

In Search of the Real Wright Flyer

Building a replica of the first airplane requires a certain resourcefulness. Anybody got any horsehide glue?

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IT'S ALL ORVILLE'S FAULT. THE WRIGHT BROTHERS' FIRST POWERED AIRPLANE made four short flights at Kitty Hawk, North Carolina, on December 17, 1903. After the last one, as the brothers stood talking, a gust of wind caught the airplane and tumbled it head over heels, cracking it into a jumble of sticks and wire. The Wrights crammed the parts (many of which were scavenged for their future airplanes) into a crate and shipped them home to Dayton, Ohio, where they remained unassembled until Orville rebuilt the Flyer in 1928 for display in the Science Museum in London, England.

Orville worked from memory—the brothers had produced little documentation because they always worried about rivals stealing their designs—and without the help of Wilbur, who had died of typhoid in 1912. Could Orville recall the few last-minute adaptations they had made before his first flight? Orville's reconstruction, now hanging center stage at the National Air and Space Museum in Washington, D.C., is only his best guess at the original. We'll never know exactly what flew in 1903.

As a result, anyone who takes on the task of building a 1903 Wright Flyer today must also resort to some guesswork, backed by three sources: the Wrights' series of spectacular glass-negative photographs of the airplane, their letters, and a set of blueprints drawn from Orville's reconstructed Flyer. Between these sources lies a minefield of missing details about fittings and spacing—issues critical to the delicate design. How a builder chooses to fill in the gaps will determine not only whether the airplane is "accurate," but if it will even fly.

As the centennial of powered flight approaches, three notable teams are hard at work on the problem. Ken Hyde of the Wright Experience is determined to engineer the most accurate Flyer possible. The Los Angeles chapter of the American Institute of Aeronautics and Astronautics (AIAA) wants a Flyer that is relatively stable and airworthy. Rick Young of Flugmaschine Wright is more interested in the process of discovery, and in re-creating the brothers' working relationship.

As these modern-day builders struggle with the finer points of strut spacing and wing rib construction, each faces the same questions: Is history (and the pilot) better served by accuracy or interpretation? How many risks are worth taking—in the name of authenticity—with a re-creation of something as unstable and dangerous as the world's first airplane?

Rick Young walks briskly to the end of the hangar that is the Virginia Aviation Museum in Richmond. There, the skeleton of his Flyer is alone along the far wall, the gleaming wood

frame standing tall in a gallery full of its dark metal progeny. A freckled, energetic bundle of a man with pale hair and trim beard, Young is well known in aircraft building circles for reconstructing and flying the Wrights' pre-1903 gliders. He also worked with Ken Hyde and the Wright Experience project, but ultimately broke things off after a few disagreements.

Young plans to test fly his replica in Virginia this winter, provided his diet takes off 30-odd pounds, bringing him closer to Wilbur's weight of 140. Although his schedule puts him in the air before the other teams, Young maintains that such a first is beside the point.

"I'm not trying to experience the first flight," he explains. "I'm trying to re-create what the Wright brothers went through." Young works with an assistant, Grover Cleveland Taylor, in the close way he imagines that the Wrights worked. Young and a Chicago partner are funding the project themselves, "otherwise," he says, "you spend all your time raising money. Funding is all agenda-driven, and you have to do things the way [the sponsors] want." He estimates they will spend a mere \$250,000 on their Flyer, saving money by following in the Wright tradition of using everyday materials.

"Take an issue like glues," he explains earnestly. "The Wright brothers used horsehide glue. We could try to acquire that, but what's more honest to the experience, getting the normal glue that's right there, or going to the ends of the earth to get horsehide glue?" The Wrights relied on standard off-the-shelf materials, he says. "So use the everyday glue, stay on the normal scale rather than spend a fortune."

Glue is an easy problem to solve. At a table next to the Flyer, Young unrolls a set of blueprints the National Air and Space Museum made as part of a Flyer conservation project in 1985. Here, the real problems begin.

In Orville's sketch, each rib is made from two long strips of wood, held together with small blocks. But on the Flyer hanging in the Smithsonian, each of the ribs is cut into two pieces—one larger piece forward of the rear spar, and one smaller, tapering piece aft of the rear spar. Small pieces of steel hold the two pieces together to form a single rib that fits across the spar.

"It's wrong," Young frowns as he punches keys on his laptop computer and calls up a copy of Orville's letter with the rib drawing. "Orville said that it was a single piece of ash. Why would you cut it into two pieces? It makes no sense." Young believes that all of the ribs were broken when the airplane tumbled, and that in the reconstruction, Orville stuck the rear pieces back on by connecting them with the spring steel. Rather than re-create the apparent repair, Young's replica defers to Orville's original sketch, with one-piece ribs made by splitting lengthwise single pieces of ash, each one then carefully fitted onto and slid into place along the two spars.

Although Young is proud of his ribs, he's even more pleased with the process of discovery that led to their design. "Partnering on a problem is the purest way to a solution," he says, waving his arm toward the Flyer as Taylor adjusts a fitting on the elevator assembly. "Three people become the tyranny of the majority. But two people will battle it out until the answer

emerges. I think Orville—I mean Grover—would agree,” he says, then blushes at his slip of the tongue.

In the office above his spacious hangar in Warrenton, Virginia, Ken Hyde pulls on a pair of white cotton gloves and reaches inside a small cardboard box for a plastic bag. He is a thin man, stooping over as he gently removes a bundle of fabric and spreads it on a table. “It was used for ladies’ undergarments,” he explains, reverently unfolding the yellowed muslin. What Hyde has in the plastic bag is a four-foot length from the lower left wing of the original Flyer. He’s got two more in storage, relics from the days after Orville’s death when Wright family descendants spread out the fabric on the living room floor in Dayton and cut it up for their inheritance. Hyde winces as he mentions the cutting.

Hyde’s dream team of builders is the one against which all others are being measured, not only because Hyde won the contract to fly at Kitty Hawk for the centennial, or because Ford Motor Company and the Experimental Aircraft Association put up hundreds of thousands of dollars to do it, but also because the deep-pocketed backers believe the Wright Experience is building the most accurate Flyer possible.

Hyde is as calm as Rick Young is energetic. He speaks with a genteel Southern drawl, as smoothly as you would expect from a former airline captain who has become used to hanging out with corporate bigwigs. His bearing as he stands erect turns his pressed khakis and denim shirt into a uniform. When he gets really excited he might lean forward a bit and lift his eyebrows. He does this when he talks about the Wrights’ engineering achievements.

Hyde has spent months reverse-engineering the Flyer’s engine and airframe from photographs, letters, and blueprints. But he has one additional source—an impressive collection of original artifacts. These came in handy in replicating the propellers, for example. The only detailed drawings that exist are for the 1911 propellers, which the Wrights planned to mass-produce. To reproduce the props of earlier models, Hyde relied on originals loaned by the National Park Service station at Kitty Hawk, and Marianne Hudec, a niece of the Wrights. He computer-scanned the undamaged half of the 1903 propeller and created its opposite blade to make a digital model for testing as well as a template for carving a duplicate.

Then one fortunate day, Larry Parks, an expert on antique woodworking hand tools and techniques, read about Hyde in the Washington Post. He got on his motorcycle and rode from his home in Warrenton, Virginia, to Hyde’s shop to offer his services. In no time Parks had glued up some layers of spruce to make a laminated blank for Hyde. Then he finished it off with a hatchet, spokeshave, plane, draw knife, and gouge. He was able to fit his tools into marks on the original propeller fragment and determine that a no. 2 gouge had done the bulk of the shaping, peeling off luxuriously long ringlets of blonde wood as it sliced into the spruce.

But Hyde doesn’t have an original 1903 wing rib, so he puzzled somewhat over the mystery of the two-piece design.

“That spring steel is really a screw up,” he concluded. His wind tunnel tests on scale models convinced him that the original spar for the one-piece rib, as drawn in Orville’s letter, was too

small to support the wing. Hyde believes the brothers recognized that problem at Kitty Hawk, then made a last-minute adjustment without documenting it. They made a bigger spar, he believes, then chopped each rib open and reattached the two sections to the spar with the steel. "Some historians will jump up and down and say 'untrue,' " Hyde says. "But we tested the fabric and there is metal rubbing, which shows [the steel straps] were there on the day they flew in 1903." Never mind that the steel makes for a less-flexible wing, or that it's clearly a bad design on what everyone agrees is an unstable airplane, or even that the Wrights themselves used a one-piece rib on all later aircraft. In the interest of accuracy, Hyde says, he's using the steel. "We re-create the mistake."

Once historians get into this minute a level of detail, it's difficult for them to set limits for themselves. After examining the National Air and Space Museum Flyer, Hyde is convinced that Orville's reconstruction job holds a secret message, one that seems to support Rick Young's one-piece-rib theory. "[Orville] was very careful to put different kinds of wood in the repairs," Hyde says. "In the blueprints, in some ribs you'll see spruce in front, ash in middle, and spruce in back. He was saying, 'This is not original.' " Hyde doesn't like to be called obsessed, but the fact is that no average aircraft home-builder could create this airplane.

And therein lies another discrepancy. Hyde's work is pristine, but the Wrights' airplane was surprisingly crude. It was built quickly during the Victorian era, when manufacturing standards for many of the off-the-shelf materials the Wrights used were somewhat lax. The fabric, for example, contains threads with large differences in diameter. Since most modern fabrics use more uniform threads on today's high-speed machinery, it's almost impossible to replicate the coarser material the Wrights used. The fabric was not "doped," or coated with paint or other smoothing and stiffening agents, so the weave's characteristics and permeability are key to the airplane's performance. And yet, to be absolutely accurate, a replica must be found. It is one of those myriad missing details that worries Hyde, Rick Young, and the AIAA team as well.

Lest someone forget that the centennial is, after all, about flight, one team is building a reminder. "The Wrights set out to build an airplane that would fly," says AIAA project engineer Fred Culick, a research fellow at the California Institute of Technology in Pasadena. "You can agonize over the details but nobody will ever know, so you might as well guess and build it the way it ought to be built." In other words, for this group, it's not a matter of producing the most accurate airframe, but making it capable of taking to the air, and safely.

It's no small matter. According to the handful of pilots who have flown one, the flight characteristics of the Flyer are very squirrely. The airplane is unstable and ultra-sensitive to pitch changes. "You fly it enough and you're going to break your neck," warns Ken Kellett, one of the few pilots aside from the Wrights who have made and flown a 1903 Flyer. He built his when he was 23 and living in Colorado, and he finished it just in time to fly it at Kitty Hawk in 1978 for the 75th anniversary of controlled, powered flight. He flew it at Kitty Hawk again for the 80th anniversary.

Like the Wrights, Kellett first built and flew replicas of the 1900 and 1902 Wright gliders. That training is important to success in the Flyer, says Rick Young, who has built and flown reproductions of every Wright glider. "There are things that you wouldn't discover on a simulator because you don't have the static and inertia component...of attitudes and acceleration." In simpler words, you're not really moving when you're in the simulator chair. Hyde's team will also train on his 1902 glider. "That's where the Wrights got all their training from, and there's really no substitute," he says.

Kellett now builds and restores airplanes for Kermit Weeks' Fantasy of Flight Museum in Polk City, Florida. He spent nearly a year and \$3,000 building his Flyer in the mid-1970s. The main challenge in creating an accurate reproduction, he remembers, was to make the thing as rough as the original. "Ken Hyde does exquisite work," Kellett says. "But the undercarriage nails on the original are hammered over on the backside. I want to see him do that, bang a nail through there and smash it flat on the other side. I couldn't bring myself to do it. I can't make an airplane that crude. People would slam my work."

Kellett built his two-part ribs according to the blueprints because he hadn't seen Orville's sketch. He dismisses the wing rib as the least interesting problem the airplane poses. He found something else to obsess about. "Everyone wants to take one tiny thing and microscope it," he says. "My microscope was on the canard assembly." The two-surface elevator on the front of the Flyer "physically will not take the movement it is supposed to do," he found. "The geometry doesn't work." Kellett's elevator "binds up," he says, instead of moving smoothly. In 1985, Kellett was invited to visit the National Air and Space Museum during its conservation of the 1903 Flyer. He manipulated the original elevator controls, he says, and found that they bound up the same way.

Wright experts don't consider Kellett's Flyer absolutely accurate because he made modifications to the airframe and his engine is lighter and more powerful than the original. Kellett argues that the modifications fall into the gray area every builder will have to negotiate, and that between his greater body weight and his running the engine at lower rpm, he came close to matching the Flyer performance. Accurate or not, Kellett has logged 23 flights in his, for a total of four minutes (the Wrights had just over a minute between them). "This plane is unstable," he warns. "Once it comes off the track, it's going to do what it wants to do."

Fred Culick agrees, and as the first pilot in line to fly the AIAA model, he's taking steps to minimize the risk. The AIAA team has studied data from wind tunnel tests of two subscale models built in 1980 and a full-scale airframe replica built in 1999. The team won't fly that one, however. "The airplane is very seriously unstable in pitch and roll, very unstable directionally," Culick says. "Well, we're making a few changes."

Jack Cherne, a longtime aerospace engineer and the AIAA Wright project director, explains that the team is changing the airfoil shape slightly, and adding more power in response to the wind tunnel results. The 40-horsepower engine contrasts sharply with the 10 to 12 horsepower

that the Wrights' engine generated, so they must beef up the airframe. "We're making sure the plane can handle the added power," Cherne says.

The AIAA team isn't bothered by the accuracy of details. The members are not obsessing about horsepower, or finding the definitive strut placement or determining the exact bracket weight. "Those aren't the problems the Wrights were obsessed with," says Culick. They wanted to get an airplane into the air and fly it, he says, and that is exactly what AIAA plans to do.

Cherne points out that the team hopes to fly its Flyer regularly at airshows. "The idea is to give the impressions of the first flight," Culick says. "Take off, fly low, land safely, don't bust the airplane. For that you're not going to worry about a quarterinch on the length of a strut." The airplane will look like a Wright Flyer, and will have most of its flight characteristics. It will be, Culick says, "not what you'd call a safe plane, but not as unsafe as the Wrights found out themselves."

Today, the original 1903 Wright Flyer floats silently above the entry of the National Air and Space Museum keeping its secrets. The white muslin-covered wings and fragile-looking wooden spars barely seem to support the mannequin lying on the lower wing. Millions of visitors have looked at this symbol of craftsmanship, courage, and ingenuity with admiration and awe.

But Ken Hyde, Rick Young, and the engineers of AIAA see instead a confusing puzzle of wrong fittings, misplaced nail holes, uneven struts, a faulty elevator, and two-piece wing ribs. The questions that it raises are maddening. We know that it flew, but the details are a mystery that may never be solved. Perhaps that is the best monument to the genius of Wilbur and Orville Wright.

Sidebar: More Flyers

To celebrate the centennial of powered flight next year, more than 25 Wright Flyer replicas, built to varying degrees of accuracy and airworthiness, will be hung in lobbies and paraded through towns. A select few will even fly with some brave pilot in the hip cradle.

Master woodworker and pilot Nick Engler of West Milton, Ohio, re-created all of the Wrights' gliders under the auspices of his nonprofit business, the Wright Aeroplane Company, before attempting the 1903 Flyer this year. He's also working on a reproduction of the 1905 model. He plans to fly all the aircraft at an airshow in Dayton, Ohio, in July.

In a piece of derringdo that the Wrights would have admired, Lieutenant Commander Klas Ohman, a pilot for the U.S. Navy, will fly Engler's 1903 replica off the deck of the USS Kitty Hawk in Tokyo harbor this winter. The aircraft carrier will be underway to simulate the wind conditions that the original needed in order to fly.

Dana Smith, a pilot and restorer in Limerick, Maine, who ran an aviation maintenance technicians school for 25 years, bypassed the 1903 aircraft for what he calls "safer, more stable" designs. He has been flying his replica of a Wrights' 1909 airplane for four years and has built three other models, including the Wright Model R, which in 1910 could fly 70 mph. He will fly several this May at the Festival of Flight in Fayetteville, North Carolina.

Other Flyers created for takeoff include a reproduction from Carnesville, Georgia, built by John Reynolds and slated to fly at the Atlanta Motor Speedway in August, and a replica by engineering students at Utah State University for Dayton's celebration in July. And on December 17, 2003, the Wright Redux Association of Glen Ellyn, Illinois, will launch its machine from the lawn of Chicago's Museum of Science and Industry.