

# Excitement Is in the Air

## Santa Cruz locals are taking aviation to a higher level

By Ryan Masters

**C**hris Laws examines the partially deconstructed engine of his Warner Sportster, a two-seat open cockpit plane hangared at Watsonville Municipal Airport. He's been up all night fabricating a part for the engine, a project that is already months old.

"Change one thing and it cascades," said Laws. "Suddenly you have to change a dozen things. There's so much fabrication involved. It can be all-consuming."

Laws is the longest-running president of the Experimental Aircraft Association (EAA) Chapter 119, a Watsonville aviation institution that dates back to 1961. One of the EAA's first affiliates, 119 took its designator from chapter founder Jim Carter's Santa Cruz address: 119 Kennan Street.

The first thing to know about Experimental Aircraft is that the term "experimental" is misleading. Experimental aircraft does not refer to rocket-powered planes flown by seat-of-the-pants test pilots like Chuck Yeager. Rather, it's an FAA category that encompasses recreational aircraft built at home — usually from kits, in which the airplane is partially fabricated, or plans, in which the builder purchases or manufactures all the parts and assembles them. In other words, it's model-making for really adventurous grownups.

While test pilots like Yeager risk life and limb to prove theories, break barriers, and test designs, the estimated 33,000 experimental aircraft in the U.S. are no more dangerous than commercially built or "certified" aircraft. Insurance companies charge roughly the same rates for both home-builts and production aircraft, indicating they view each plane as equally risky.

Before an airworthiness certificate can be issued, the builder must provide logs documenting every step of the construction process and the plane must be inspected by a designated professional. Once this is done, a pilot must fly at least 25 hours over a non-populated area to make sure everything is working properly. Only then can passengers be flown in the aircraft. Once approved, the amateur-built airplane is subject to additional inspections every 12 months.

Twenty-four photos make up the "Home-Built Wall of Fame" inside the Watsonville Aviation Education Center. Half of the photos feature the same type of aircraft: the RV, a low-wing mono-

(Above) The Joby S2 VTOL (vertical take off and landing) aircraft was one the early concepts at Joby Aviation for their flying taxi.

plane sold by Oregon-based Van's Aircraft. RVs dominate the home-built market. As of February 2019, 10,400 RV kits had been completed and flown.

People build and fly their own planes for different reasons: the challenge of it, independence, lower maintenance costs,



(Above) Experimental Aircraft Association President Chris Laws works on the engine of his Warner Sportster.





Photo: Dan Coyro

(Top) Neal Saiki (R) of NTS Works, prepares to launch his human-powered helicopter on Scotts Valley High School's gym floor. Helping Saiki set up are Scotts Larwood, Kyle Naydo, and Chad Frost.

better performance, the latest technology, the camaraderie.

"The home-built crowd is a tight-knit community," said Laws. "If I ever need a part, I know someone will give or sell or trade me what I need. There's a lot of knowledge shared. And everyone is really down to earth. They're mostly blue-collar, nine-to-five types."

A homebuilt kit or plan can range from roughly \$10,000 to more than \$100,000 based on various design and material options. By comparison, a Cessna 172 fresh off the factory production line costs more than \$250,000.

Non-RV aircraft also grace the Homebuilt Wall of Fame: a Kitfox, a Jabiru, a Fisher Celebrity, a Barnett tandem Gyroplane, a Glasair. Laws pauses at a photo of man piloting a Northwing Maverick Ultra-lite Trike. "That's Dan White, he was president of the EAA for a

time," said Laws. "He was killed piloting that Trike in 2005."

White had a huge influence on EAA Chapter 119, according to Laws. In addition to advocating for aviation programs in local high schools, White was a familiar face around the hangars and always willing to help other homebuilders work on electrical systems or fabricate parts.

"I never said it was the safest hobby in the world," said Laws. "Flying — all types of flying — has some risk involved."

Mention experimental aircraft in the same breath as the Monterey Bay and many people will recall the tragic death of "Rocky Mountain High" singer John Denver in 1997. Denver crashed his Adrian Davis Long-EZ plane into Monterey Bay off Pacific Grove. The wreck was so total the singer had to be identified by his fingerprints.

A close friend and hangar neighbor of Laws recently hit a 15-pound Canadian Snow Goose with the leading edge of his RV's wing. The plane cartwheeled sideways and landed on its nose, but he walked away. Laws shrugs at these tales.

"The numbers are really clear on this," he said. "Homebuilt aircraft are really safe. Especially when they're flown by the original owner. Sometimes things like a 15-pound goose happen, but for the most part, if you run all your safety checks and fly smart, you're all good. If not? Well, it's like that Chuck Yeager quote: 'There are old pilots and there are bold pilots, but there are no old, bold pilots.'"

One way or another, Santa Cruz County has its share of bold, innovative pilots.

### Gabe DeVault and the E-Gull

As Employee Number One at Santa Cruz start-up Zero Motorcycles, Gabe DeVault's work on the bike engine's power system helped turn Zero into one of the best independent electric motorcycle brands in the world.

In 2013, DeVault left Zero to work for Bonny Doon-based Joby Aviation. CEO and founder JoeBen Bivert was at the cutting edge of airframe design, fabrication, aerodynamic analysis, and electric motor design. Projects included the cruise motors in NASA's lithium ion-powered X-57 Maxwell, an experimental electric plane, and LEAPTech, a carbon composite wing section with 18 electric motors powered by lithium iron phosphate batteries. Each motor can be operated independently at different speeds for optimized performance.

"I like to joke that I went to work for Joby Aviation and built a truck," said DeVault.

But what a truck. In order to test the experimental wing, DeVault engineered and built a semi-truck with a rig on its back that, when driven at 70 miles per hour across a dry lakebed at Edwards Air Force Base, simulates the conditions of a wind tunnel. LEAPTech is a key element of NASA's plan to help a significant portion of the aircraft industry transition to electrical propulsion within the next decade, according to the federal agency's website.

In 2018, Joby Aviation moved its "flying taxi startup" from the Santa Cruz Mountains to Marina Municipal Airport in Monterey County. JoeBen and his engineers design and build prototypes of small, electric planes that take off and land vertically. Around the same time, DeVault decided to realize a long-held



(Top) JoeBen Bivert, Stanford graduate and seasoned inventor, at his office in the Santa Cruz Mountains.

Photo: Mickey Carroll



time, DeVault decided to realize a long-held dream: Convert an airplane to run entirely on electricity.

"I was at a place in life where I could do it and, as it happens, this airplane became available," said DeVault.

"This airplane" actually was a Thunder Gull, a high-wing, tricycle gear, ultralight aircraft designed by Mark Beierle at California's Earthstar Aircraft. Even for an aircraft in the ultralight category, the Thunder Gull is small, with a wing area of only 95 square feet and a wingspan of 17.6 feet.

"Legally it's the same as a hang glider or paraglider," DeVault said. "You need a pilot's license. And, for the record, I can and do fly other, more traditional aircraft."

To convert a Thunder Gull into an "E-Gull," DeVault re-engineered it to run on a Zero motorcycle engine. "There's actually a long tradition of motorcycle engines being used in small and experimental aircraft. Plus, I helped Zero make it, so I know it's good."

Of course, Zero Motorcycles would not condone the use of its engine in an aircraft, so DeVault bought one and stripped it for parts. The process was quick. It took a few days to pull the parts and a few weeks to complete the conversion. How does it perform? Like the Tesla of the skies.

"I'd compare it to any other electric vehicle. It has a ridiculous amount of power and torque when you push the throttle. It climbs 1,200 to 1,500 feet a minute," said DeVault.

It's also safer and more reliable.

"With a normal gas engine you have this endless preflight checklist. When I fly the electric plane it's so simple it feels like I'm forgetting something," DeVault said. "A significant number of accidents are due to some kind of power system failure [in the combustible engine]. Electric systems are so much more reliable."

### JoeBen Bivert and Joby Aviation

JoeBen Bivert and the Joby Aviation engineers have a dream. They want to save one billion people one hour a day in commute time.

"Every day, traffic congestion limits humanity's potential. Our vision is to design, build, and operate a flying car that can take off and land vertically for a public transportation use case," Joby's lead engineer of systems integration and testing Santiago Morales said at a National Instruments conference.

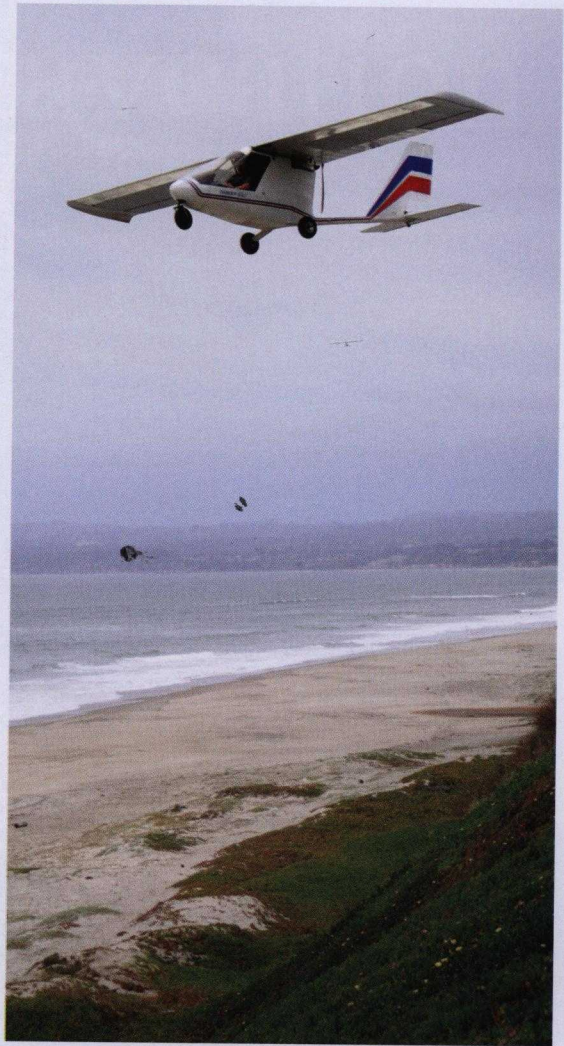
Bivert was born and raised off the grid on a Santa Cruz hippie commune. A third-generation Santa Cruzan, Bivert claims the redwoods and the Pacific Ocean taught him to dream big. After he made a fortune on the bendable cell phone tripod called the

GorillaPod, Bivert launched a slew of companies focused on solving larger problems.

"I started Joby Aviation with the goal of replacing cars with planes. Instead of driving, we will be flying," Bivert said at a recent Santa Cruz Works conference. "We cover massive swaths of our cities with roads and parking lots. Think what we could do with that space. We can fundamentally change the whole fabric of twentieth century life. We can create a future that's more exciting and sustainable."

To achieve this ambitious goal, Bivert and Joby Aviation have been hiring engineers "voraciously," he said. Until last year, this huge team was dug into a limestone quarry in the Bonny Doon region of the Santa Cruz Mountains, "vigorously designing and building the next generation of transportation." The company was founded in 2009 and has raised \$130 million in venture capital funding to date, including a \$100 million investment round led by Intel. In the fall of 2018, Joby moved into the Marina Airport.

While the prototypes are highly confidential, Morales described the flying taxi as being capable of taking off and landing vertically like a helicopter and carrying four adult passengers for 150 miles on a single charge. It will also be 100 times quieter than a helicopter during takeoff and nearly silent in air.



(Top) Gabe DeVault's electric powered Thunder Gulf takes off from a private air strip near Watsonville.



(Above) Neal Saiki of NTS Works checks a measurement on his human-powered helicopter. In 1989, Neal Saiki helped design the first self-propelled helicopter to ever achieve liftoff.



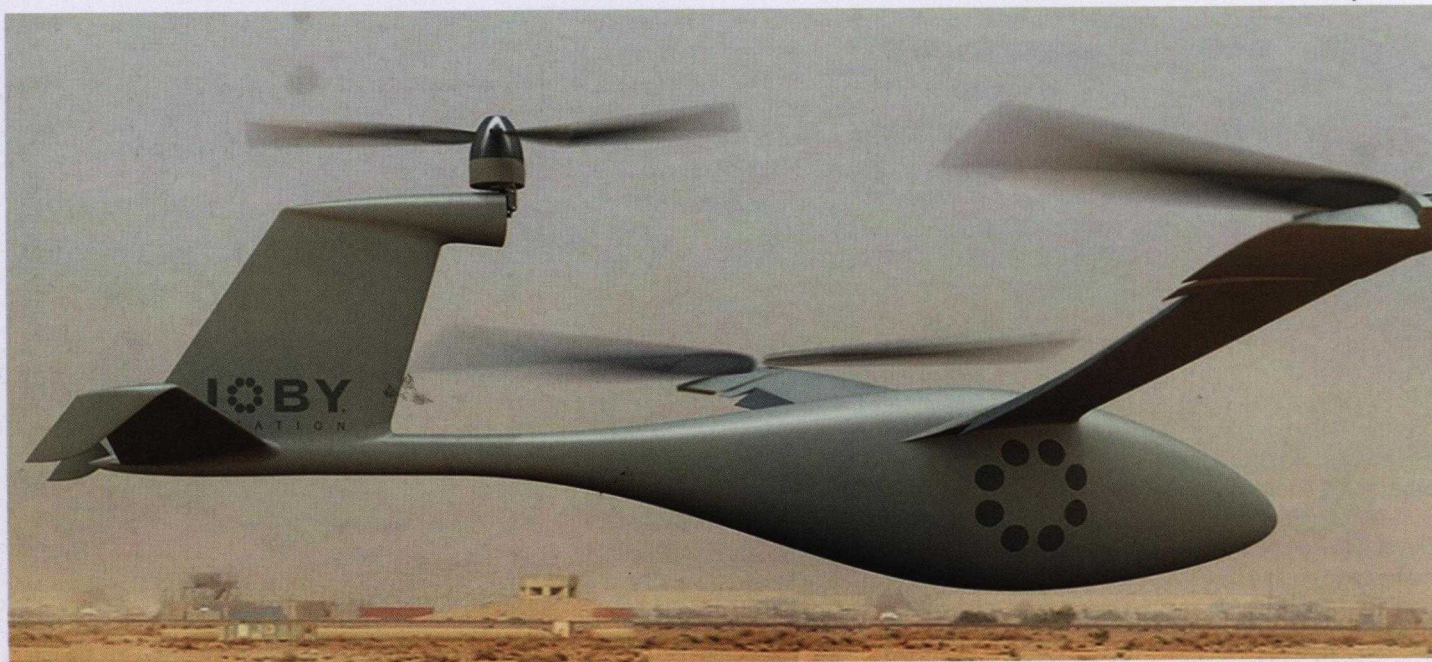


Photo: Courtesy Joby Aviation

(Above) Developed in collaboration with NASA, Joby Aviation's *Lotus S* is an electric VTOL that has the potential to achieve 24-hour endurance. Two bladed rotors on the wing tips provide liftoff and landing; once in the air the rotors close becoming part of the wing to allow the vehicle to fly.

The time is right for JoeBen's flying taxi, according to Morales, thanks to several current tech trends.

"We now have high-density, cost-effective batteries that can take thousands of charge cycles. We have compact, high torque electric engines. We have new ways of manufacturing and making composites that really open up potential solutions," Morales said. "The air taxi is the new paradigm in transportation."

### Neal Saiki and the Upturn

As an aeronautical engineering student at the California Polytechnic State University in 1989, Neal Saiki helped design the first self-propelled helicopter ever to manage liftoff. The Da Vinci III hovered for just seven seconds at an altitude of eight inches, but the accomplishment was enormous — and enormously challenging for the pilot.

"We hired an Olympic-class athlete to fly it," Saiki said. "After pedaling the helicopter as hard as he could for ten seconds, he passed out cold."

Physics does not favor human-powered flight, yet long before Icarus plummeted to his death, a timeless symbol of overreach, humans have dreamed of flying under their own power. The flight of the Da Vinci III was a major victory, but it wasn't good enough to win the Igor I. Sikorsky Prize, a \$250,000 award for the first controlled human-powered flight achieving 10 feet of altitude for one minute or more.

After Saiki completed his studies at Cal

Poly, he earned a master's degree in aeronautical engineering while studying drag on low-speed aircraft at NASA. "Pretty boring stuff, actually," he said. After NASA, he worked as a consulting engineer for the better part of a decade, developing products and creating patents and intellectual property for dozens of companies. His work, in particular his full suspension chassis designs, were integral to Santa Cruz Bicycle's fairly quick rise to market prominence.

In 2006, Saiki founded Zero Motorcycles in his Scotts Valley garage. Today, Zero is the leading electric motorcycle manufacturer in the world with over 130 employees. Saiki also served as CTO, personally developing technology such as lithium ion battery packs, electric motors, and motorcycle frames.

Yet nearly two decades later, Saiki's experience with Da Vinci III at Cal Poly nagged at him. He wanted another shot at the Sikorsky Prize. Using a management shakeup in his company as a catalyst, Saiki walked away from Zero Motorcycles and back into his garage, throwing himself into the monumental task of creating an aircraft that could be powered by human muscle. Using ultra-lightweight parts fabricated all over the country and developing a computer system that would stabilize the aircraft, he ran tests at a friend's private hangar and worked at break-neck speed to try again to win the coveted Sikorski Prize. It was not to be.

"When I set out on the helicopter project, there weren't too many other people interested in the Sikorski. Not long after I began, a

bunch of really well-funded university teams began to pursue the problem," Saiki said. "It was clear before too long that I just didn't have the resources to compete."

A team from the University of Toronto ultimately won the Sikorsky Prize on June 13, 2013, with a 64-second flight that attained more than 10 feet of altitude. Saiki's helicopter, the Upturn, successfully flew for 10 seconds, climbing to about two feet. 🚁

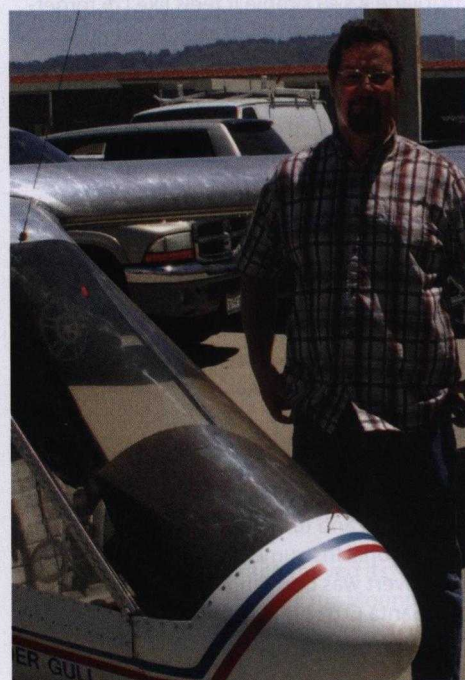


Photo: Mickey Carroll

(Above) Gabe DeVault with his Thunder Gull at recent EEA meeting in Watsonville.