Speaking of Science

Human-Powered Flight: Californians Claim Kremer Prize

To some of those who have envied the birds their ability to soar through the skies, gasoline- or jet-powered flight has seemed a poor substitute. To these souls, the real goal has always been for man to fly under his own power. Now what may be one of mankind's oldest dreams has been made a reality by a team of Californians, headed by Paul MacCready, Jr., a champion sailplane pilot and an aeronautical engineer from Pasadena. In the process, the team members have won themselves £50,000 ($86,000) for being the first to fly a human-powered aircraft around a specially designed course.

In actuality, the flight was something less than birdlike. The aircraft is an ultralight contraption weighing only 77 pounds and consisting almost entirely of an enormous wing with a span of 96 feet, bigger than that of a DC-9 jet airliner. For almost 7½ minutes, a Bakersfield bicyclist and hang-glider enthusiast named Bryan Allen pedaled away in a cockpit dangling beneath the wing and thereby propelled the aptly named craft—the Gossamer Condor (Fig. 1)—around a figure-eight shaped course at an average speed of 11 miles per hour. Completion of the flight around two turning points at least a half mile apart, while maintaining a minimum 10-foot altitude, qualified the team for the Kremer Prize, which was first offered in 1959 and has been awaiting a claimant ever since.

The prize is named after British industrialist Henry Kremer, who is a physical fitness buff. Possibly motivated as much by the idea of the English countryside populated with healthy citizens puffing away in aircraft powered by themselves as by the more soul-stirring vision of conquering an age-old goal, Kremer put up £5000 to be given to the first Briton to fly around the figure eight under his own power. Rules were drawn up and the competition administered by the Royal Aeronautical Society. Over the years, the prize money was gradually upped to the present £50,000 and the contest opened to all comers. The society has also held two international symposia devoted to man-powered flight.

As numerous competitors, mainly British, tried and failed to collect the Kremer Prize, it became clear that the rules makers had devised an exceedingly arduous test for man-powered flight. It turns out, relatively speaking, that flying a straight path is not difficult, having been accomplished several times. The longest flight is 6900 feet by a Japanese airplane that was built by university students as part of their course work. The real test comes in negotiating the turns without crashing. A successful turn requires an exceptionally well-conditioned athlete who can combine a peak physical effort with the mental work needed to control the flight, as well as a carefully designed aircraft.

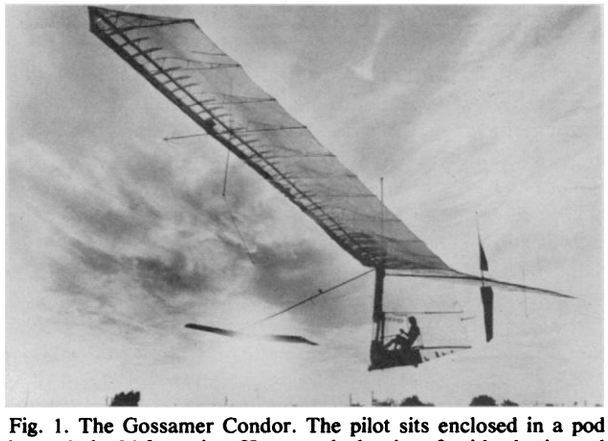

Fig. 1. The Gossamer Condor. The pilot sits enclosed in a pod beneath the 96-foot wing. He controls the aircraft with a horizontal stabilizer (canard) located in front of the cockpit. A bicycle-like mechanism translates the pilot's pedaling action into turning a single propeller in the rear of the plane. [Source: UPI]

MacCready was able to succeed where others failed by using a completely new approach. He started with the idea that, if he could triple the dimensions of a hang glider without increasing its weight, the horsepower needed to fly (about 1/3 hp) would be within the capability of a man. From this point, MacCready says, the plane practically designed itself in that a relatively simple aerodynamics equation quickly led him to the features necessary for a man-powered craft. For example, one kind of aerodynamic drag increased with the cube of the velocity, suggesting that the slowest possible airspeed was advisable. This, in turn, had implications for the size and shape of the wing. And so on.

But the biggest departure from previous practice was in MacCready's decision to construct the aircraft so simply that it could be rapidly repaired and easily modified after crashes or rough landings. In the year from July 1976, when MacCready was inspired to try for the Kremer Prize, to the successful flight on 23 August, there were 430 test flights and 12 significantly different versions of the Gossamer Condor. Although the shapes of the wing and the propeller were in part designed by way of sophisticated interactive computer programs written by one of MacCready's team members, Peter Lissaman, the ultimate test was always whether the craft would really fly. Fine tuning of the design was therefore accomplished by way of the many test flights. Construction materials were selected to provide the least possible weight while providing the minimum structural strength needed. Materials included thin-walled aluminum tubing, stainless steel piano wire, thin sheets of Mylar, Styrofoam, corrugated cardboard, and balsa wood.

The successful effort took place at Shafter, California, which is near Bakersfield. The site was chosen because many days of the year there have near-zero winds. The turbulence associated with even a breeze of 3 knots can have a devastating effect on a superlight, slow-flying craft such as all human-powered airplanes must be. The prize-winning flight has been certified by Royal Aeronautical Society sanctioned observers, and a claim has been filed. As of press time, the prize has not been actually awarded.

What the future holds for man-powered flight is unclear. MacCready thinks that the design of his plane could be considerably improved to reduce the physical strength needed to fly it. But the Gossamer Condor is so big and requires so many special conditions for flying that there is little prospect for a new weekend sport, he acknowledges. MacCready does see, however, certain ideas now current in hang gliding and soaring merging with the principles used in designing the Gossamer Condor and possibly creating a new field of ultralight aircraft that could blossom in the next decade.—ARTHUR L. ROBINSON