Paul MacCready Sees Great Promise In Using Kites to Tap Power of Wind

Editor's note: Following are concepts involving kites by AeroVironment Inc., of Monrovia, California. The firm is headed by the inventor of the 90-pound Gossamer Condor, the first man-propelled airplane, now occupying a place of honor in the Smithsonian's National Air and Space Museum in Washington, D.C.

By Dr. Paul B. MacCready

There are kite challenges in our planning, specifically a) a device that can be induced to stay aloft indefinitely at 700 to 1,000 feet above ground, in all wind and weather conditions, to monitor video and meteorogical and acoustic signals and telemeter the information elsewhere, b) the use of a kite to extract energy from the winds in the atmosphere, the kite moving back and forth crossways to the wind so as to extract extra energy until the wind slows to below half the ordinary stall speed of the kites (at ever slower wind the kite can be kept aloft by energy from the ground, but does not acquire energy from aloft), c) various kites to move nearly crosswind and provide thrust in almost all directions to land or water vehicles, and d) making small versions of such kites serve as a propeller for vehicles which can go downwind or upwind faster than the wind speed.

Techniques With Coupled Devices

If we consider a kite on a string, we realize the kite can be aloft and interact with a stronger relative wind than is available were it to be affixed onto the surface of a slow vehicle. The kite can be used to tow a ground or water vehicle. The kite can also be guided to pull at an angle nearly 80 degrees from the relative wind at the kite altitude, and can provide a good force to the ground vehicle that is pulled with say 80 degrees of the kite line direction. Energy for the ground vehicle comes from the pull component in the direction of motion of the vehicle. Alternatively, the kite can extract energy by a propeller mounted on it. This decreases its performance, but provides an independent source of energy (which presumably is brought to the ground via two insulated wires that comprise the line to the kite).

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An advantage of the kite is that it can be controlled to move fast: left and right, up and down. Its speed becomes much faster than the wind speed, and the power it derives can be far larger than with the motionless kite. To some extent it operates like the whirling blade of a wind turbine, its effectiveness relating to the swept area. Further, when the wind becomes somewhat too light to support the stationary kite, the moving to and fro can provide line tension and thus allow it to remain aloft.

Kites are used rarely for research purposes, but deserve more attention. Giant kites have been experimented with for carrying a significant energy generator aloft. In many locations the wind aloft is three to four times stronger than near the ground, so a wind turbine aloft could in such circumstances obtain 27 to 64 times the energy than it would at the surface. If the generating kite were programmed to dash to and fro, it could extract even more energy. There have been energy projects proposed for high stationary kites. The challenge comes from operating in air space that must be avoided by aircraft, and dealing with the natural variations of wind.

In summary, there is huge energy aloft, derivable from kite generation, but not yet activated.

Another technology makes use of a pair of kites, or sailplanes, separated by a long line but not connected to the ground. If the two vehicles are operating at different altitudes in air with different speeds and directions, they can extract energy----perhaps enough energy to keep the two vehicles aloft, and possibly enough additional to provide power for immediate or delayed fast propulsion.

Exploiting Atmospheric Turbulence

Paul MacCready's doctoral thesis at the California Institute of Technology in 1952 was on atmospheric turbulence. He founded AeroVironment, which now has several hundred employees, to develop instrumentation and efficient flight vehicles for the aerospace industry and government.

His company produced the first man-powered airplane, which won a $100,000 prize for flying a measured mile. A $214,000 prize was won for crossing the English Channel. A solar-powered 247-foot aircraft attained an altitude of 96,000 feet. AeroVironment developed a pterodactyl which flew with flapping wings. It pioneered in the development of fuel cell devices for powering airplanes and land and water vehicles.

Dr. MacCready's work, talks, and writings all fit the challenge of finding a balance between nature and future technology. He notes that nature has evolved some creatures of amazing efficiency, and that humans are just beginning to realize the social costs of wasted energy. He feels we can learn from natural creatures, and often improve on their techniques----for movement through air, on land, and on and under water. Atmospheric turbulence can help an airplane, or bird, or kite, fly. Kites can move objects downwind even faster than the wind; and streams, currents, waves, and tides can all be exploited for energy.

Brainstorming With the Wizard

Three Drachen Foundation board members had the unique opportunity to meet with aeronautical legend Paul MaCready at his Southern California AeroVironment offices late last year. The three were Scott Skinner, Monument, Colorado, president of the Foundation; Joe Hadzicki, San Diego, inventor of the Revolution kite; and Dave Lang, Seattle, an aerospace expert.

MacCready's unique career path has ranged from cloud-seeding, to testing for automobile emissions, to human-powered flight, and now, finally, to a leadership position in energy conservation, lightweight motors, and remotely powered vehicles.

The four discussed two kite-related projects Dr. MacCready had worked on----aerial monitoring and power generation.

In the early 1970s, MacCready said he experimented with a kite system he hoped would provide a 24-hour, 7-days-a-week environmental monitoring capability. His idea was to use balloons, tethered above kites, which would streamline and trail the kites when the wind was adequate for normal kite flight, but in no wind the balloons would fly above and suspend the system; it was his thought that numerous monitoring systems might not only give valuable on-site information but also be a visual reminder to the public of public environmental degradation. For various reasons, he discontinued the project.

MacCready said that while interested in power generation, he had no hands-on experience in the field. Lang then took the lead in explaining a power generation scheme being studied in Italy and New Zealand known as the KiWi Gen project. Lang talked of his own findings when he studied kite power generation ideas on behalf of the Foundation in 2004.

"In my judgment, this presentation by Lang was perhaps the most important development of the meeting, since it allowed Dave, Joe, and myself to really explore ideas that might bear fruit in the power generation field," says Skinner.

"Inspired by MacCready's ability to think big and outside the box and his overriding environmental concerns, we three decided that, however outlandish, kite power generation deserved a major place in the Foundation's

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Dr. MacCready (second from left) meets with Drachen Foundation board members Dave Lang (left), Scott Skinner, and Joe Hadzicki.

priorities. Even if there is not a viable economic solution, the Foundation can be a facilitator of information for groups interested in the idea. Additionally, work that we do in the field can be translated to a number of interesting school projects in the scientific arena. From what might be viewed as a rather generic interview has come a great deal of excitement as the Drachen group continues to look at kite power as a potentially inexpensive power generation option."

Says Lang: "I was taken by MacCready's unpretentiousness. He is mild mannered, yet he became animated with us and thoroughly enjoyed talking about things dear to his heart.

"He has a generalist's approach and a strict business sense. For instance, regarding kite power, he seemed to feel that the necessary condition was to have secured patents prior to embarking on a venture, rather than doing some development work to see if any of it made any sense. He seemed to have a bit of Scots streak, this from the man who runs a company doing business on the order of $180 million a year, and growing rapidly.

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Dave Lang diagrams a kite power generation project.

"The discussion, although a long one, never got around to current kite technology, but in all it was a delightful, stimulating visit. I even had a brainstorm about a kite power project I am involved in right in the middle of the meeting. Later, back at our hotel, the Drachen group had a great, useful technical discussion----it was undoubtedly the MacCready effect."

The long meeting with MacCready was videotaped for the Drachen archive.

Paul MacCready Answers 3 Questions

Ask him a question, receive a profound answer.

Drachen Foundation: How do you define success?
Paul MacCready: Success means achieving a goal----economic, social, military, etc.----that establishes a reality onto which further success can be built.

DF: What is your advice to young people?
PM: Look for innovation, whether it turns out right or wrong, because it launches you further along the way toward new and realistic solutions. Innovation is best spawned by looking for solutions to all sorts of challenges early in your youth. It's hard just to introduce the concept when in or after college. Experiment, try new approaches, look at the big picture, interact with those folks who stimulate your tasks.

DF: How do you want to be remembered?
PM: It makes no difference to me. The ideas and accomplishments may deserve remembrance, but not who did them.