

The Last Fireflight

When the Fire Nation Aeronautical Research Commission canceled Project Fireflight in 188, they thought everything that could've been learned from the program had been. But seven years later, the last of the Fireflight prototypes showed that it still had one last lesson to teach.
by Professor Asami Sato

EDITOR'S NOTE: This is an excerpt from Professor Sato's book, *Challenging the Cold Silence: The Inside Story of Project Phoenix Flight*. It has never before been published in Galactic Standard.



Mighty Wings – Shown here during Flight 4-43 in 187, the *Agni IV* was the most advanced test aircraft Project Fireflight produced. At the controls is Major Minhua of the Fire Air Force, with Capt. Tosa as Firebending Thrust Officer. This flight was briefly supersonic.

"THERE SHE IS, THE *AGNI IV*," said Captain Tosa, gesturing to the aircraft standing in the middle of the hangar. At first glance it looked like a slightly antiquated jet fighter – it had the same streamlined shape, with steeply swept wings that looked a little bit short for the size of the fuselage, and a single circular exhaust nozzle at the back. Closer inspection, though, showed that whatever it was, it couldn't be a jet; there were no air intakes for an engine. An aircraft powered by a firebender wouldn't need

them, since the hot gases of which fire is made are not just heated but *created* by the act of firebending itself.¹

Korra went up the metal stairs standing next to the plane and bent to peer through the bubble canopy into the cockpit, then gestured for me to

¹ Far greater physicists than I am have tried, and failed, to figure out how this can possibly work. It flagrantly violates the laws of conservation of both mass *and* energy... but it happens anyway. Not even those scientists whose sensibilities are mortally offended by the phenomenon can deny it. Many spiritualists, especially those given to deploring the "encroachment" of modern technology and science on our world, have been known to be quite smug about that.

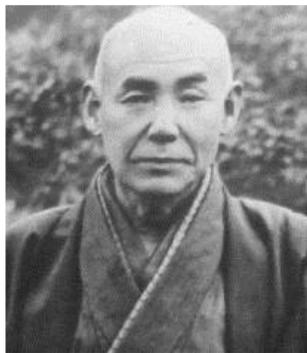
join her. While I climbed up next to her, Captain Tosa mounted a similar set of steps on the other side and opened the canopy to give us a better view.

The *Agni IV* had a tandem cockpit, except that the rear seat faced aft, so that the two-person crew would be sitting back-to-back. The front seat was for the pilot, naturally, and there was nothing too unusual up there, apart from the lack of any engine instruments or controls. The seat in back faced what looked rather like a large funnel of a silvery-colored metal, its wide end perhaps two feet in diameter and covered with a sort of coarse grille, its narrow end disappearing into the bulkhead at the back of the cockpit. Apart from this peculiar apparatus, that crew-member had only a couple of dials and a pair of foot pedals, similar to rudder pedals, to deal with.

Korra reached into the cockpit and pinged a fingernail against the funnel, listening to the sound it made. "Hmm," she said, "platinum." Then, turning a wry grin to me, she asked rhetorically, "Why is it always platinum?"

"High melting point," said Tosa, who didn't have the background to know that she was joking with me. "That's the intake for the Fireflight system."

Without waiting to be invited, Korra vaulted the coaming and plunked herself into the rear seat, rolled her shoulders to settle herself in, and then adopted a couple of different seated fire-bending positions, without actually producing any flame, to get a feel for the geometry of the thing.



Professor Koga (120-188), inventor of the Fireflight engine.

"Huh," she said, looking back over her shoulder at me. "Feels pretty weird, but there's no reason I can think of why it

wouldn't work."

"Oh, it works, Avatar, I promise you that," said Tosa. "I was FTO – firebending thrust officer – on seventeen Fireflight tests, nine of them in this aircraft."

"What are the pedals for?" Korra asked him, depressing one.

"They reposition vanes in the expander-expulsor array," Tosa explained. "It changes the shape of the exhaust flame, which can alter the way the thrust is applied to the airframe. Enhances maneuverability. Professor Koga called it 'thrust vectoring'."

"Ah," said Korra, nodding. "And these gauges tell you if you're overheating the works, or about to overspeed and rip the wings off," she added.

"In theory," said Tosa. "In practice, nobody ever even got them to the yellow line. The problem with the Fireflight system is that it works, but it's not efficient enough for one person to get the best out of it. In ten years of refinement, the best we could achieve was bare adequacy. Human *chi* reserves are just not deep enough. The *Agni IV* was the most advanced test aircraft we ever managed to produce; the airframe is capable of level supersonic flight. But our most powerful FTO – who wasn't me, just for the record – could only sustain it for six seconds, and she damned near burned herself out doing it. Eight weeks in hospital, and it was a year before she could bend again. Doctors didn't think she'd ever be able to for a while."

"That's rough," said Korra sympathetically. "I'm glad she recovered. She sounds like quite a gal - it takes real guts to push yourself that hard."

Tosa nodded. "Chihiro was always one of the true believers – didn't want to accept that we'd gotten everything we could out of the technology, and it just wasn't enough. When we got word that the project was canceled, she thought if we could get a sustained supersonic flight on the books, the brass might reconsider. Instead... that was our last test flight."

"Hmm," said Korra, her face thoughtful, as she gazed into the shadowed depths of the Fireflight intake for a few seconds.

Then she turned to me again, a sly grin coming onto her face, and said, "You know what I'm thinking."

"That's never been hard to figure out," I replied with a matching grin.

Captain Tosa looked from one of us to the other, looking unsure whether to be frightened or delighted.

"You're not serious," he said, but he can be forgiven for that lapse. After all, he had only known us personally for twenty minutes.

The colonel put up surprisingly little fight about us taking the experimental aircraft up for its first test flight in seven years. I think he hoped we might kill ourselves. As it happened, we nearly managed to oblige him.

The *Agni IV* was the only one of the Project Fireflight test aircraft that could take off under its own power; the previous three all had to be carried aloft by converted *Burning Rain*-class heavy bombers.² A service tug towed us to the runway, lined us up for takeoff, and left us there; a moment later, the base control tower radioed to say that we had an open field and clear airspace to commence a test flight at our discretion.

"Are you ready, Korra?" I asked, glancing up at a mirror in which I could see a similar mirror facing her.

She nodded, her teeth flashing in a grin below the slightly tinted visor of her helmet. "Let's do it," she said. Then she closed her eyes, gathered herself, and directed a steady flame into the Fireflight intake as I released the wheel brakes.

Slightly to my surprise, the *Agni IV* did indeed start to roll. The ship was a little sluggish compared to a similarly-sized jet – her takeoff run was nothing like as aggressive as my S.15's,

for example – but she got moving, and before long I could feel the wings taking up the load, the wheels getting light on the ground.

"I see what Tosa meant," Korra observed, her tone conversational. "This is hard work!"

Finally, though, the *Agni IV* came off the ground and began to climb. The tower vectored us to a test area where we could try whatever we wanted without fear of running afoul of any other traffic. Through trial and error, we figured out how to fly the curious beast. I kept reaching for throttles that weren't there, and until we worked out our coordination, Korra and I were often at cross purposes with my flight controls versus her ability to adjust the direction of the ship's thrust.

Eventually, though, we sorted it out and started to get a sense of what the aircraft could really do. It was fairly impressive, especially for a plane without any engines, but it wasn't going to get us where we needed to go.

"Nrrgh, this is frustrating," Korra grumbled after about half an hour. "I can feel the potential here, and at this speed it's not very taxing, but it's like pushing a cart uphill through mud." She paused for a moment, thinking, then asked, "Are you up for taking things to the next level?"

"When am I not?" I replied, smiling. I made doubly sure of my grip on the control column, and that the ship was in a level and properly trimmed attitude, then met her eyes in the double mirrors and told her, "Do it."

She grinned, and then her eyes went white and our day got a whole lot more exciting. I grasped what she was doing at once. She wasn't just using the Avatar State to make the flight more interesting; she was simulating the effect of Sozin's Comet on an ordinary firebender, to see whether the Fireflight system had a chance of providing adequate performance under those conditions.

As the thrust available to the *Agni IV* doubled, then doubled again, and then again, I came to feel that the signs pointed very much toward

² Ah, the Fire Nation, always with the cheerfully evocative names for its military hardware. I've always been particularly fond of the *Burning Rain* and the *Hidden Death*-class submarine.

yes. With that kind of power pumping through the Fireflight unit, the aircraft's previously lackluster performance became sharper and more aggressive, in addition to simply faster. The system seemed to perform better, more smoothly and efficiently, at normally unattainable input levels; it was as if there were a step in its performance curve that no normal FTO had been able to push it over in previous tests, and above which it became much more effective.

"*Like butter!*" Korra declared cheerfully in the Voice of the Avatar as we streaked through the sky. Observers back at the base told us later that, at the peak of our little test, our exhaust cone was a full quarter-mile long. Korra took care to keep us comfortably below the redline on her airspeed indicator, but even limiting her output that way, she was driving us to speeds and altitudes no Fireflight test had ever achieved. At 45,000 feet, I decided I'd pushed it hard enough for a simple fact-finding flight, eased the *Agni IV* into an unaggressive descent, and started a long, gentle turn for home. We were still supersonic, but the experience was so smooth it was almost unexciting.

Until the expander-expulsor burst, anyway. Then it was exciting.

"*Whoops!*" said Korra, as more or less everything to the rear of the Fireflight intake cone disintegrated into a mass of flame and smoke. She cut off her own flame at once, of course, but by then the fire was self-sustaining, feeding on the materials of the aircraft itself. With the empennage destroyed, I hadn't much in the way of control. There was no percentage in sticking around to experience what came next.

It occurred to me, belatedly, to hope that the small maintenance budget had included upkeep for the rocket charges in the ejection seats as I reached between my knees and yanked upward on the yellow handle. I had never actually done that before, in more than two decades of flying. I'd bailed out of airships and propeller-driven aircraft several times, and once even off of a sky

bison, but never actually had to eject from a jet. It was an interesting experience, and not even terribly traumatic, but then, conditions were just about ideal (relatively speaking). It was a bright, sunny day and there wasn't much wind. The seats blasted us clear of the *Agni IV*'s wreckage, then fell away from us to plummet, smoking, into the sea far below.

We were at more than 20,000 feet, up where there isn't enough air to sustain life. Korra, being an airbender, would presumably have no problem with that, but my first order of business was to get down to an altitude where the atmosphere would be of some use to me, so I left my parachute where it was, angled myself head-downward, and pressed my arms to my sides, making my body present as little resistance as possible to the wind screaming past my helmet. I didn't have an altimeter on me, not having *expected* to go high-altitude skydiving today, so I had to count mentally and try to estimate how far I had fallen based on the time that had gone by.³

At what I thought was around 5,000 feet, I pulled my main chute; it opened perfectly, bringing me up with a crisp snap, and all became quiet. It was a beautiful day, and I had no worries as I descended gently toward the sea. I looked around to see where Korra had gotten off to, and found her no more than a few yards to my left, steering her parachute into formation with mine.

"That went really well until the last part!" she said cheerfully, all a-grin. "I think we're onto something here."

I had to laugh, because I had been thinking exactly the same thing.

³ This is not a trivial calculation to do in your head when you're falling at terminal velocity.