north," Orville explained, "where our carpenters never have their houses completed, nor the painters their houses painted, the fisherman never has any fish." Their self-reliance was put to the test. They lived mainly on local eggs, tomatoes, and hot biscuits, though these had to be made without milk, so "pitiable" were the local cows. The only things that thrived on the Outer Banks, Orville decided, were bedbugs, mosquitoes, and wood ticks. Wilbur longed especially for butter and coffee, corn bread and bacon. On the other hand the scene from the tent door—the scene from almost any point—was spectacular, with great stretches of water and sand dunes and beach and a tremendous sky overhead, with cumulus clouds rising like castles, thrilling to behold against the blue. Long flat

horizons reached far in the distance in every direction. And then there was the wind, always the wind. It was not just that it blew nearly all the time, it was the same force that had sculpted the sand hills and great dunes of Kitty Hawk that shaped and kept shaping the whole surrounding landscape. Far from home, on their own in a way they had never been, the brothers seemed to sense as they never had the adventure of life. Orville would later say that even with all the adversities they had to face, it was the happiest time they had ever known. Birds on the wing, birds of every kind by the hundreds, filled the air—eagles, snow-white gannets, hawks, pigeons, turkey vultures, or buzzards as they were known on the Outer Banks, with wing spans of as much as six feet. Wilbur devoted hours to studying their movements in the wind, filling pages of his notebook, sometimes adding small drawings. The reality of what birds could do —the miracle of birds—remained a subject of continuing importance and fascination, and birdlife on the Outer Banks was beyond anything they had ever imagined, recalling lines from Mouillard's *Empire of the Air*. The vulture's needs are few, and his strength is moderate. And so what does he know? He knows how to rise, how to float aloft, to sweep the field with keen vision, to sail upon the wind without effort . . . he sails and spends no force, he never hurries, he uses the wind. But how did the soaring bird use the wind, and wind only, to sail aloft and bank and turn as it wished? Buzzards were masters of the art. The dihedral angle, a shallow V-shape, of the wings was an advantage only in still air, Wilbur wrote in his

notebook. The buzzard which uses the dihedral angle finds greater difficulty to maintain equilibrium in strong winds than eagles and hawks which hold their wings level. The hen hawk can rise faster than the buzzard and its motion is steadier. It displays less effort in maintaining its balance. Hawks are better soarers than buzzards but more often resort to flapping because they wish greater speed. A damp day is favorable for soaring unless there is a high wind. No bird soars in a calm. "All soarers, but especially the buzzard, seem to keep their fore-and-aft balance more by shifting the center of resistance than by shifting the center of lift," Wilbur wrote. If a buzzard be soaring to leeward of the observer, at a distance of a thousand feet . . . the cross section of its wings will be a mere line when the bird is moving from the observer but when it moves toward him the wings appear broad. This would indicate that its wings are always inclined upward, which seems contrary to reason. A bird when soaring does not seem to alternately rise and fall as some observers thought. Any rising or falling is irregular and seems to be disturbances of fore-and-aft equilibrium produced by gusts. In light winds the birds seem to rise constantly without any downward turns. For the local citizens the two brothers from Ohio were extremely hard to figure. One named John T. Daniels, known as "John T." to distinguish him from his father, who was also John Daniels, said later, "We couldn't help thinking they were just a pair of poor nuts. They'd stand on the beach for hours at a time just looking at the gulls flying, soaring, dipping." Gannets, the giant seabirds with a wingspread of five

to six feet, seemed their particular interest. They would watch the gannets and imitate the movements of their wings with their arms and hands. They could imitate every movement of the wings of those gannets; we thought they were crazy, but we just had to admire the way they could move their arms this way and that and bend their elbows and wrist bones up and down and which way, just like the gannets. "Learning the secret of flight from a bird," Orville would say, "was a good deal like learning the secret of magic from a magician." For Katharine's benefit, he wrote also of a "very tame" mockingbird that lived in the one tree overhanging the tent and sang the whole day long. The sunsets, he told her, were the most beautiful he had ever seen, the clouds lighting up in all colors, the stars at night so bright he could read his watch by them. They were now taking photographs of nearly everything—tent, views, sand, and water, even the mockingbird in the treetop, but primarily the glider in action. Many nights the wind was such that they had to leap from bed to hold the tent down. "When we crawl out of the tent to fix things, the sand fairly blinds us," Orville wrote. "It blows across the ground in clouds." But they could not complain. "We came down here for wind and sand and we have got them." The night when one of Kitty Hawk's 45-mile-an-hour storms struck with a sound like thunder, there was no sleep. And the winds were cold. "We each have two blankets, but almost freeze every night," Orville wrote. "The wind blows in on my head, and I pull the blankets up over my head, when my feet freeze and I reverse the process. I keep this up all night

and in the morning am hardly able to tell 'where I'm at.'" Their daily sustenance had reached a new low: Well, part of the time we eat hot biscuits and eggs and tomatoes; part of the time eggs and part tomatoes. Just now we are out of gasoline and coffee. Therefore no hot drink or bread or crackers. The order sent off Tuesday has been delayed by the winds. Will is "most starved." Nonetheless, as Katharine knew, they were having a splendid time, especially because of their work, but also in good measure because of the "Kitty Hawkers," whose consistent friendliness and desire to be of help, whose stories and ways of looking at life and expressing their opinions, made an enormous difference. The brothers were now hearing, as they had not before, words like "disremember" for "forget" and such expressions as "I'll not be seeing you tomorrow," or smooth water described being "slick calm." "Hoi toide" was "high tide." A young Tommy Tate, the sixteen-year-old nephew of Bill Tate, informed Orville at one point that the richest man on Kitty Hawk was "Doc" Cogswell, a "druggist" by profession. Orville inquired how much money Doc had. "Why, his brother owes him fifteen thousand dollars!" Tommy said, as though that settled the question. Bill Tate's interest in what the Ohio men were trying to achieve and his eagerness to be of help seemed only to grow. Needing to provide for his family no less than ever, he put in two or three hours a day at his own work in order to give the rest of his time to the brothers. Others as well had come to see them as more than mere eccentrics. Life on the Outer Banks was harsh. Making ends meet was a constant

struggle. Hard workers were greatly admired and in the words of John T. Daniels, the Wrights were “two of the workingest boys” ever seen, “and when they worked, they worked. . . . They had their whole heart and soul in what they were doing.” By mid-October time was running short. Wilbur had been away from Dayton for nearly six weeks and word had come from Katharine that she had had to fire the young man Orville had left in charge of the bicycle shop in their absence. But the brothers still needed one sustained practice at manned flight. With the help of Bill Tate, they dragged the glider four miles to Kill Devil Hills, a cluster of three prominent sand dunes that Tate, in his letter of August 18, had rightly described as having “not a tree or bush anywhere.” The three hills, known as Big Hill, Little Hill, and West Hill, had heights of approximately 100 feet, 30 feet, and 60 feet respectively, but were also being constantly changed in height and shape by the winds. The view from the top of Big Hill was spectacular in all directions. Three quarters of a mile to the east, beyond the beach, was the great sweep of the bluegreen Atlantic; to the north stood a series of immense sand hills; to the south, a long fresh pond and dark woods; and to the west, “the view of views,” with Roanoke Island and Roanoke Sound. The day was clear, the wind just as wished. It was October 19, and after nearly four years of concentrated study and effort by the brothers, it proved a day of days. Wilbur made one manned flight after another. How many is unknown, no count was kept. He did record, however, flights of 300 to 400 feet in length and speeds on landing of



nearly 30 miles an hour. Only Wilbur did the flying. But now, in contrast to his customary use of the first-person singular when describing how things were progressing, he switched to the first-person plural, as in the lengthy report he later wrote to Octave Chanute. "And although in appearance it was a dangerous practice, we found it perfectly safe and comfortable, except for the flying sand." During his first days at Kitty Hawk, Wilbur had closed a letter to his father saying it would be no great disappointment to him were he to accomplish practically nothing there. He considered it "a pleasure trip." And certainly it was for both brothers—to be off on their own in a setting so entirely different from any they had ever known and doing what mattered to them above all. They had hoped to learn much of value there and they had, more even than expected. They felt they had found the way forward. With characteristic understatement, Wilbur summarized by saying they were able to return home "without having our pet theories completely knocked in the head by the hard logic of experience, and our own brains dashed out in the bargain." He said nothing of the fact that for the first time he had experienced the thrill of flying. They packed for home certain they would return. Their machine, having more than served its purpose, was left behind and Bill Tate was told the materials were his to use as he wished. From the undamaged portions of the sateen wing covering, Addie Tate was to sew dresses for their two daughters. III. Work at the bicycle shop and the routines of family life at home continued for Wilbur and Orville much as

usual over the next eight months, but nothing so occupied their free time and thoughts as did preparations for a return to Kitty Hawk. Plans for a new glider were under way, their concentration on the problems still to be solved. Writing again to Octave Chanute, Wilbur said the new glider would be built on the same general plan as the previous model, only larger and with “improved construction in its details.” Exactly what those improvements might entail, he did not say, just as he did not say it would be the largest glider ever built until then. The further difference “in its details” was that the curve of the wings would be greater, based on measurements calculated by Otto Lilienthal. When Chanute wrote to tell Wilbur he expected to be passing through Dayton sometime soon and would like to stop over, Wilbur said he and Orville welcomed the possibility of his visit, but explained that the bicycle business, being what it was in springtime, occupied their attention twelve to fourteen hours a day. However, they were “entirely free” on Sundays. To have a man of Octave Chanute’s standing come to call would be a high tribute. He was not only one of the world’s leading authorities on aviation, and on gliders in particular, but enjoyed an international reputation as an engineer, builder of railroads and major bridges, including the Kansas City Bridge, the first span over the Missouri River. He arrived at 7 Hawthorn Street on June 26, a Wednesday not a Sunday, which seems not to have mattered. Bishop Wright, Wilbur, Orville, and Katharine were all on hand to welcome him as he came onto the front porch and into the house for lunch. At age seventy, Chanute

was short, stout, and dapper, with a lingering fringe of white hair about the ears, a mustache, and thin white goatee. He was both kindly in manner and extremely talkative. Katharine and young Carrie Kayler had worked hard on the preparations for the meal, but little notice seems to have been taken of it, so involved were the hosts and their guest with conversation. The range and content of the discussion are not known, except that Chanute had brought a gift for the brothers, a portable French anemometer, by which they could accurately measure the speed of the wind, something of great value they had been unable to do before. Then, a few days after departing Dayton, Chanute wrote to suggest that two men with whom he worked join the brothers when they returned to Kitty Hawk the coming summer. Although the brothers did not necessarily agree with Chanute's philosophy that progress in science was always best served by everyone working openly together, they accepted Chanute's suggestion if only out of respect. By mid-June they were far enough along with their new machine to move up their departure to early July, and, importantly, knowing that in their absence this time the bicycle shop would be in reliable hands. Charles—Charlie—Taylor had been born on a farm in Illinois and arrived in Dayton in 1896, still in his twenties, looking for work as a mechanic. Employed first making farm machinery, he had soon set up his own machine shop, and from time to time helped out with the Wrights, making coaster brakes and other parts for their bicycles. Unlike the bachelor brothers, Charlie was married with two children, and he

smoked cigars, one after another nearly all day. He also worked quite as hard as they and with skill rarely to be found. Stopping by the bicycle shop one evening that June just to “gas,” as he said, he was asked if he would like to work there full-time.

“They offered me \$18 a week,” he later recalled. “That was pretty good money. . . . Besides, I liked the Wrights. . . . So far as I can figure out, Will and Orv hired me to worry about their bicycle business so they could concentrate on their flying studies and experiments. . . . And I must have satisfied them for they didn’t hire anyone else for eight years.” Of all those who were to enter the lives of the brothers, few were to prove of such value and none was to so aggravate sister Katharine.

Wilbur and Orville left Dayton together on their second expedition to Kitty Hawk by train the evening of Sunday, July 7, 1901, and for the next several weeks were to experience conditions that made those they had known during their previous visit seem like mere inconveniences. They arrived at Elizabeth City just after one of the worst hurricanes in memory, with winds recorded at 93 miles an hour. Two days passed before they were able to sail for Kitty Hawk. After a night at the Tates’, sharing the most uncomfortable bed either had ever endured, they set off for the foot of Kill Devil Hills and in an all-day drenching rain began setting up camp, a big part of which at that location required driving a pipe 10 to 12 feet into the ground to serve as a well, there being no source of fresh water within a mile. It was Bill Tate who told them how to get “good water” and who arranged permission from the owners of the

land at Kill Devil Hills to establish themselves there. Because the new glider was to be so large, the shed or hangar for it had also to be good-sized. Orville would proudly describe what they built as a “grand institution with awnings at both ends, that is, with big doors hinged at the top, which we swing open and prop up.” In little time, with pine boards shipped over from Elizabeth City, they built a long, solid shed, 16 by 25 feet and 6 feet in height, that would have been considered by many a substantial accomplishment in itself, and they did it in remarkably little time. Then, just as they were about to start work on the glider, they were hit by misery of a kind and on a scale they had never experienced or even imagined. Among long-standing summer visitors to Nags Head, the old wisdom was that the infamous Outer Banks “skeeters” struck en masse only once every ten or twelve years. On July 18, it suddenly became clear 1901 was one of those years. As Orville wrote, the mosquitoes appeared “in the form of a mighty cloud, almost darkening the sun.” It was by far the worst experience of his life, he would tell Katharine. The agonies of typhoid fever were “as nothing” by comparison. There was no way of escaping the mosquitoes. The sand and grass and trees and hills and everything was fairly covered with them. They chewed us clear through our underwear and socks. Lumps began swelling up all over my body like hen’s eggs. We attempted to escape by going to bed, which we did at a little after five o’clock. . . . We put our cots out under the awnings and wrapped up in our blankets with only our noses protruding from the folds, thus

exposing the least possible surface to attack. Until then the wind had been blowing at 20 miles an hour. Now it had dropped off entirely and the summer heat kept mounting. Our blankets then became unbearable. The perspiration would roll off of us in torrents. We would partly uncover and the mosquitoes would swoop down upon us in vast multitudes. We would make a few desperate and vain slaps, and again retire behind our blankets. Misery! Misery! Morning brought little relief from the suffering. At first they tried working, but had to give up, so unrelenting was the onslaught. In preparation for the night ahead they built frames and mosquito nets for their cots, then moved the cots 20 to 30 feet from the tent, and crawled in under the nets and again under their blankets. None of this worked. Such was the torture of the night that followed, Orville vowed that come morning they would head for home. By morning, however, their characteristic resolve returned. The demon mosquitoes had diminished appreciably and in the days to come grew fewer still. But the torment they had been through would never be forgotten. As it happened, one of the two men Octave Chanute wished to have join the brothers in their experiments had arrived just as the mosquitoes struck and so shared in the miseries. He was Edward Huffaker of Chuckey City, Tennessee, a former employee of the Smithsonian Institution and author of a Smithsonian pamphlet, *On Soaring Flight*. Now a protégé of Chanute, he had brought with him a disassembled glider of his own design built at Chanute's expense. To Wilbur and Orville he seemed at first a welcome

addition. The second to join the group, young George Alexander Spratt from Coatesville, Pennsylvania, had little in the way of appropriate background for the work at hand. Chanute had described him as having medical training that could prove valuable in case of an accident, but Spratt had abandoned his medical ambitions after finishing medical school several years before. About all he could offer as reason for his participation was that flying had been the dream of his life, which was altogether true. He arrived in the last days of the mosquito siege. The hangar-workshop at Kill Devil Hills was now to provide lodging for four. As the chief cook, Orville arranged a corner kitchen with a gas stove fashioned out of a metal barrel and shelves lined with canned goods—Arm & Hammer baking soda, Chase & Sanborn coffee, Royal Purple Hand-Packed tomatoes, Gold Dust Green Gage plums. Fresh butter, eggs, bacon, and watermelon had to be carried on foot from Kitty Hawk. Huffaker expressed amazement at the brothers' "mechanical facility" but was to prove increasingly irksome to them, lazy and indifferent about such daily necessities as washing dishes. He was also inclined to make use of the personal possessions of the others without bothering to ask permission. As tiresome as anything for the sons of Bishop Wright was to hear Huffaker go on about "character building," rather than hard work, being the great aim in life. The more they learned about the glider he had designed and planned to test but never did, the more they considered it a joke. Spratt, by contrast, helped every way he could and was excellent

company. On July 27, with the glider at last ready, the experiments began. The day was clear, the wind at Kill Devil Hills, about 13 miles an hour. Besides Huffaker and Spratt, Bill Tate and his half-brother Dan were on hand to assist. Wilbur was to do all the gliding. As they made ready for the first launch into the wind, Orville and Spratt positioned themselves at the corners. Expectations were high. But no sooner was the machine up than it nosed straight into the ground only a few yards from where it started. Wilbur, it seemed, had positioned himself too far forward. In a second try, having shifted back a bit, he did no better. Finally, after several more failed attempts, he moved back nearly a foot from where he started and sailed off more than 100 yards. To all present but Wilbur and Orville this flight seemed a huge success. To the brothers it was disappointing. The machine had not performed as expected, not, in fact, as well as the one of the year before. Wilbur had had to use the full power of the rudder to keep from plowing into the ground or rising so high as to lose headway. Something was "radically wrong." In a glide later the same day, the machine kept rising higher and higher till it lost all headway, exactly "the fix" that had plunged Otto Lilienthal to his death. Responding to a shout from Orville, Wilbur turned the rudder to its full extent and only then did the glider settle slowly to the ground, maintaining a horizontal position almost perfectly, and landing with no damage or injury. Wilbur went again. And again. Several times the same experience was repeated and with the same result. On one glide the machine even began to



drift backward. “The adjustments of the machine are away off,” Orville explained to Katharine. The curvature, or “camber,” of the wings, from the leading edges to the rear, was too great and had to be changed. It was this that concerned them the most, the ideal camber, or curve, of the wing from its leading to its trailing edge, being that which gave the wing the most lift against the pull of gravity. What was so troubling was that the ratio they had gone by was exactly what Lilienthal had recommended, about 1 to 12, whereas for their glider of the year before, Machine No. 1, the brothers had used a ratio of 1 to 22. They stopped gliding for several days to rebuild—flatten—the wings back to a camber close to what it had been in 1900, and with fine results. Photographs were taken of Wilbur soaring through the air exactly as wished. He himself would write, “The machine with its new curvature never failed to respond promptly to even small movements of the rudder.

The operator could cause it to almost skim the ground, following the undulations of its surface, or he could cause it to sail out almost on a level with the starting point, and passing high above the foot of the hill, gradually settle down to the ground. Further, he had no trouble landing quite smoothly at speeds of 20 miles an hour or more. Work on the wings had filled the first week of August, during which Octave Chanute arrived on the scene. His protégé Huffaker had only praise for the Wrights. As Wilbur had said earlier in a letter to Bishop Wright, “Mr. Huffaker remarked that he would not be surprised to see history made here in the next six weeks. Our opinion is

not so flattering. He is astonished at our mechanical facility, and as he has attributed his own failures to the lack of this, he thinks the problem solved when these difficulties . . . are overcome, while we expect to find further difficulties of a theoretic nature which must be met by new mechanical designs. Chanute, too, was greatly impressed by what he saw. He recorded little at the time, however, and apparently had few questions, as different as his own methods had been over the years. For all the time and study he had devoted to the science of gliding, he himself had never physically ventured into the air. The successful tests flown with the reconstructed wings took place on August 8. The following day Wilbur was back at the controls and in the air once more. But again there were problems, this time of a different and even more troubling kind. Their wing-warping system of which the brothers were so proud was not responding as expected, and they could not understand why. When the left wing dipped low, while skimming close to the ground for landing, Wilbur had pulled hard on the elevator to no effect. It was like trying to open a barn door in a strong wind. Then suddenly the glider plunged into the sand, throwing him forward through the elevator and leaving him a bruised eye and nose and painful ribs. Octave Chanute left Kitty Hawk two days later, convinced the Wrights had made more progress and with a larger glider than anyone thus far, and urged them to keep on with their work. In the days following, it rained without letup, and to add to his miseries Wilbur contracted a cold. George Spratt departed,

then Edward Huffaker, but not before helping himself to one of Wilbur's blankets. On August 20, Wilbur and Orville, too, said their goodbyes to the Tates and others and were on their way home. What they talked about on the train heading back to Ohio was neither recorded at the time nor discussed in any detail afterward. Yet it is clear from a few of their later comments that they were as down in spirit about their work as they had ever been, and especially Wilbur. It was not just that their machine had performed so poorly, or that so much still remained to be solved, but that so many of the long-established, supposedly reliable calculations and tables prepared by the likes of Lilienthal, Langley, and Chanute—data the brothers had taken as gospel—had proven to be wrong and could no longer be trusted. Clearly those esteemed authorities had been guessing, “groping in the dark.” The accepted tables were, in a word, “worthless.” According to what Orville was to write years later, Wilbur was at such a low point he declared that “not in a thousand years would man ever fly.” Once home, however, according to Katharine, they talked mainly of how disagreeable Edward Huffaker had been.