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PAUL B. MACCREADY



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**P**ERHAPS NO ONE since Leonardo da Vinci was more fascinated by aviation, and the excitement of soaring through the skies like birds, than Dr. Paul MacCready. In 1485, Leonardo designed the first human-powered flying machine. In 1977, MacCready, for the first time in 492 years, made one fly!

A gracious man with a sense of humor, he carried many honors:

- U.S. Soaring Hall of Fame, 1954
- Otto Lilienthal Medal, Fédération Aéronautique Internationale, 1956
- Distinguished Alumni Award, California Institute of Technology, 1978
- Public Service Group Achievement Award, NASA, 1978
- Collier Trophy, National Aeronautics Association, 1979
- Reed Aeronautical Award, American Institute of Aeronautics and Astronautics, 1979
- Edward Longstreth Medal, Franklin Institute, 1979
- Gold Air Medal, Fédération Aéronautique Internationale, 1979
- Engineer of the Century Gold Medal, American Society of Mechanical Engineers, 1980
- Spirit of St. Louis Medal, 1980
- Inventor of the Year Award, Association for the Advancement of Invention and Innovation, 1981
- Klemperer Award, Organisation Scientifique et Technique du Vol à Voile, 1981
- I. B. Laskowitz Award, New York Academy of Sciences, 1981
- Lindbergh Award, Lindbergh Foundation, 1982
- Golden Plate Award, American Academy of Achievement, 1982
- Distinguished Service Award, Federal Aviation Administration
- Frontiers of Science and Technology Award, 1986
- “Lipper Award,” for outstanding contribution to creativity, O-M Association, 1986
- Guggenheim Medal, 1987
- Trophy for Current Achievement, National Air and Space Museum, 1988
- National Aviation Hall of Fame, Dayton, Ohio, 1991
- Edward N. Cole Award for Automotive Engineering Innovation, Society of Automotive Engineers, 1991
- Scientist of the Year, ARCS Foundation, San Diego Chapter, 1992
- Pioneer of Invention, United Inventors Association, 1992
- Chrysler Design Award for Innovation in Design, 1993
- Honorary Member designation, American Meteorological Society, 1995
- Ralph Coats Roe Medal, American Society of Mechanical Engineers, 1998
- Howard Hughes Memorial Award, Aero Club of Southern California, 1999
- Blue Sky Merit Award for 1998, Calstart, 1999

National Convention of the Soaring Society of America, dedication, 1999  
 Special Achievement Award, *Design News*, 1999  
 “Most influential people of the century,” *Time* magazine, 1999  
 Lifetime Achievement Aviation Week Laureate Award, 1999  
 Commemorative stamp, Palau: “Environmental Heroes of the 20th Century,” 2000  
 William B. Johnson Memorial Award, Institute for the Advancement of Engineering, 2000  
 National Design Award—Product Design, Cooper-Hewitt, National Design Museum, 2000  
 Hoyt Clarke Hottel Award, American Solar Energy Society, 2001  
 World Technology Award for Energy, England, 2001  
 First Annual Award, Prince Alvaro de Orleans-Borbon Fund, 2001  
 Walker Prize, Museum of Science, Boston, 2002  
 International von Kármán Wings Award, Aerospace Historical Society, 2002  
 Ninth Annual Heinz Award in Technology, the Economy and Employment, 2003  
 Bower Award and Prize for Achievement in Science, 2003  
 Honorary Doctorate, Washington & Jefferson College, 2007

Biographies of Paul are numerous, and a search of the digital world will reveal even video dissertations by Paul, which are most interesting. Many of the biographies describe Paul’s early life in New Haven, where, he said, there weren’t too many nearby friends, so he focused on hobbies like building model airplanes. Later he progressed to flying full-size airplanes and flying solo at age sixteen. After university studies at Yale and the California Institute of Technology he became involved in soaring, which had always been dominated by Europeans. In 1956, Paul was the first American to be the world soaring champion. This fame connected him to business interests in Europe more than thirty years later.

Paul was a famous inventor. With his team at AeroVironment he invented more vehicles housed in the Smithsonian museums than anyone else, including the *Gossamer Condor*, *Gossamer Albatross*, *Flying Pterodactyl*, *GM Sunracer*, and *Dragon Eye*. These vehicles, which illustrated his mantra of doing more with less and demonstrated his passion for energy efficiency, are well documented in books and other publications. What is less well recorded is Paul’s business sense, which ensured that he and his associates were well compensated for their efforts. This memoir will deal with narratives relating to that sense.

As a General Motors executive working in the field of batteries and electric vehicles, I met Paul in 1989. His AeroVironment team had been developing the Santana concept vehicle for GM and was working with

my GM team at the Delco Remy Division on the battery system. The Santana name had been picked by AeroVironment as the familiar name for the Santa Ana winds that blow the smog out of the Los Angeles basin. About a week before the show, a name change was forced by a trademark search and the Santana was renamed Impact, which became a bit of an industry joke. The car was introduced in January at the 1990 Los Angeles auto show. It was very well received and set off a major effort directed at mass production. This effort continued until the car was introduced in 1996.

During that interval, I traveled often to Monrovia, home of AeroVironment. I got to know Paul well and learned of another of his great interests—distributed generation of electricity. Paul was aware that in the developing world many did not have electricity. In Mexico alone, he said, there were twenty-five thousand villages with no electricity. A simple solar-cell array and a 12-volt battery could pump water from the valley to the village, eliminating the need to carry water up the hill. He developed village electrification kits that could serve that purpose and dreamed of forming a company called DESC, Distributed Electrification Systems Company.

AeroVironment was then almost twenty years old and, although famous as an R&D think tank, had no real commercial income. Perhaps Paul's greatest asset was his awareness that what he was good at was inventing and not business. Acting on this belief, he hired outsiders to operate the company, while he remained free to invent.

Paul accompanied me in 1999 to Germany to visit with Continental AG, a partner with Delco Remy, to develop the first hybrid electric systems for General Motors, an integrated starter-alternator system for commercial pickup trucks. Continental had a new CEO, Hans Albert Beller, who was a private pilot and considered Paul one of his heroes. We traveled to Heidelberg, where we enjoyed a cold beer in a sunny plaza while we waited for Beller to arrive the next day. At Paul's suggestion, we walked up to the Heidelberg Castle at the edge of the city. Paul was in a very relaxed and reflective mood as we looked back over Heidelberg.

The next morning Beller arrived with his wife, Alexis, to lead us on a tour of Bavaria. We would have lunch and perhaps go flying in Beller's plane. We arrived at Der Schafhof Amorbach, a quaint Bavarian restaurant, in a drizzling rain. As we were seated for lunch, Beller told Paul that the lunch would be determined by whether they would fly after lunch. Given the bad weather, it was decided that lunch would feature a lot of good German wine. After lunch the "red-nosed" group traveled to Michelstadt, Beller's hometown, to the small airport where Beller kept his plane.

The plane was a 1930s vintage Stampe, a trainer for the Belgian air force that was in mint condition. It was only right to roll the biplane out of the hangar to get a good picture. It was only right to “prop” the engine to hear it run. Well, “What the heck, let’s take her up. It’s been a while since we had lunch!” So they did “take her up”; Paul in the front seat and Beller in the rear and in command. They took off into the gray German sky as Alexis and I watched with concern. After about an hour, which seemed much longer, out of the haze the Stampe came in for a landing—actually three landings—touchdown, 10-foot bounce, another touchdown, 5-foot bounce, and a final touchdown and taxi back to the spectators. Both pilots were red-nosed and smiling.

We made our way to the small café/bar at the airport for some beer. As we entered, the establishment became quiet, and you could see the pilots saying to each other, “That’s Paul MacCready!” He was still revered as the former soaring champion of the world.

The next day we traveled to Starnberg outside Munich, to visit the small R&D company that had developed the hybrid system for Continental. The firm, Grundl & Hoffman, had just been purchased by Continental. It was an AeroVironment kind of company. We met with Dr. Grundl. After viewing their facility, we returned to Munich to visit the Deutsches Museum to view the exhibit on bird wings, which Paul had studied several times earlier. Bird wings were studied by Leonardo and by Otto Lilienthal. Lilienthal’s treatise on the subject, a book entitled *Birdflight as the Basis of Aviation*, was the “bible” to early aircraft designers such as Wilbur Wright. It was hard to get Paul away from this exhibit to make connections for our flight home.

About a year later, in the fall of 2000, Paul invited Beller to visit AeroVironment. Paul had planned to take Beller flying in a World War II aircraft at the aviation museum at the Santa Monica Airport. The night before, Paul hosted dinner at the Athenaeum at Caltech, but before dinner he said he wanted us to meet a friend who was an illusionist. What Paul had planned was meeting his good friend Al Seckel, a cognitive neuroscientist at Caltech. As we entered Al’s home, which was situated above the Rose Bowl, he led us down a long hallway and asked everyone to look at a picture at the end of the hall and then walk toward it. Everyone got slightly ill as they got close and tried to focus on the picture. Then they could see the reason. It wasn’t a picture. It was a three-dimensional pyramid that protruded from the wall. Paul was quite amused as Beller tried to focus on the various levels of the pyramid, thinking that it was flat, as a feeling of mild nausea developed. Al delivered an ad hoc lecture on how our brains work. It was a fascinating beginning to the evening. We retreated to the Athenaeum; Beller and Alexis, my wife, Barbara, and I, and Paul’s wife, Judy.

The next morning we convened at the Santa Monica Airport as guests of Lt. David Price, a former Navy pilot, who was chairman of the Santa Monica Museum of Flying. Paul was on the museum board. He knew that Price would give Beller the ride of his life in a P51 Mustang. Alexis said Beller couldn't sleep the night before in anticipation of the ride. Off they went for about an hour doing barrel rolls up the California coast and buzzing the towers on Mt. Wilson. Beller returned exhilarated and in a full sweat. Paul was amused as he watched with his son Tyler, who was the next passenger.

Later Paul took us to Dockweiler Beach, where a reunion was under way for the U.S. Hang Gliding Association, of which Paul was a founding charter member in 1971. Walking along the beach where the gliders were taking off with Paul was like walking into the airport bar in Germany. You could hear everyone whispering, "That's Paul MacCready!"

As stated in Paul's public profile on the American Philosophical Society Web site, "He was most interested in fostering creativity and innovation among young people." In 2001 Paul traveled to Indianapolis to meet with Dr. Charles Dietzen (Dr. Chuck), a pediatric physical medicine and rehabilitation specialist, international medicine enthusiast, entrepreneur, professor, athlete, and founder (in 1997) of the Timmy Foundation. After working with Mother Teresa in Calcutta in 1996, Dr. Chuck was inspired to broaden his commitment to serve children in an international setting and empower others to do the same. The foundation provides direct medical assistance and healthcare services to low-income communities in the developing world through short-term medical brigades with missions now in Colombia, Ecuador, Guatemala, and Nigeria.

In Dr. Chuck's practice in Indianapolis he had a dream to have his physically disabled patients (many of whom were students in high school and college, although they couldn't walk or could talk only by touching computer keys that activate voice signals) build a human-powered aircraft that could be flown by a paraplegic athlete. The aircraft that he had chosen was the *Gossamer Albatross* modified into the *Gossamer Spirit*, designed so that the athlete could hand-pedal the aircraft. Paul had agreed to provide the technical counsel to make this project possible, starting by providing the drawings for the *Gossamer Albatross*.

Paul arrived for this meeting after having a mild argument with the airline pilot about the temperature in the cabin. The pilot argued that the temperature was comfortable. Paul showed the pilot his hand-held thermometer, which showed that it was quite warm. (Paul usually traveled with a thermometer and a compass.) He proceeded to meet with

the dean of engineering at IUPUI (Indiana University Purdue University Indianapolis) to discuss the *Gossamer Spirit* project. He presented a device that looked like a handheld harmonica: two wooden pieces separated by a metallic slice. It was Paul's latest invention, a handheld gym. By squeezing with your fist, or between your knees, or pressing in with your foot, or leaning on it against other objects, you could exercise every muscle in your body. And you could carry it in your pocket! More of doing more with less.

Paul met with the students who were to accomplish the amazing task of building the *Gossamer Spirit* in the Energy Storage and Conversion Laboratory at the Purdue School of Engineering at IUPUI with Dr. Chuck. These were sharp kids. It wasn't surprising to hear them say, "That's Paul MacCready!" Paul was just as motivated by meeting the kids as they were to meet America's number one engineer. Sadly, the project has not yet matured and, in Paul's absence, it probably won't.

Paul's connection to Purdue continued. Purdue has a very large School of Aeronautics and Astronautics (the home of many of the NASA astronauts). The president at the time was Martin Jischke, an aeronautical engineer who idolized Paul. Paul returned in 2002 to give the commencement address to the engineering class in Indianapolis. He again returned to the main campus in West Lafayette in 2004 to address the entire School of Aeronautics and Astronautics in Fowler Hall. Paul was introduced by John Sullivan, then head of the school, and President Jischke sat in the front row.

Eventually the philosophy of doing more with less made AeroVironment a very valuable company, and those who were part of the AeroVironment family were very well compensated. AeroVironment became a company worth more than \$600 million, and it was valued so highly because of "Paul's model airplanes"!—more properly, unmanned aircraft vehicles, or UAVs. In warfare a valuable asset is "situational awareness"—knowing where the enemy is located and what he is doing. Traditionally, that asset was achieved by sending a soldier out to scout the enemy, a very dangerous assignment. In modern warfare, the soldier takes a small UAV from a backpack, assembles it, and hand-launches it to fly over enemy territory. The UAV is fitted with very sophisticated GPS and navigation systems and carries cameras and other sensors that telemeter the information back to the soldier's unit. In effect, the fighting unit on the ground has the equivalent of a satellite in the sky at its command—doing what a satellite could do with a backpackable "model airplane." Every military organization in the world wants this capability, and thanks to Paul and AeroVironment many allies of America have this capability. The same capability is provided for police work, agricultural studies, and wildfire fighting.

The value of AeroVironment was established in January 2007, when AeroVironment made its stock available in an initial public offering. Paul didn't have much time to enjoy this good fortune; he died seven months later. Those who knew Paul knew that he lived a frugal life and didn't spend a lot of money. It was part of doing more with less.

Two of Paul's passionate interests were education and the environment. They are intertwined. He said publicly and emphatically that our education system destroys creativity. Paul did not attend public schools at either the secondary or college levels. If he were still with us, I believe he would press for education reform. His concern for the environment was twofold—traffic and livestock. Regarding traffic, he was frustrated that we don't use the third dimension for travel and that travel speed in urban areas is asymptotically approaching zero. Paul had long favored, and was still developing, vehicles to use the air to navigate. Regarding livestock, Paul was concerned with a geometric increase in the number of chickens, ducks, cows, pigs, sheep, and other animals husbanded to feed the world and the effect that this animal population has on pollution and ground water reserves. Solving these last two problems will require revamping the education system and unleashing human creativity.

Although Paul didn't profess to know the ultimate solutions to these issues, his lifetime objective was to operate so that the world would be a better place in twenty-five years. He certainly made life better for those around him.

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