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Touch the Wind

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by

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In the early days of flight, one of the key steps in making a go-no-go weather decision was to wet a finger in your mouth and hold it up into the air. If one side dried faster than the other, it was too windy to fly. CEOs in today's corporate aviation world would likely not look too kindly on the results of such a decision. But in 1910, the pilots in our fledgling profession were flying aircraft that were so fragile that the slightest wind would ground them. In contrast, the corporate airplanes of today are strong, fast, and capable of flying in all except the severest of weather. At the hands of a skilled pilot, today's aircraft are able to make landings in low visibility conditions that would have left our colleagues of 1910 littered about the countryside.

We sometimes take for granted the operation of the flight and navigational instruments. The information they produce is presented by indicators up front, right there on the instrument panel where they belong and where they've been for most of the careers of those of us flying today.

Certainly it was not always that way. Somebody had to conceive of the instruments, create them, test their operation, and develop procedures for using them.

That somebody was Jimmy Doolittle.

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Most of us remember Jimmy Doolittle as a hero of World War II, the Medal of Honor winner who led the carrier-launched B-25 raid on Tokyo, a mission that gave the nation a shot in the arm during the darkest days of the war. Some of us remember him as the Schneider Trophy winner in 1925, or as the person who broke the transcontinental speed record in a DH-4 in 1922. Certainly these were important contributions but perhaps his most lasting gift to the world of aviation was the long-term result of the blind-flying experiments that he conducted seventy years ago at Mitchell Field.

In those days arguments raged among pilots about instinctive flying. Some pilots claimed that their instincts were sufficient to allow them to fly even in the worst of weather. Others, such as Doolittle, argued that as important as instincts were, the right kind of equipment was necessary for blind flying. Equipment like the turn and bank indicator which Elmer Sperry had invented in 1917 and which many pilots carried around in their flight kits as many of us carry around portable GPSs today. When Doolittle made that record breaking trans-continental flight in 1922, he flew in weather using a turn and bank indicator as an attitude instrument.

But in the early 20s, most airplanes were ill equipped for instrument flight. Many pilots realized the folly of flying in the weather and flight was limited to contact flying with the ability to see the horizon a paramount requirement. Automobile road maps with distance scales that varied between maps were used for navigation.

In the mid 20s Capt. David A. Myers, a flight surgeon with the Army Air Corps demonstrated the value of the eyes (and the fallibility of the motion sensing system of the ears) with a Jones-Barany chair. He had determined that after the rotation of the chair became steady, unaccelerated, the pilot sitting in the seat with his eyes closed could not determine the direction of the turn. Further experiments with the chair included the installation of a box that was equipped with a magnetic compass and a turn and bank indicator. The pilot placed his face against the box while the chair was in motion and was successful in identifying the direction and rate of the turn.

In 1926, the great philanthropist, Daniel Guggenheim, created a fund for the promotion of aeronautics. Some $2,500,000 was set aside for the fund in which two of the objectives were: the dissipation of fog and the improvement and perfection of instruments allowing airplanes to fly properly in fog. The stage was now set for serious scientific exploration of instrument-based flight.

In August 1928, Lt. James H. Doolittle was borrowed from the Army to head the Full Flight Laboratory situated at Mitchell Field, New York. Doolittle was a seasoned pilot. Early in his career he had learned the value of a careful, rational approach to flying. He said on several occasions, "I well realized that the pilot who flew within his limitations would probably live to a ripe old age, whereas the pilot who flew beyond them would not." He was a wise choice by the Guggenheim foundation not only for his pilot skills but also because of his academic background; he had both a Masters and Doctorate in Aeronautics from MIT.

Doolittle was faced with a problem which had two major components: the need to position the aircraft with precision to a touchdown point and the need to control the three axes of the airplane without using outside references. Several approaches had already been tried. In England, for example, experiments were conducted using tethered balloons in still air fog. While some success was garnered the approach was too fragile and undependable. Blind landings had also been attempted by dragging weights and using long tail skids. Another system which used a buried cable was also tried in England, France and the U.S. The electrified cable circled the field with a lead in to the landing area. Sensitive receiving equipment was mounted in the cockpit, but the system proved to be too-sensitive. It required the pilot to make a precision turn very close to the field at a low altitude, a dangerous combination. The idea was abandoned.

The U.S. Bureau of Standards and the Army had developed a radio range which seemed to offer some hope for the navigational problem. It could easily be adapted to existing conventional airborne equipment.

To conduct the experiments, Doolittle purchased two aircraft, a Consolidated NY-2 Navy training plane powered by the Wright J-5 radial. The second airplane was also a Navy bird, a Vought Corsair O2U-1 equipped with a Pratt and Whitney Wasp engine.

The NY-2 was a good choice because of its rugged construction. It was meant for use as a pontoon seaplane trainer. The pontoons were removed and a beefed-up landing gear was installed to take the anticipated shock of instrument landings. This aircraft was to be used as the primary aircraft for approach and landing experiments. The Corsair, on the other hand, was to be used primarily as a cross-country aircraft. It was also ruggedly built and fast, attributes that Doolittle sought for the cross-country missions.

Doolittle flew several flights using the conventional instruments of the period, magnetic compass, turn and bank indicator, altimeter, and airspeed indicator. He found that the turn and bank indicator was sufficient to control the airplane in cruise flight but that it was not precise enough to keep the wings level close to the ground. It was more a qualitative than a quantitative instrument.

He also determined that the magnetic compass was not consistently reliable, it had a northerly turning error. It was clear to Doolittle that more instrumentation was needed to overcome the shortcomings of the present equipment. Two German instruments, the Anschutz and the Gyrorector, were examined but proved to be unsatisfactory.

Doolittle realized that no existing instruments could do the job so he sketched out an instrument that combined both heading and attitude information and took his idea to Elmer Sperry, Sr., who headed the Sperry Gyroscope Company and who also had a deep interest in aeronautics. Sperry looked at Doolittle's sketch and recommended for simplicity's sake, two instruments, one for heading and the other for attitude. Sperry Sr. assigned the task to his son Elmer Jr. who then brilliantly led the development of the Sperry Artificial Horizon and the Sperry Directional Gyroscope. These are the parents of the instruments we use today.

The two instruments were installed on the NY-2 and Doolittle made hundreds of simulated blind landings. The aircraft was equipped with a hood that covered the entire back cockpit. (Naturally a safety observer pilot occupied the front cockpit.) Doolittle describes the procedure. "To make a landing, the airplane was put in a glide at 60 m.p.h., with some power on, and flown directly into the ground. Although this was about 15 m.p.h. above stalling speed, the landing gear absorbed the shock of landing and if the angle of glide was just right the airplane did not even bounce. Actually after a while, it was possible to make consistently perfect landings by this method."

With the addition of the Sperry instruments, it was now possible to control the airplane with a great amount of precision solely by the use of flight instruments. Now it was time to attack the other problem, that of precision navigation. For this Doolittle turned to the radio experts: "Excellent cooperation was obtained from companies and individuals we worked with during the period. Among them were the Pioneer Instrument Co., the Taylor Instrument Co., the Radio Corp. of America, and Bell Telephone Laboratories, who installed the modern radio transmitter and provided miniature earphones with molded plugs. Very valuable help was also received from the Bureau of Standards, which designed and installed most of the ground and radio navigation equipment."

A somewhat portable two-leg radio range was used as a homing beacon and another as a fan-marker beacon. The homing beacon was set on the far side (departure side) of the airfield and the marker beacon was set up on the approach side. Initially, the pattern was flown by using only aural signals. Doolittle concluded that ". . .while aural signals were satisfactory for rough aerial navigation, it would be much better if we had a visual indicator in the cockpit for the precise directional control needed during the final phase of blind landings."

To overcome this problem, an instrument was designed which was composed of two reeds which vibrated according to the signal strength. As Doolittle explains, "If the pilot was to the right of the radio beam, the left reed vibrated more vigorously. If on course both reeds vibrated through the same arc. As the airplane approached the radio station, the amplitude of vibration increased. A single reed started to vibrate as the fan type marker beacon was approached. It reached maximum amplitude then quickly dropped to zero when the plane was directly overhead, rapidly building up to maximum again, and then tapered down as the airplane pulled away."

The radio range was used for approach course guidance. Glide path guidance was a thing of the future. At the fan-marker, Doolittle would set the power, begin a descent at 60 m.p.h. and fly the range course until the airplane contacted the ground, much as we do a non-precision approach today, except, of course, our minimums are quite higher.

During these trials, Doolittle determined that the current barometric altimeter was not adequate to accurately determine the height above the ground. He needed one that could measure to 10 feet or so rather than the one currently in use which measured to the nearest 50 or 100 feet.

The Kollsman company developed such an altimeter and Paul Kollsman demonstrated it to Doolittle while holding the new altimeter in his lap on a test flight. The altimeter had two hands and the instrument was marked with 20 foot graduations. The fast hand made a complete revolution for each 1,000 feet. Doolittle commented that this altimeter was ". . .more than one order of magnitude more accurate than earlier altimeters."

The other part of the experiments concerned fog dispersal. Several avenues were explored but the one that seemed to hold the most promise was FIDO (Fog, Intense Dispersal Of). This technique used large blowtorches to burn off the fog. The team was alerted to this method by a local gravel pit operator who used a large blowtorch to dry gravel. He noticed when he when fog was present, it quickly dissipated once the blowtorch was ignited. The gravel pit operator brought the device to Mitchell Field and they waited for several months for a dense fog. When it finally came they tried to use the blowtorch but it proved ineffective, the fog remained stubbornly in place. Rather than lose the opportunity presented by the thick fog, Doolittle climbed into the back cockpit of the NY-2 and without an observer in the front seat took off, flew a complete circuit of the field and made a landing, all on instruments. Mr. Guggenheim arrived a few minutes later, but by that time the fog had lifted. Doolittle wanted to demonstrate a blind flight, under the hood, but without a front observer. Guggenheim insisted that a safety observer be retained in the front cockpit. Doolittle describes what happened next.

“We both got into the airplane, and the hood over my cockpit was closed. The engine was again warmed up and I taxied the airplane out and turned into the takeoff direction of the radio beam. We took off and flew west in a gradual climb. At about 1,000 feet, the airplane was leveled off and a 180° turn was made to the left. This course was flown several miles and another 180° turn to the left was made. The airplane was lined up on the left side of the radio range located on the west side of Mitchell Field, and a gradual descent started. I leveled off at 200 feet above the ground and flew at this altitude until the fan beacon on the east side of the airfield was passed. From this point the airplane was flown into the ground, using the instrument landing procedure previously developed. Actually, despite previous practice, the final approach and landing were sloppy. This entire flight was made under the hood in a completely covered cockpit which had been carefully sealed to keep out all light. The flight, from takeoff to landing, had lasted 15 minutes. It was the first time an airplane had been taken off, flown over a set course, and landed by instruments alone.”

The date was September 24, 1929; it was the birth of instrument flight. Today we no longer need to wet a finger and touch the wind; Jimmy Doolittle has already done that for us.