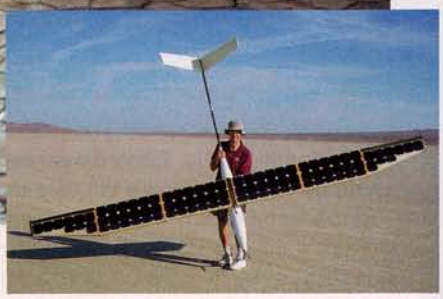
THE QUEST FOR ETERNAL FLIGHT

Engineers dream of a solar plane that never needs to land. Far-fetched? They've just hit the 24-hour mark. *By Stuart F. Brown*

TOP: JEFF KEESAMAN



Alan Cocconi with his solar-powered airplane; above, the plane, its "runway," and a control trailer in the California desert.

THIS JUST IN

SEEN THROUGH THE EYE OF a tiny videocamera aboard Alan Cocconi's remarkable unmanned airplane, parallel rows of runway lights become discernible as the craft turns into its final approach for a nighttime landing. *SoLong*, as the plane is called, touches down at about 30 miles per hour and slows to a stop. The "runway" turns out to be the crazed alkaline surface of El Mirage Dry Lake in the Mojave Desert northeast of Los Angeles. And the illumination system reveals itself to be a bunch of recreational-vehicle dome lights bought at Home Depot for $2 apiece. But Cocconi has just achieved an engineering milestone. Using a mixture of the most advanced technology on earth and parts pilfered from flashlights and a bathroom scale, he has kept his radio-controlled solar-electric plane aloft for 24 consecutive hours in the longest flight ever made by an electric-powered aircraft.

Cocconi is chasing the dream of an electrically powered "eternal airplane" that can stay aloft for days or months on end. That idea was first articulated by Dr. Paul MacCready, chairman of AeroVironment Inc. in nearby Monrovia, which has built several renowned human- and solar-powered planes. AeroVironment's 247-foot-wingspan Helios solar-electric plane achieved great feats—including climbing to an altitude of 97,000 feet, higher than any other non-rocket plane—before being destroyed in a testing accident in Hawaii two years ago. "Alan has been very dedicated to the subject of systems efficiency, and now the work is paying off," MacCready said after *SoLong*'s 24-hour flight. "It's a step in the direction of the eternal airplane."

Why an eternal airplane? There is the conceptual elegance of building something that goes up but does not come down. There could also be practical uses for a craft that dwells in the sky and draws its power from the sun: telecommunications without satellites, for instance, or environmental monitoring, and of course military surveillance, although Cocconi prefers to focus on peaceful applications. (Cocconi, who has a peace symbol made of tape on the rear window of his Subaru, has to keep a sharp eye out at El Mirage for the Predator military drones that builder General Atomics flight-tests in the area. "They fly them every day," he says, "so I'm always trying to avoid the Predators.")

A lanky guy with an easy grin, Cocconi is one of the

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smartest electro/mechanical/aeronautical engineers around. Electrons and molecules of air are among his best friends. I first met him in Australia in 1987, where he was tending to the sophisticated power-supply system he fabricated for the GM Sunraycer solar-electric car (built by AeroVironment) that outran all rivals in a race across the continent. Since then his company, AC Propulsion in San Dimas, Calif., has fabricated battery packs, powerful and efficient motors, and the magical black boxes of circuitry needed by the developers of hybrid and electric vehicles. He has also built battery-electric sports cars that sprint up the nearby San Gabriel mountains like nobody's business.

For the past year and a half Cocconi has been cloistered in his house—which is cluttered with electronic test equipment, workbenches, and a metalworking lathe—building the 25-pound, 16-foot-wingspan plane that flew for 24 hours in late April. *SoLong* is a real piece of work, deftly integrating the latest in high-efficiency componentry: hot-rod photovoltaic cells that convert 20% of the sunlight that strikes them into electricity; a bespoke motor-drive system that spins the propeller with 88% electrical efficiency; an autopilot of Cocconi's own design; and a pack of 96 cylindrical lithium-ion rechargeable batteries. "Laptop computers have driven the battery improvements that kept us in the air during the night," he observes. Cocconi custom-machined the aluminum tooling needed to bend the solar cells to conform with the curvature of *SoLong*'s graceful composite wings.

Next up: flying through two nights in June.

SoLong's flight in April was a labor-intensive affair. "The idea was to achieve a 24-hour flight initially, and then to try flying through two consecutive nights in June, when the days are longest," Cocconi says. Five experienced radio-controlled aircraft pilots took turns guiding the craft, searching for thermal updrafts rising from the desert floor during the daylight hours to give *SoLong* altitude for free, like a lazily circling hawk looking for prey. Only when the plane descended to a minimum safe altitude did its electric motor switch on, spending solar energy stored in its batteries to stay aloft. The propeller's twin carbon-fiber blades are attached to a variable-pitch hub that automatically seeks an optimal blade angle for the amount of motor power being used at the moment. When the motor shuts down, the prop blades fold back against the airplane's nose to minimize drag. Mission control is a five- by eight-foot trailer packed with computers and equipment that logs performance data streaming in via 23 radio channels.

Cocconi's record-breaking flight sliced 24 hours pretty thin. To avoid having to fly through an entire night, the plane was launched just after midnight on April 21 with its batteries fully charged. *SoLong* made its takeoff run along the whitish, dusty surface of the dry lakebed on a wheeled dolly made mostly of PVC plastic pipe of the type sold at ... Home Depot.

As its wings bit the air and the plane climbed into the night, the dolly stayed behind on the ground; *SoLong* relies on wingtip and belly skids for landing. When the sun rose at 6:10, electric current gradually began flowing from the 76 wingtop solar cells, augmenting the power from the batteries. By 2:30 in the afternoon the batteries were full again, and when the aircraft finally touched down just after midnight it still had 40% of its battery power remaining. "We could have flown for four more hours, but we couldn't have it made to dawn with that setup," Cocconi says. With that goal in mind, he'll be adding two more pounds of laptop batteries for the two-night flight planned for June. If that succeeds, nobody will be able to say Cocconi sliced it too thin. *SoLong* will have ventured into the unfamiliar skies of eternity.

The longest airplane flight on record is the famous 1986 round-the-world trip by Burt Rutan's *Voyager*, which took nine days. But *Voyager* was piloted, piston-powered, and could fly only as long as its fuel supply permitted.

Efficiency-obsessed engineers like Cocconi and MacCready are believers in the power of amazing demonstrations to change the way people think about energy use and the possibilities of ultralightweight technology. As new materials and components are invented and existing ones continue to improve, their machines will begin to look less like exercises in exotica and more like something that can work. Like those cool drawings in Leonardo da Vinci's notebook. F

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