A Lofty Idea for Atmospheric Research

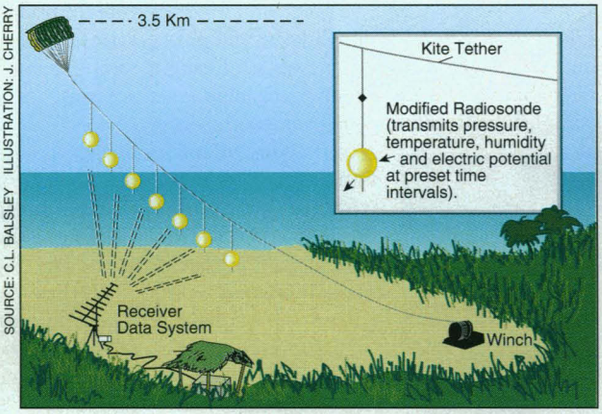
Need to measure global change in the upper troposphere? Can't do it by plane or balloon? Go fly a kite!

WHEN A PROPOSAL TO MONITOR THE atmosphere's electric field landed on Ronald Taylor's desk in April 1990, the National Science Foundation program manager for physical meteorology couldn't help chuckling. Taylor recalls laughing not at the type of data aeronomer Ben Balsley of the University of Colorado at Boulder was seeking but at the "crazy" way Balsley planned to collect it: by kite. But Taylor also remembers being brought back down to Earth by the time he'd digested the proposal. Suddenly Balsley's idea of tethering meteorological instruments to a truck-sized kite and sending it soaring above the Pacific Ocean's Christmas Island seemed "just crazy enough to be successful."

Sure enough, Balsley's kite made a successful maiden voyage in the fall of 1990—a 4-day flight only fully described in the January 1992 *Bulletin of the American Meteorological Society*. The kite hoisted seven instrument packages to an altitude of 3.5 kilometers, where they measured humidity, temperature, pressure, and electric potential in the troposphere. But that has proved just an enticement for the Colorado aeronomer. Knowing that meteorologists would really like to probe the stratosphere—about 10 kilometers higher than his prototype had flown—to get at such big-time issues as the ozone hole and global warming, Balsley began to plot more elaborate excursions. And this time around he figures to have won even more fans. "I'm looking forward to seeing Balsley's stuff," says Earle Williams, a geophysicist at MIT who studies atmospheric electricity. Balsley's kites, he says, are "tying into the global circuit in a new way."

The appeal of kites (to atmospheric scientists, that is) is their ability to hover for weeks over a single location, unlike a balloon or airplane. The result: a long-term profile of atmospheric conditions that couldn't be obtained otherwise, Balsley says. And that, he adds, means "we can go a long way toward putting better numbers into the global models" of atmospheric phenomena.

A breezy pursuit. *Scientists launch a mylar kite* (right) *into the troposphere above Christmas Island.*



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The idea is by no means a new one. Balsley is attempting to resurrect a scientific tool that boomed after Benjamin Franklin's pioneering experiments in the 1750s, in which the Philadelphian used the famous kite strung with a key to detect electrical charge in thunderclouds. Scientific kiting continued to flourish until the early 1900s, when sounding balloons and airplanes began to displace it. But even into the 1930s the U.S. Weather Bureau maintained kite stations. (The last was closed in 1933, ending the kiting era.) By the end of World War Two, though, scientific kites had all but faded into the meteorological history books.

To get the kites flying again, Balsley had to overcome a number of obstacles. Foremost is the fact that to be most useful in research, the new generation of kites has to fly much higher than the kites of bygone days—as high as the lower stratosphere, from 11 to 16 kilometers up. To reach such heights takes a lot of string, the weight of which would keep ordinary kites earthbound. Neither a five-and-dimer nor a standard meteorological kite would be up to the challenge.

For his trial run of a stratospheric voyager, Balsley hired Pennsylvania-based Modelsym, Inc. to build a prototype kite that would be tough enough to take the 5 to 10 meters-per-second trade winds that blow high above Christmas Island. The kite system Modelsym came up with consists of 2 Kevlar-laced mylar parafoils, each measuring 2.9 by 4.3 meters, strung together on a

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Kevlar tether. Four such parafoils together should provide enough lift to reach the lower stratosphere, Balsley says. Computer modeling done by Joe Williams, president of Modelsym, predicts that such a kite system could attain altitudes in excess of 19 kilometers, nearly double the record height achieved by a meteorological kite.

But kiting at anything more than a few hundred meters can run afoul of airplane traffic patterns. Then again, how many jets—or sleighs —would you guess are routed past Christmas Island? More seriously, though, only a handful of Pacific islands and the polar regions remain sufficiently jet-free for the long-term, high altitude flights Balsley has in mind. And yet, he argues that there's plenty of interesting atmospheric science to be done in those remote regions, and he is now seeking funding for a 4-year series of kite experiments at Christmas Island and Antarctica.

The plan is to loft instruments into the lower stratosphere for weeks on end to measure processes such as the transport of water vapor from the troposphere into the stratosphere, the reflective properties of cirrus clouds, and various chemical processes such as ozone production and depletion. Once the sturdy kites reach their holding altitudes, says Balsley, the only things that could end the fun are stormy weather or a long lull in the trade winds that keep the kite aloft. Or, given enough time in the thin air of the lower stratosphere, the sun's ultraviolet rays. Eventually, these would disintegrate a kite's mylar, and it would plunge back to Earth as surely as Icarus did, his wax wings melted by the sun. ■ RICHARD STONE