AIR-CAM

INTO AFRICA

An experimental with a mission

BY AMY LABODA

It's almost trite: "Build it and they will come." That's usually the case when an experimental aircraft designer toys with a radically different class of aircraft designed with a specific operational task in mind. ■ In Phillip Lockwood's case, however, they came to him first. *National Geographic* magazine, famous for its brilliant photojournalism of people and wildlife in exotic and remote environments, came to Lockwood looking for an ideal camera platform from which to capture the essence of a mammoth story titled "The Last Place On Earth." The subject of the documentary: animals untouched by human presence, living in the most isolated rain forest in

PHOTOGRAPHY BY PHIL LOCKWOOD

the world—the Sangha-Ngoko rain forest of the Congo, on the African continent.

As with all remaining uninhabited areas on earth, there is a reason that no one ventures beyond the western banks of the Ndoki River. The native tribes, primarily Pygmies, believe that the forest east of the river is inhabited by Mokele Mbembe, a dinosaur-like creature that can kill elephants. The few scientists who have ventured into the forest since 1987 have found that the prevalence of insect-borne diseases alone is deterrent enough to keep humans from trespassing within the rain forest's boundaries. Lockwood knew that he had to design an aircraft that could safely and unobtrusively fly at tree-top height for hours over a region in which he might not survive if his engine quit.

The Sangha-Ngoko may be the last place on earth where animals do not know human hunters, but if the logging consortia have their way, it won't last until the end of the century. It isn't the logging that destroys the forest—mahogany trees are surgically removed with minimal impact on the environment—but the roads that the loggers leave behind, which give hunters direct access to game that has no innate fear of man. That is why *National Geographic* editors felt it was critical to dedicate huge amounts of manpower and cash to document the forest and publish its plight...before it is gone.

The aircraft would fly at tree-top height over a region in which the pilot might not survive if he crashed.

"The project was well under way when I decided that we needed a special camera platform for the shoot over the jungle," says Michael Nichols, contract photographer for *National Geographic*. "I went to see my editor on the project at *Geographic*, Mary Smith, who simply told me that Phillip Lockwood was the man to call about the airplane, so I did." It was the beginning of a beautiful relationship.

"Nichols came to see me and asked about getting a Maxair Drifter," says Lockwood, who, at the time, had his own Rotax engine distributorship and light aircraft accessories company, Lockwood Aviation in Sebring, Florida. "When he explained the mission over the rain forest, I told him that I had been working on the concept of a twin-engine camera plane that I called Air-Cam, which could, on one engine, help me glide over a hazardous area so that I could get to a safe landing area. He said, 'That's great, build it—we'll buy one.' I quoted him a price of about $40,000. We probably spent

The Air-Cam was transported from the USAID camp by river and over difficult terrain back to Bomassa in May 1994.

three times as much, but it was a great way to launch the whole project. I had always wanted to get into light aircraft manufacturing. The time schedule we were under was a push, but we made it happen."

The Air-Cam turned out to be such a success for the *National Geographic* project that Lockwood decided to put the aircraft into production as a kit. To meet *National Geographic's* timeframe, Lockwood turned his energies away from his thriving light aircraft and engine parts distributorship and threw himself into designing and manufacturing the Air-Cam. "We needed an airplane that would do precisely and reliably what we asked it to the first time out, so we put a lot of energy into its design," says Lockwood. "I hired two aeronautical engineers from Embry-Riddle Aeronautical University to run stress analyses on the critical components. One of them, Mike Schwartz, stayed on to become chief project engineer as the Air-Cam was prepared for production."

Lockwood was uncompromising when it came to strength and lightness. The Air-Cam prototypes use 6-inch-diameter 6061/T6 aluminum alloy fuselage tubing, drawn and seamless. Available from only one source in the United States, it has to be shipped by air from Washington and requires up to 22 weeks for delivery.

The first arrival in Bomassa was in November 1993 (above). Bryan Harvey is at right, while Mike Fay is left of the nose.

The original airplane delivered to Africa had a stepped-and-sleeved landing gear. The landing gear currently used on production kits is 4130 steel tubing with a taper—optimized to keep the stress points even throughout the length of the gear—mated to large, 600 × 6 inch tires and wheels. Lockwood had his reasons: "They asked me how long and how wide I needed the strip they were hewing out of the jungle, and I told them 600 feet of useful runway and 60 feet wide. When they asked me how smooth I needed it, I got a little uncomfortable. Finally I told them to climb in their Land Cruiser and drive up and down the runway at 40 mph. When it was smooth enough to do that without throwing people out of the vehicle, it was smooth enough for the Air-Cam." Despite his advice, the first stepped-and-sleeved gear was damaged on one of the landings at the strip, which is why the new, tapered gear legs were developed.

The first Air-Cam prototype sports a 32-foot wing covered in Dacron fabric. The engines are two liquid-cooled, 64-horsepower Rotax 582s equipped with dual electronic ignitions. The airplane carries a backup 12-volt battery. With both engines turning there is more than enough electricity to run dual Trimble GPS receivers and all the camera equipment you can mount on board. The welded aluminum main fuel tank and engines are mounted on top of the center section of the wing, making the remaining wing exten-

sions easy to remove for transport or storage. The prototype Air-Cam has a maximum gross weight of 1,300 pounds and a useful load of 560 pounds. The airplane's major components are stressed and tested to Federal Aviation Regulation Part 23 criteria. (One catch prohibiting Air-Cam's FAA certification is that no multi-engine category exists in the Sportplane certification criteria.)

Because *Geographic* was so pressed for time, its pilot never had a chance to learn how to fly the Air-Cam, which forced Lockwood to make a decision: If the project was to succeed with his airplane, he would have to go to the Congo and fly it himself. He arrived in Brazzaville, the capital of Congo, in mid-October 1993, to find himself in the middle of a civil war—and without the Air-Cam.

They kept shipping pallets of perishable fresh fruit instead of the Air-Cam, which was not deemed priority.

"*Geographic* spent $23,000 to airship the boxes to us in Brazzaville, and everything went smoothly until the freight arrived in Johannesburg, South Africa. There it was to be loaded onto one of the biweekly flights that Air Afrique ran up to Congo. But they kept shipping pallets of perishable fresh fruit instead of the Air-Cam—which, despite the 'Rush' labels on it, was not deemed priority," says Lockwood. It took the U.S. embassies in both countries and three frustrating weeks of waiting (with machine-gun fire and mortar rounds flying around him) for Lockwood to get all the parts shipped to Brazzaville. Three days later the Air-Cam was reassembled and ready for its longest cross-country—a seven-hour, 500-mile flight north to the just-hewn airstrip at Bomassa, the base camp.

"We were loaded to the gills. The last fax I had [received] told me to bring plenty of octane boost, fuel additives, oil, and a torque wrench. Mike Fay, head scientist at the United States Agency for International Development (USAID) research camp, came along and arranged it so we weren't thrown

AL CARPENTER

The GPS receiver was essential for travel over the region. Locals carry a section of wing (left) back to Bomassa from the USAID camp in 1994. Air-Cam number two (above) is shown flying over Lake Istokpoga, Florida.

in jail," says Lockwood. "He had a letter from everyone—the U.S. Embassy, the police. Still, we were detained everywhere we landed, primarily because we looked like nothing people had ever seen before; and with the civil war going on, hassling strangers was definitely in vogue." Fay is a pilot himself and helped immensely.

Parts of the strip hewn from the rain forest at Bomassa were a little narrow; it was a bit soft in spots, and a mammoth termite mound obstructed the approach and departure path (definitely a one-way-in, one-way-out operation). Still, it would do.

By this time, the season for the special fruiting trees they were hoping would lure the chimps out was over. The majority of the *Geographic* group were sick with flu-like symptoms, and the weather was horrible, with large thunderstorms threatening to tear the airplane to shreds. Within a week a decision had been made: Go home for the holidays (it was now late November) and regroup. The next day the Air-Cam was disassembled and portaged through the rain forest to a storage area in the USAID base camp where it would stay until the expedition returned in May 1994.

Over the winter Lockwood put his knowledge of Air-Cam number one to good use, redesigning the landing gear, upgrading components, and assembling Air-Cam prototype number two, which flew at Sun 'n Fun and Oshkosh in 1994. When Nichols and Lockwood and their support staff returned to the Congo in late spring, the weather was better, the war was over, and Lockwood had a much clearer picture of what he had gotten himself into. "I was confident in the airplane's ability to do the job, but my wife was expecting our first child in July, and I worried about getting home in time," he says.

His fears were basically unfounded. The week-long trip from Sebring to the base camp at Bomassa was grueling, but there were few surprises. Fuel was available on the black market in Ouesso and came up-river with them in 55-gallon drums by dugout canoe, moving at about 6 mph (those handheld GPS units work on water, too). Vicious ants nesting in the disassembled tubing, a brake fluid leak, and troublesome fuel leaks were repairable with some patience and ingenuity (the arrival of a shipment of brake fluid

from Germany helped a lot). Friday, May 20, finally delivered better weather. After bad weather all morning, the skies cleared and Lockwood and Nichols took off in the glow of golden afternoon light and 50-mile visibility to find three groups of wild elephants exposed in *bies* (openings in the rain forest, typically 300 feet in diameter with a water hole at the center). "A day to write home about," Lockwood penned in his journal.

It was as if the tide had turned. The team flew every day for the next week and completed the photo mission, capturing stills and motion footage of wild pigs, elephants, apes—everything that could be seen in the openings and across the top of the rain forest. On Saturday, May 28, Lockwood disassembled the Air-Cam for his last time and helped natives and USAID staff transport it, by ground and by dugout, to its storage place at the base camp.

Once the mission was complete, the airplane became part of the USAID and the World Wildlife Fund's ongoing mission to keep the rain forest pristine. It will be used to patrol the area, looking for poachers, and to track wildlife for research, in an effort to convince the Congolese government to leave the preserve as it is and protect it from encroachment from logging companies and hunters.

Lockwood made it home in plenty of time to see his wife deliver a healthy baby boy. □

MARKETING THE AIR-CAM

The evolution continues

With Air-Cam's original mission behind it and the *National Geographic* article published (in July 1995), Air-Cam has continued to evolve. The airplane's potential drew in an investor, Antonio Laeza; and with new money for capital improvements, Lockwood Aircraft Corporation was born. With investors came new manufacturing equipment and further refinement of the production Air-Cam. The company displayed a fuselage section of the first production-model Air-Cam in April at the Sun 'n Fun EAA Fly-in and has 26 deposits in hand. Pilots from as far away as Saudi Arabia, England, Australia, and Hong Kong have expressed interest in purchasing the airplane. The first delivery was scheduled for October.

"What encourages us is the way pilots react to it once they've flown it," says Lockwood. Retired Gen. Chuck Yeager took the aircraft for a spin at Sun 'n Fun and afterward, with a smile on his face, spent a good half-hour grilling Lockwood for more information on the ins and outs of its flight-test regime, wiring, props, and engine configuration.

The airplane can be built as a fly-away for export; the first three production airplanes are for export or public use. Domestically it is sold as a kit. With wings of pre-sewn Dacron held taut with a constant-tension rig and many parts prefabricated, the Air-Cam kit comes very close to the FAA's 51-percent rule. (The advisory circulars on the subject state that the builder has to construct the "majority" of the airplane.) Pop rivets or solid rivets can be used in construction (solid rivets are better if the aircraft is to be constantly exposed to salt water, for instance). Most builders will want to paint over the fabric.

AL CARPENTER

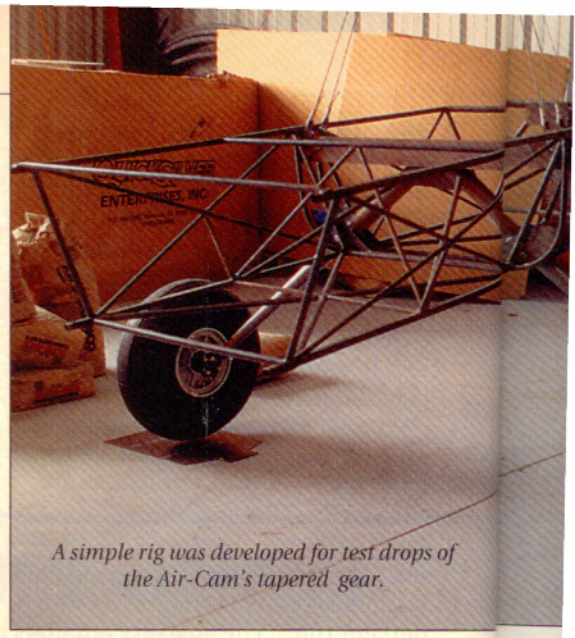
'We are working hard to push the Air-Cam's V_{MC} to a speed below that at which it stalls in all configurations.'

The primary changes in the production Air-Cam include a 36-foot wingspan (up from 32 feet) with sheared wing tips for improved single-engine handling. The wing now has a higher aspect ratio, which means better efficiency and improved performance. "We are working hard to push the Air-Cam's V_{MC} to a speed below that at which it stalls in all configurations, for added safety," says Lockwood. The production model also sports a larger vertical stabilizer, standing 8.5 feet high, with a tapered spar and a relocated horizontal stabilizer to keep it in the prop wash but out of the wing wash. The company has also chosen to move to a stressed-skin monocoque construction for the fuselage, making it both stiffer and stronger, which is necessary to accommodate the loads from the larger tail.

Flying the Air-Cam isn't at all like flying an ultralight, despite its appearance. The airplane has a heavy, firm,

positive control feel throughout pitch, roll, and yaw axes. If anything, the long wings require leading turns with the rudder. The Air-Cam has positive dynamic stability throughout all axes. Takeoff with flaps and a 10-knot headwind is a rush. The airplane hardly rolls past the point where the throttles hit the full-power stops. Then you rotate and climb at a deck angle between 25 and 35 degrees pitch up, at 45 mph and 1,200 to 1,500 fpm. If you're an experienced multiengine pilot, the initial climb angle is terrifying (visions of V_{MC} rollovers dance through your head)—but hang on until you discover how the Air-Cam performs.

With the engines so close to the center line there is hardly any perceptible yawing when one engine suddenly loses power. The procedure is simple, and the aircraft's behavior is exemplary—lower the nose and add rudder to balance the asymmetrical thrust. No abrupt maneuvering is necessary, as the Air-Cam doesn't seem to want to flip on its back, and even the yawing of the nose into the dead engine feels as



A simple rig was developed for test drops of the Air-Cam's tapered gear.

though it is happening in slow motion, compared to a Piper Aztec or Seneca, for example. Depending on your flight attitude, you may or may not need to bring up the power on the good engine to maintain altitude. That good engine will allow you to climb at blue line (even fully loaded).

You need a multiengine rating to fly the Air-Cam, but you'll find that it behaves infinitely better than any conventional multiengine airplane in which you might train. Stalls at 36 mph are as docile as its V_{MC} maneuvers. The airplane breaks cleanly and recovers with less than 50 feet of lost altitude.

The airplane is designed with huge electrically actuated flaps that, combined with the excess power and strong fixed gear, make it an ideal short-and-rough field machine. The operations off the strip in the Congo should be proof enough of what the prototype can do; the production airplane will do the job even better.

How much is too much extra power available in a twin? Sitting on the runway, Lockwood pulls the power to idle on the left engine and proceeds to the stops on the right engine. The Air-Cam (loaded with two souls and a third of a tank of fuel) rolls for 700 feet or so, rotates, and climbs at a respectable 500 fpm with the left engine's prop windmilling listlessly. The airplane is designed to achieve a 200-foot-per-minute single-engine climb rate at its 1,400-pound maximum gross weight on an 85-degree day at 1,000 feet above sea level.

At altitude, the two Rotax 582s sound like overgrown sewing machines humming through the sky. The wind noise will get to you long before your eardrums wear out. But it's the open

cockpit that makes the machine what it is—the perfect camera platform. From the back seat the view is an unobstructed 120 degrees, plus overhead and underneath, with hardly a strut or guy wire to cut across the scene.

Landings are best carried out with power into the flare. The prototype makes full-stall landings by first contacting with the tailwheel, then the mains. The production model, with the altered tail, makes three-point landings more traditionally.

The Air-Cam's big tail keeps flying right down to taxi speed, which means that the pilot's taildragger taxiing skills must be up to snuff when it is windy. But otherwise it is a docile machine, both on the ground and in the air.

Price for the standard Air-Cam kit is currently $34,000. The airplane flown for this test has an optional ballistic parachute recovery system, navigation lights with strobes, a rear-seat gauge package, ELT, Ultracom helmet intercom system, ICOM portable 760-channel radio, push-to-talk switches, external radio antenna kit, and aerothane UV-block wing coating. It costs approximately $38,500.

Of the 26 Air-Cams sold, only two will be flown strictly as camera platforms, says Lockwood. One airplane is slated for law enforcement use, and several others are headed out to airline captains. That's fine with Lockwood—as far as he's concerned, the Air-Cam is the best kit airplane available for flying very low and slow over terrain on which you can't land. He designed it that way, and it certainly hasn't let him down. □

Lockwood Aircraft Air-Cam
Base price: $34,000
Price as tested: $38,500

Specifications

Powerplants	2 Rotax 582s (64 hp ea)
Propellers	2 three-blade, 64-in-dia composite
Wingspan	36 ft
Wing area	200 sq ft
Length	26 ft 9 inches
Empty weight	850 lbs
Max gross weight	1,400 lbs
Max useful load	550 lbs
Fuel capacity	24 gallons
Fuel burn at 62 mph	6.6 gph

Performance

Range at 65 mph (50 percent power), with reserve	200 miles
Single-engine rate of climb	200 fpm
Rate of climb	1,200 fpm

Limiting and Recommended Airspeeds

Stall speed	35 mph
Cruise speed	40 to 80 mph
V_{NE}	100 mph
V_Y	50 mph
V_{YSE}	52 mph

For more information, contact Lockwood Aircraft Corporation, 280 Hendricks Way, Sebring, Florida 33870-7546; telephone 941/655-4242, fax 941/655-0310.

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.