On mythical wings: Pedaling to Greece

The mythical Greek inventor Daedalus escaped from the island of Crete on wings he had fashioned from feathers and wax. Next year, if all goes well, a somewhat more sophisticated human-powered aircraft will take off from Crete — on a 69-mile flight across the Mediterranean Sea to the Greek mainland.

The proposed flight, called the Daedalus project, would be three times longer than the current world distance record for a human-powered aircraft. That record was set during the Gossamer Albatross's 1979 flight across the English Channel (SN: 6/16/79, p. 390).

"Such a flight is technically, physiologically, meteorologically and logistically feasible," says a report released this week. The completion of this feasibility study, sponsored by the Massachusetts Institute of Technology (MIT) and the Smithsonian Institution in Washington, D.C., marks the end of the Daedalus project's first phase. A small group of volunteers, centered at MIT, is now preparing to design, build and test a craft suitable for the journey.

Several features make this new airplane different from previous designs. Powered by a man or woman pedaling a bicyclelike mechanism that turns a propeller, the airplane will have an electronic flight-control system. This would enable it to fly at night or in light fog, when the calm air necessary for flight is more likely to occur.

Because Crete's northwestern coast is very rugged and has few beaches, the airplane must also be strong enough to be launched safely from a cliff. However, throughout most of its flight, the plane would skim the sea's surface at a height of 15 feet or so.

The craft, constructed from lightweight materials, would weigh about 68 pounds. As now envisioned, its wingspan would be 102 feet. For this project, MIT engineer Mark Drela designed a new airfoil that, according to his computer simulations, should slice through the air 30 percent more efficiently than previously used airfoils. "We tried to squeeze every last bit of performance out of this airfoil," says Drela. The Daedalus team is also using a new graphite composite as the main supporting element in the wings to provide the necessary stiffness.

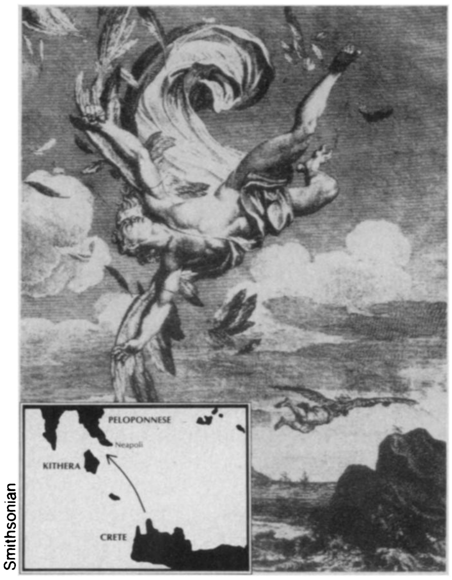
This new technology could eventually lead to unmanned planes that cruise high in the atmosphere for months at a time. At 70,000 feet or more, such vehicles could make atmospheric measurements or act as spy planes and communications centers (SN: 11/10/79, p. 327). "Someday, you may even see something like this in an [unmanned] airplane that can fly in the Martian atmosphere," says Daedalus project leader John S. Langford, who works for the Institute for Defense Analyses in Alexandria, Va.

The project has also provided useful data on the limits of human endurance. The Daedalus pilot would have to generate a quarter of a horsepower for at least four hours; that's roughly equivalent to running two marathons, one right after the other. Laboratory tests at the Yale University medical school in New Haven, Conn., showed that a few "elite" athletes could make the flight. "Physiological limits don't seem to be encountered," says human factors engineer Steven R. Bussolari of MIT. "The best candidates would come from endurance events that involve cycling." Keeping the pilot cool may turn out to be the biggest problem.

Another concern was the weather. Looking at historical weather data, the team established that March, April or September would be the best months for an attempt. "The summer is slightly better for [low] winds, but it's too hot, even at night," says Langford. "The soonest that we could do it would be the spring of 1987."

The Daedalus team has selected several potential takeoff and landing sites. Automatic weather stations at a few of the sites are now providing detailed information about local weather conditions.

One thing the Daedalus team wants to avoid is the fate of Icarus, the son of Daedalus. Icarus suffered a structural failure when he climbed too high and the sun melted the wax holding his feathery wings together. Daedalus himself, however, made it. — *I. Peterson*



Smithsonian

While Icarus crashed into the sea, his father, Daedalus, flapped his way to safety. The map shows the proposed route that a new human-powered aircraft is to take to commemorate Daedalus's feat.

Electric currents transported quantally

The discovery of quantum effects at the beginning of this century divided the world of physics into two quite different domains, the microscopic and the macroscopic. In the microscopic domain — that of atoms, molecules and structures smaller than atoms — changes in physical quantities occur in a jumpy fashion: They go by the quantum, the least change possible in a given situation. The macroscopic domain is the familiar world of large objects, where changes can be, or can seem to be, smooth and continuous. Until a couple of years ago, objects that behaved quantally were all given by nature; things built by humans belonged to the macroscopic order. Now, working in the borderland between the two domains, physicists have learned to construct objects that behave in a quantum fashion.

These somewhat macroscopic quantum objects are tiny metal wires and rings and tiny metal-oxide semiconductors (MOSFETs). William J. Skocpol of AT&T Bell Laboratories at Holmdel, N.J., calls the MOSFETs "nanolaboratories for quantum transport effects," implying they are a billionth the size of ordinary laboratories. The rings are typically 8,500 angstroms across (the length of one wave of red light) and made of wire 500 angstroms thick. The quantum transport effects involve electrons that make electric currents in these devices, and those currents behave quite strangely compared with currents in ordinary electric wires. The effects were described last week at the American Physical Society meeting in Las Vegas, Nev.

In these very small pieces of metal, quantum mechanical wave effects become important. Every object in the quantum mechanical domain is both a wave and a particle, and the strange effects come from the behavior of the waves associated with electrons. The source of resistance of concern in these experiments is impurities, foreign atoms. When electrons hit impurities they are knocked out of their paths and they scatter. An electron encountering a lot of impurities executes a random walk. It may even backscatter, as Skocpol points out, and return to its starting point. If one regards electrons as waves, the scattered waves may be split, and when they recombine, if they are still in phase with each other, they will reinforce each other, but if they are out of phase they will cancel each other. This wave interference effect alters the electrical conductance of the metal.

In the macroscopic domain, the effects of individual impurities should average out. Physicists thought they had under-