

THE *First* PRACTICAL AIRPLANE

Part I: The Wright's dogged pursuit of useful flight

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Two weeks after arriving home from the windblown sands of North Carolina's Outer Banks, the Wright brothers were working on their next flying machine. New Year's Day saw Orville sending the engine casting patterns to Harry Maltby for changes. (A few days later he returned the patterns, saying he couldn't make the requested changes.) Casting patterns for the pistons and cylinders were sent out, with instructions to make three sets. Charlie Taylor got to work on a pair of new engines. At least one was needed for the new *Flyer*, since the 1903 *Flyer* engine's crankcase was broken when the *Flyer* was rolled over by the wind after the fourth flight on December 17. The second engine would be used for tests. By the third week of January they were sawing wood for new uprights and ribs, and construction of the *Flyer II* was well underway.

The 1904 Wright *Flyer II* was

nearly identical in shape and form to the 1903 machine, with one important exception: They changed the wing camber from 1 in 20 to 1 in 25, flattening out the wing's cross section, which slightly reduced its drag, but also its lift. As the summer months progressed, the heat and humidity affected the unvarnished wooden structure, and the airfoil further flattened out to about a 1 in 30 camber. They were counting on the additional speed possible with the higher-horsepower engine and the lower drag of the airfoil to make up for the lower lift generated by the flatter airfoil.

It didn't work.

For 1905, they'd go back to the 1 in 20 camber. Other changes included a revision to the hinge point for the forward rudder (what we refer to as their elevator), since the 1903 machine's forward rudder was mistakenly hinged aft of the center of pressure and had a tendency

to snatch the controls from the operator and to move to the full-up or full-down position when the control was moved in flight. The location of the engine was also revised to move the center of gravity. During the season, they also installed steel bars weighing as much as 70 pounds under forward rudder, bringing the total weight of the machine to about 915 pounds.

Due to the scarcity in Dayton of spruce long enough for their purposes, the brothers were forced to use pine for their spars, which caused a fair amount of frustration when repairs had to be made. The pine snapped easier than the spruce, causing the number of repairs to be higher. An order was placed for spruce, but it would be later in the summer before the wood would arrive at their shop.

There was one pair of parts that were legacies from the 1903 Kitty Hawk *Flyer*—the propellers. Both



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By May of 1904, the Wrights had built a new version of the *Flyer* they had tested in Kitty Hawk at the end of the previous year. Desiring a closer location to their home in Dayton, they gained permission to fly in Torrance Huffman's prairie pasture, just a few miles outside of Dayton. There, they built a hangar shed to house their airplane, shown in these photographs in its initial 1904 configuration. Orville leans on the strut while chatting with his older brother Wilbur, standing on the right. What appears to be a Richards anemometer is mounted to an outboard wing strut, just behind Wilbur's head. You can clearly see a larger gasoline tank and a radiator/expansion tank mounted on center-section struts near the horizontal four-cylinder engine. The forward rudder (elevator) is clearly different in plan form from the 1903 Kitty Hawk *Flyer*.

airscrews had survived the tumble over the sand after the fourth flight on December 17 and were to be used on the 1904 machine for the very first trials. It is unclear exactly when they were removed from the 1904 machine, but it seems likely it was in advance of this notation made on August 10, 1904:

"Broke rudder before final landing. Broke screw" was the entry related to a 640-foot flight made by W.W. and noted in Wilbur's Diary E. (In their diaries, the brothers referred to each other by their initials.)

On Monday, May 23, 1904, they invited the press (but no photographers), their father, and a few friends for the first flight of the new machine. It was a tough day for the brothers. They fully expected they would, at the very least, be able to duplicate the distance flown the previous December. It didn't work out the way they had planned.

While both had become the

world's most experienced glider pilots over hundreds of glides since they started flying from the Great Hill near Kitty Hawk, North Carolina, when they started flying again in 1904 they had a combined total of only 98 seconds of powered flying time—Orville with a total time of 27 seconds, Wilbur with 71 precious ticks of the stopwatch in his diary/logbook. This inexperience and the combined effects of density altitude and a very narrow performance envelope added to their challenges.

After waiting for high winds to subside on that Monday in May, they were dismayed to see the wind die off almost completely. They placed the *Flyer II* on the new 100-foot launching rail they had built, and one of the brothers (it's not clear in their diaries which of the two) settled into the padded leather hip cradle and grasped the wooden controls. The engine proved difficult to start and ran poorly, misfiring irregularly. The signal given, the engine lever was moved over to the far right and the restraining clip tripped. With hardly a breath of wind blowing, the *Flyer* started down the track. But the combination of a much higher density altitude than they had at Kitty Hawk and the misfiring engine caused the *Flyer* to show no propensity to fly;

it unceremoniously ran off the end of the track.

A few days later, with the weather still unsettled and rainy, Orville managed a meager 25-foot hop. Once again, their father, 76-year-old Bishop Milton Wright, made the 8-mile trip on the interurban trolley from the west side of Dayton to Simms Station, across the road from Huffman Prairie.

The summer of 1904 would be a real test of the brothers' persistence. They were somewhat surprised and very disappointed in the initial trials, and probably a bit embarrassed as well. Not since the train ride home from North Carolina in August of 1901 had they been more perplexed and frustrated in their aerial experiments.

June, July, and August would go past before they would equal, based on time aloft, their last flight of 59 seconds on December 17, 1903. They finally did it on Thursday, September 15, 1904, in a flight that lasted 59-1/2 seconds, according to the stopwatch and Richard anemometer mounted on the *Flyer*. That day's flight was made easier to accomplish thanks to one more innovation that was added to their list of accomplishments that fall: the construction and use of a catapult to launch their airplanes.

They didn't have the steady breezes



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In 1904, the Wrights would accumulate 45 minutes of flying time during 105 flights. Most of the flights were measured in seconds, such as this effort, flight number 30. Wilbur is shown in mid-flight on August 13, 1904. He would cover 784 feet in 22-3/4 seconds, skimming low over the tall grass in Huffman Prairie. Two interesting details (see insets) are present in this image. First, on the left, below the right wing of the *Flyer II*, a couple

of people can be seen riding in a horse-drawn cart. One can only imagine what they were thinking as the biplane skimmed the grass. Second, on the far right, it appears Charlie Taylor is the man in shirt-sleeves with his hands on his hips as the *Flyer II* clatters by.



they had taken advantage of along North Carolina's Outer Banks. Recognizing that much lower average wind speeds were available in central Ohio during the summertime, the brothers built a longer set of launching rails, each section measuring 20 feet. At one point, 12 sections of rail were laid and staked to the ground for a total of 240 feet, but it was soon discovered that laying that much track was not particularly useful. It took too long to lay the rail, and often when the last section was lined up and bolted to its neighbor, the brothers and Taylor would discover that the wind had begun to shift. Shortening the rail helped get the job done sooner, but consistent launches were only possible when there was a strong breeze. Too often attempts in marginal conditions ended in nothing more than a short hop. By midsummer, the catapult was ready for a September 7, 1904, trial.

A 20-foot tall derrick was placed behind the *Flyer*, and a 3:1 ratio rope and pulley block and tackle were installed. The rope ran from the top of

the derrick down to the base and over another pulley, where it changed direction and ran alongside the rail to the opposite end of the shorter track (now 60 feet). There it made a 180-degree turn at the launching end of the rail, running back to the *Flyer* perched on top of its launching truck. There it was attached to the launching truck, which had small bicycle hub wheels that rode on the metal-topped wooden rail. A second rope attached to a stake driven into the ground restrained the *Flyer*. When a 1,200-pound weight was dropped 16-1/2 feet, thanks to the 3:1 ratio the end of the rope attached to the launching truck would be pulled 50 feet down the rail, accelerating the *Flyer* to flying speed. Each weight the brothers used tipped the scales at 200 pounds. On a number of occasions, 1,200 pounds proved to be inadequate, and the weight being dropped was increased to 1,600 pounds.

It is often assumed the Wrights always launched their *Flyers* into the wind, and while it was certainly their goal, their diaries make clear that crosswind takeoffs were often at-

tempted and accomplished, simply due to the vagaries of the wind direction. Thanks to the rapid acceleration from the catapult, the controls were effective quickly, giving the pilot the ability to counteract the effect of the crosswind.

A few weeks after starting to use the new launching system, they flew longer and farther than ever before. On a cloudy Tuesday morning, September 20, 1904, starting with a crosswind from the left, Wilbur managed a flight of just over a minute in time, covering 2,520 feet. He also managed to perform a pair of turns during the flight, the first to the left and the second to the right, landing as he came close to the fence near the road and the trolley line. Based on writings by Wilbur in early 1912, in a disposition related to the Wright vs. Herring/Curtiss lawsuit, it appears he may have been attempting the first circled flight, but turned back in the opposite direction when he realized his turn's path would put him in conflict with a tree he depicted in a diary map of the day's events.

On the next flight, Orville did

even better than that, and an interested and erudite witness was there to see the flight.

Sixty-four-year-old Amos Root, the editor of *Gleanings in Bee Culture*, had driven 175 miles to visit friends in Xenia, Ohio, and made a side trip to Huffman Prairie to meet the Wrights. He'd been reading about them in the few mentions made in the press up to that date and wanted to see for himself what was happening outside of Dayton. As luck would have it, he arrived on September 20.

Root was no crackpot looking for a cause. A leading citizen of Medina, Ohio, he bought the first bicycle in northern Ohio in the 1870s, and he purchased a new Olds Runabout motorcar in 1903. Root was known as a fellow who was willing to embrace new technologies as soon as they were viable. He drove the Olds on a 400-mile tour of Ohio during the summer of 1904 and drove to Huffman Prairie in September. Root had established a successful business centered on beekeeping and is known today as the father of the modern beehive. His business, A.I. Root Inc., a company now known as a worldwide supplier of candles and beeswax, is still in its original building in Medina.

The cloudy skies gave way to rain later in the day, with the breeze shifting from out of the northwest to crossing the field from the northeast. As shown in a diagram drawn in Wilbur's diary, Orville, with a right crosswind to compensate for as he started, was launched off the rail. He pitched the *Flyer* up to climb just a few feet, and then proceeded to do something no one had ever done with a powered airplane—he flew the *Flyer II* for one minute, thirty-five and two-fifths seconds and flew in a complete 360-degree turn, landing only because he neared the northeast boundary of the field!

Root was amazed, and the moment was not lost on him. In the January 1, 1905, edition of *Bee Culture*, he wrote:

"The operator takes his place ly-



Why Skids?

I've often been asked by youngsters and adults alike why the Wrights used skids instead of wheels on their early airplanes.

To most it seems pretty obvious that wheels, especially the tall, thin wheels used so often on the automobiles, buggies, and bicycles of their time, would be fairly useless on the loose dune sands of the Outer Banks. But why not use them when they started flying at Huffman Prairie?

One factor at work in their decision to use skids on their early designs was weight. The Wrights were fastidious calculators of the weight of each component of their flying machines, and since they viewed each glider and powered *Flyer* as a science experiment, the total weight of the powered machine was carefully balanced against the power available from their engines.

In the early *Flyers*, the performance envelope between stalling and cruising flight was very narrow, and any additional weight and drag was judged on its merits. For the same reason, until the power of the engines built by the Wrights and Charlie Taylor was able to provide enough thrust, the pilot lay prone on the lower wing, minimizing his drag profile. Only after the power increased was the pilot allowed to control the machine while sitting up. You can experience how uncomfortable lying prone for extended periods could be. Next time you're at home watching television, try lying on your stomach and watching an entire episode of your favorite sitcom for the entire half-hour—no breaks, no stretching, just you and your head tilted upward as if you needed to always see where you were headed. You can bet the brothers looked forward to that power increase!

The other reason was terrain. The Wrights didn't yet have the luxury of a prepared field that was long and free of obstructions. The terra firma at Huffman Prairie was once a low swamp, and the field was primarily filled with hummocks of grass about 6 inches tall. A pair of flexible spruce skids could ride along the tops of uneven terrain, soaking up the shocks and spreading the load along a pair of runners, but a pair of wheels would have to be set on axles mounted in some sort of shock-absorbing apparatus, all of which added, you guessed it, weight. And in case you needed to land in a smaller field, a set of wheels might need one more device: brakes. A pair of wheels offered little resistance to stopping, but a set of skids brought you to a stop much quicker, with little chance of nosing over.

Eventually, the Wrights had the aircraft performance and the field conditions that would allow them to dispense with the ungainly launching rail and catapult system, but until then, they plied the skies of America and Europe with a pair of graceful spruce skids.



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The Wrights struggled during all of 1904 with controllability issues and fighting the effects of what we have come to understand as density altitude. Too often, a flight would end with the *Flyer II* darting into the ground, such as this incident at the end of flight 31 on August 16, 1904. Orville was the pilot. The fellow standing to the right of the launching rail appears to be Charlie Taylor, the Wrights' mechanic. Flights ending like this prompted the brothers to create a catapult system, which they started using on September 7, 1904. The addition of the catapult meant that flights could be started at a speed that would allow the *Flyer* to accelerate, and the Wrights' flight times immediately began to increase.



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The leaves have fallen, but the excitement of being able to fly the *Flyer II* for over a minute at a time was irresistible for the brothers as they both learned how to control their recalcitrant flying machine, and continued to refine their design. This photograph

of flight 85 was taken on November 16, 1904, during a flight in which Orville covered 1,760 feet in 40-1/2 seconds.

Consistent flight continued to elude them, even while they were able to keep the *Flyer II* in the air for more than five minutes, sometimes circling the field four or five times. When they concluded the 1904 flying season on December 9, they had plenty of scientific work ahead of them. Confident they could solve the problems, the following spring was spent trying to sell their flying machine and later, building a new airplane. At the beginning of the summer of 1905, they stood ready to fly in the air at their will. The *Flyer III* would test their resolve.

ing flat on his face. This position offers less resistance to the wind. The engine is started and got up to speed. The machine is held until ready to start by a sort of trap to be sprung when all is ready; then with a tremendous flapping and snapping of the four-cylinder engine, the huge machine springs aloft. When it turned that circle, and came near the starting point, I was right in front [of] it; and I said then, and I believe still, it was one of the grandest sights, if not the grandest sight, of my life. Imagine

a locomotive without any wheels, we will say, but with white wings instead, we will further say—a locomotive made of aluminum. Well now, imagine that locomotive with wings that spread 20 feet each way, coming right toward you with the tremendous flap of its propellers, and you have something like what I saw. The younger brother bade me move to one side for fear it might come down suddenly; but I tell you friends, the sensation that one feels in such a crisis is something hard to describe. The atten-

dant at one time, when the rope came off that started it, said he was shaking from head to foot as if he had a fit of ague. His shaking was uncalled for, however, for the intrepid manager succeeded in righting up his craft, and she made one of her very best flights."

Very best flight indeed; the 52nd flight the brothers made with the *Flyer II* was the longest, in terms of time and distance, they had ever made.

In 1904, they made a total of 105 flights, most of them fairly short, with limited turns performed within the confines of the field. More than once, one of the brothers would land before turning any great amount, for fear they would fly outside the boundaries of the roughly 100-acre Huffman Prairie. They were still "feeling out" the amount of turn the machine would tolerate, and more than once the turn ended in an unintended landing.

Friday, December 9, saw the end of the 1904 flying season, a season of remarkable progress and maddening problems. The airplane still was unstable in pitch, it still had the odd tendency to slide off to the side in turns, and the power available was barely enough to sustain the *Flyer* in the air. They dismantled the *Flyer II*, keeping the hardware, engines, and propellers, but burning the remaining wood and fabric. The information they had gathered in their first full season of powered flight was put to use as they began construction of the 1905 *Flyer III*.

Continued next month.

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