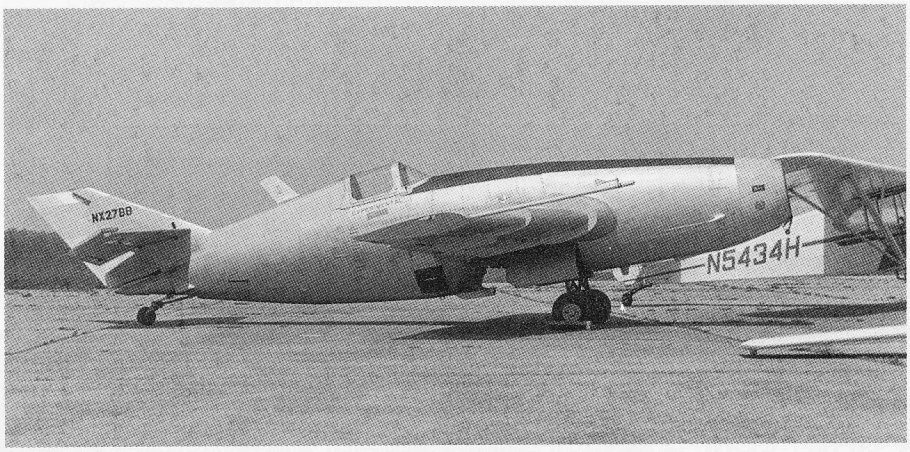
The Ball-Bartoe JW-1 Jetwing offered a viable means to make jets more efficient.

By Walter J. Boyne



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The product of innovative designer O.E. "Pete" Bartoe, the Ball-Bartoe JW-1 Jetwing was essentially a single-engine test-bed that used jet thrust to blow air over the wings.

The idea of making aircraft more efficient by controlling or directing the flow of air over the wings goes well back in history. One of the early efforts was the Crouch-Bolas biplane entrant in the 1927 Guggenheim Safe Aircraft Competition. That rather unaesthetic little aircraft used huge propellers to blow air over the wings to help with short takeoffs and landings. The basic idea remained attractive to designers through the years, and was seen again in many aircraft that tilted their wings or their engines to achieve VSTOL (very short takeoff and landing) performance. These included such types as the Hiller X-18, LTV-Hiller-Ryan XC-142A and Canadair CL-84. Others, such as the Bréguet 940, used the propeller thrust against full-span, slipstream deflecting flaps to achieve the effect. There were also such brute-force efforts as the Lockheed XFV-1 and Convair XFY-1 vertical takeoff fighters.

In the 1970s, interest was revived in the concept and two aircraft, the Boeing YC-14 and the Douglas YC-15, demonstrated just how effective the jet-blown wing could be in the advanced medium STOL transport competition for a jet replacement for the Lockheed C-130 Hercules transport. The YC-14 featured jet engines mounted well forward on the wing, with the exhaust sweeping out over full-span, variable-camber flaps. Both the Boeing and Douglas aircraft performed excellently, with productivity of about twice that of the Hercules, but budgetary restraints ruled out procurement.

Actually, all of the foregoing designs were admirable, but with the exception of the Crouch-Bolas, all were well-funded research programs that had government sponsorship. Examples of experimentation in the rarified field of VSTOL/STOL aircraft by private individuals or corporations are pretty rare.

One of the earliest of those privately funded efforts was Charles Rocheville's "Flying Wing" of 1930. That unusual twin-boom aircraft was intended for very long distance flights, and Rocheville specifically designed it to fly the Pacific Ocean. With a 60-foot wingspan and a central twin open cockpit nacelle, it was powered by a Pratt & Whitney Wasp Jr. engine. The nacelle was fitted with scoops that allowed the propeller-driven air to be pushed through one-third of the way forward from the trailing edge. Rocheville claimed that the reduced turbulence and separation of the air stream over the trailing edge resulted in improved speed and a nearly 25 percent improvement in range. Unfortunately, those claims were never validated, because the testing was cut short and the flight was never attempted. Rocheville attributed the failure to financial problems, but there is a notation in Federal Aviation Administration files that refers to wing flutter at half-fuel loads.

Another, better-known effort was that made by Willard R. Custer in his promotion of the "Custer Channel Wing." That aircraft featured propellers mounted just in front of barrel-shaped channels, and came within weeks of going into series production in the 1950s.

A third and even more remarkable private effort is the subject of this issue's "Aerial Oddities," the Ball-Bartoe JW-1 Jetwing. Essentially a single-engine test-bed demonstrating upper surface blowing, it was the product of the inventive brain of O.E. "Pete" Bartoe, who was backed by the Ball Brothers Research Organization. The Jetwing was unusual for many reasons, including the fact that it had no conventional tailpipe and was, if not a biplane, a sesquiplane.

Bartoe, aware of the always overriding need for military aircraft to be able to operate from short, unimproved airfields, also hoped that his ideas would find application in the civilian market. His jetwing concept combined a thrust-augmenting ejector with upper surface blowing. A Coanda flap (a jet-powered aircraft designed by Henri Coanda had made an attempt at flight as early as 1910) was used to achieve both thrust augmentation and powered lift.

Bartoe decided on a Pratt & Whitney JT15D-1 engine with a maximum continuous thrust rating of 2,050 pounds as his power plant. All engine air was ducted to a slot nozzle along the upper surface of the wing, located at about 30 to 40 percent of the chord. It extended for about 70 percent of the span. (It was possible to make the Jetwing a tail dragger, as it did not have a jet tailpipe and all the thrust went out over the wings.)

Although it is not obvious in photographs of the aircraft, it could be said that the Jetwing was actually a biplane, with a smaller airfoil located above the nozzle where it could act as an ejector. The Coanda flap was located along the wing in the area covered by the jet nozzle. That

arrangement provided super-circulation lift along with some additional side benefits, including a lower radar signature, lower noise level and good lateral control, even at low airspeeds.

The first flight of the Bartoe Jetwing was made on July 11, 1977, at Mojave, Calif. The pilot was none other than the great Lockheed test pilot Herman "Fish" Salmon, flying on his 65th birthday. (Salmon would soon lose his life in the crash of a Lockheed Constellation.)

The aircraft made 47 more flights in California, logging some 34 flight hours before being ferried to Boulder, Colo., for additional testing. The Jetwing was a small aircraft, with a 21 foot 9 inch wingspan, a length of 29 feet and a take-off weight of 3,336 pounds.

Salmon noted that the airplane was somewhat difficult to land because of the unusual ground effect of the blown wing, but it was fully controllable at all times. As one might infer from the photograph on P. 18, the aircraft's center of gravity was well aft and needed to be moved forward. The center of gravity problem resulted in many of Salmon's landings being made tail-wheel first, with the main gear still 2 to 6 feet in the air.

Another test pilot, Jim McKinstry, continued flight testing the Bartoe Jetwing. McKinstry reported that the aircraft was neutral to slightly unstable in pitch and could be flown at speeds as low as 25 mph. Top speed was estimated to be 325 mph, but McKinstry never pushed it past 270 mph. The rate of roll was surprisingly good, considering the small size of the Jetwing's ailerons, and McKinstry regularly rolled the aircraft as a part of his demonstration routines.

While the Jetwing had no stall speed as a conventional airplane does, at low speeds airflow changes over the tail could result in the nose of the aircraft being pushed straight down. This tendency was obviously hazardous during the landing process, especially since the fuel tank was located in the lower belly and could easily have caused an explosion by being collapsed during a hard landing. The airplane had a relatively short landing roll, aided by a spoiler–thrust reverser mounted in the wing.

When flight testing had finished and no contracts for further development materialized, Bartoe donated the aircraft to the University of Tennessee Space Institute in Tullahoma. There, it had another series of tests in the early 1980s to demonstrate the viability of upper surface blowing. Today the aircraft is maintained at the university's flight research facility at the Tullahoma Municipal Airport, where it may someday be used again for additional testing. □