

# **The Gossamer Penguin Makes Historic Solar Flight**

## **By**

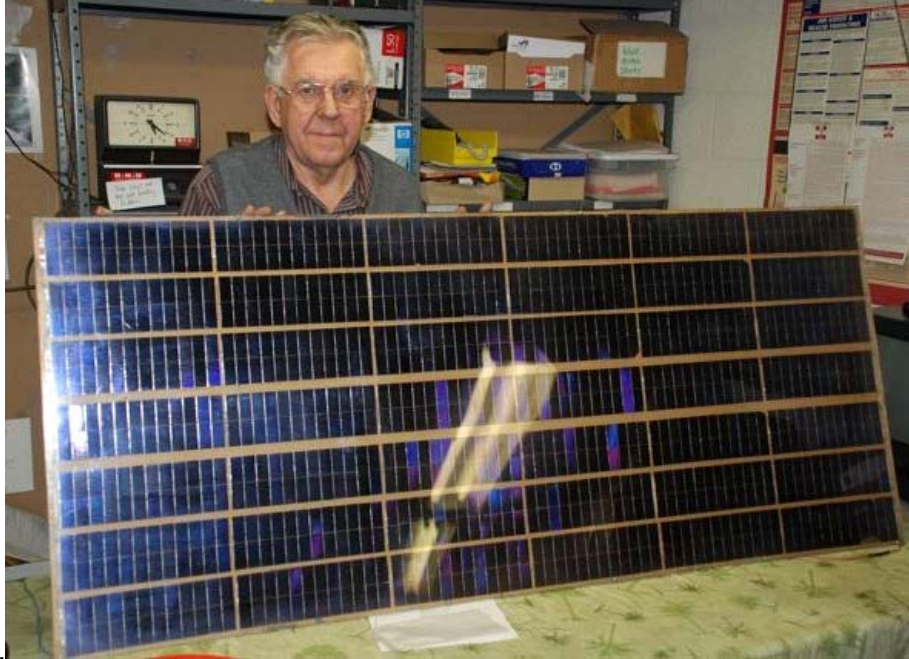
## **Bob Boucher**



**The Gossamer Penguin making its historic solar flight at Shafter California with Ray Morgan (left), Marshall MacCready Pilot, Blain Rawdon (center) and Bob Boucher (right).**

We, as modelers we can be especially proud of the historic flight of the Solar Powered Gossamer Penguin on May 19, 1980. I believe that this was the first time that a manned aircraft was flown solely on the power generated from solar cells. The Gossamer Penguin was initially built as a back-up for the Gossamer Albatross that Brian Allen pedaled across the English Channel on June 12, 1979. After this historic achievement, Paul MacCready and the Gossamer crew began to look for new fields to conquer. Bill Watson who was a member of the Gossamer Albatross Team, and who built the carbon spars and tubes used on the Penguin, invited Paul to come the IMS show in Pasadena, California to see the indoor electric contest. Bill brought Paul over to see me at the Astro Flight booth and it wasn't long before the discussion evolved to which Astro Motor would be best to power the Albatross for a pending NASA contract to measure the L / D of the Albatross. I soon had the job of building a twin Astro Cobalt 25 power package for the Albatross.

Paul MacCready came to our shop in February to pick up the motors and batteries. Since he was an old time modeler, he naturally wanted to take a tour of our facility. I showed him the damaged wings of the Sunrise I and Sunrise II with the thousands of tiny solar cells attached. (See Project Sunrise by Bob Boucher January 1976). Paul asked if I thought there would be enough power in the Sunrise solar panels to power the Albatross. A few calculations showed that we did not have quite enough power. We would need a smaller airplane and a lighter pilot. Bryan Allen the Albatross pilot weighed 140 pounds. Paul just happened to have the right combination...The Gossamer Penguin was smaller and lighter than the Albatross and Paul's thirteen year old son Marshall weighed only 95 pounds and was an experienced Albatross Pilot.



**Bob Boucher holds one of the Sunrise II Solar panels used on the Gossamer Penguin. Each Panel was made up of 1008 Solar cells measuring 2 x 4 cm.**

I agreed to lend the Astro Sunrise II solar panel to the Gossamer Team if DuPont, the sponsor of the Gossamer Programs, would be willing to cover the expense to repair the damaged solar panels. A few weeks later we were in business. Ray Morgan, an engineer at Lockheed, California took leave of absence to become Penguin Program Manager and rented a hangar near the Simi Valley California airport to erect the Penguin. He had the help of experienced Albatross veterans who were also experienced aircraft modelers like Dave Saks, Blain Rawdon, Ted Ancona, and Bill Watson. They soon had the penguin erected and ready for the first flights on battery power. I chose to use our Astro 40 Cobalt Motor for the power plant and a battery made up of 25 D size Nicads For the energy source. We had enough electrical energy to fly for about 15 minutes on a single charge. The Astro Cobalt 40 Motor is designed to run at between 10,000 and 15,000 Rpm, but the 11 foot diameter propeller on Penguin turns at 120 to 130 Rpm. The speed reduction was achieved with a three stage speed reducer that used two timing pulley stages of 5 to 1 each and a final chain reduction stage of 5.12 to 1. Early flight tests indicated that Penguin required 350 watts of electrical power to fly. This was not good news since that was all the power we could expect from the solar panels. Our earlier calculations had indicated that Penguin should have been able to fly on only 250 watts.

A flight test program was initiated to get the plane trimmed for minimum power. All the wrinkles in the Mylar skin were ironed out and all joints and gaps were filled with Mylar tape. In the meantime, Paul had obtained some solar cells from the US Air force that were loaned to the Penguin Program to supplement the three Astro Sunrise II solar panels. We now had over 400 watts to work with.

Things were looking good then disaster struck! Young Marshall was flying the Penguin at about 15 feet in altitude, simulating a solar powered flight, when the airplane was hit by a sudden gust of wind. Penguin did a quick snap roll to the left. Marshall jumped out through the thin Mylar skin on the side of the aircraft and landed on his feet on the runway. Then 70 feet of

airplane landed on top of him! Luckily, Marshall was only a little bruised and was up and walking about within a few minutes. At that point it all looked hopeless, but all the pieces were gathered up and brought back to Simi Valley.



**Astro Cobalt 40 Motor used on Gossamer Penguin. Motor is 1.75 inches in diameter and 3 inches long and weighs 13 oz.**

All the Mylar covering was stripped from the carcass and a damage assessment began. Just about every graphite spar and tube was broken in at least one place. Bill Watson began repairing the graphite spars with aluminum and Kevlar splices while the rest of the crew began making new ribs, repairing the propeller, etc. Two weeks of night and day effort by Ray Morgan and his crew had the bird back together again. While this work was going on, I was busy finishing the work on the Sunrise II solar panels and had all four panels tested and ready on Friday, May 16. We all drove up to Shafter Airport and slept in sleeping bags out on the runway so we could get an early start. By 6 PM on Saturday we had Penguin erected and the solar panels installed.

Early Sunday morning two battery powered flights were made to get Penguin properly trimmed. The first flight on Solar Power was attempted at 8 AM. The power was a bit marginal but a quick check revealed that one of the electrical connections from one of the four solar arrays was broken so we had been attempting to fly on only  $\frac{3}{4}$  power. If we had to go back to the hangar it would have meant scratching that day for any more solar flights. Shafter gets too windy after 10 AM. Time was running out. We decided to wait one half hour before trying again. I remembered that since this was to be a totally solar powered flight, we didn't need to carry the seven pound NiCad battery pack. While I removed the battery, Paul and Ray got the Gossamer Penguin ready for the historic flight.

At 9AM on May 18, 1980 the Gossamer Penguin was hand towed to an altitude of about 2 feet and released. The pilot, 13 year old Marshall MacCready, guided the Solar Powered Penguin straight down the runway while climbing to altitude of about 5 feet. Marshall held this altitude while traveling 500 feet down the runway. Paul then commanded Young Marshall to shut down the power and land. The New Age of Manned Solar Flight had arrived!

### **Gossamer Penguin Specifications**

<b>Wing Span</b>	<b>71.1 feet</b>
<b>Wing Area</b>	<b>312 square feet</b>
<b>Length</b>	<b>30 feet</b>
<b>Propeller Diameter</b>	<b>11 feet</b>
<b>Propeller Pitch</b>	<b>14 feet</b>
<b>Propeller Speed</b>	<b>120 to 130 Rpm</b>
<b>Solar Panels</b>	<b>3640 Cells , 9 pounds</b>
<b>Solar Power</b>	<b>14 Amps x 32 Volts = 448 Watts</b>
<b>Motor</b>	<b>Astro Cobalt 40</b>
<b>Empty Weight</b>	<b>68 pounds</b>
<b>Pilot</b>	<b>95 pounds</b>
<b>Gross Weight</b>	<b>163 pounds</b>

### **Milestones in Electric Flight**

**1884 Renard and Krebs fly electric powered Dirigible 10 Km around Paris, France**

**1973 Fred Militky flies electric powered one man motor glider in Austria**

**1974 Boucher Brothers fly Sunrise I solar powered UAV at Fort Irwin, California**

**1975 Bob Boucher flies Sunrise II on high altitude Solar flight at Mercury, Nevada**

**1979 Fred To flies his electric powered plane with solar battery charger in England**

**1980 Paul MacCready Gossamer Penguin first manned solar Flight Shafter, CA**

**1981 Paul MacCready Dupont Solar Challenger crossed the English Channel**