"Glued in the Sky": Stability in Kite Flight

Stability—or steadiness in the air—is only one of the characteristics that kite fliers value in a kite. They also look for lift, the design elements that enable a kite to use the wind effectively to rise into the air. Some, those who fly fighter kites or sport kites, willingly sacrifice stability for speed and responsiveness, the kite's ability to make the sharp turns and dives essential to the sport.

For one kite flier, however, stability was the overriding concern. He was Alexander Graham Bell, and he was experimenting with kites during the first decade of the twentieth century in the hope of developing a "low speed aerodrome" (Bell's term for an airplane). He valued stability over lift or speed because to be stable in the air was to be safe—or at least safer. As Bell said, "In a flying structure to be entrusted with human life, stability in the air under varying conditions is of first importance."

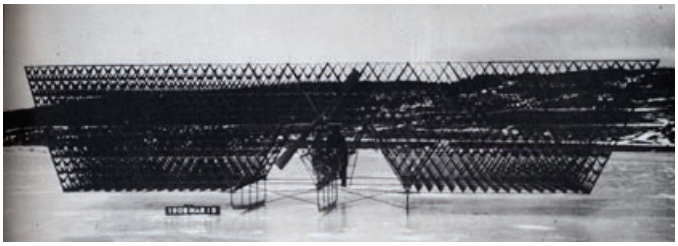
Bell had good reason for worry. The early history of aeronautical experimentation had seen numbers of accidents, even deaths. Indeed, one of Bell's own partners in the Aerial Experiment Association (active from 1907 to 1909), Lt. Thomas Selfridge, became the first person to die in an airplane. Only nine months after Selfridge had safely manned the first and only flight of Bell's giant *Cygnet* kite in 1907, he accompanied Orville Wright on a two-man test flight that crashed. Wright was seriously injured, and Selfridge did not survive.

In the words of J. H. Parkin, who has written a detailed chronicle of Bell's aerial experiments, "Bell's interest was not that a kite should fly high but that it should have perfect balance in the air, fly steadily, not sway or wander, not dive when struck by a squall, and when released should settle slowly and gently with little oscillation to the ground." A tetrahedral cell ensured this stability. When looking at a single tetra cell, imagine one side turning more into the wind. It then produces more lift than the other side and corrects back toward the most stable orientation, with each side exposed equally to the wind.

Bell's series of experiments, with different designs, methods of flying, flying lines, reinforcements (called "beading"), and porosity of covering materials, led him to favor kites constructed from many small tetrahedral-shaped cells, the aluminum spars covered in silk held taut to the frame. Packing together these cells (the largest kite Bell constructed had 3393 cells), he created a structure with more lifting surface and reliable stability without a proportionate increase in weight. As Bell's official biographer, Robert Bruce, explains, "One great advantage of a multicelled kite was that the center of pressure on each small cell moved only a fraction of the cell's length as the angle of flight changed. In a single-celled kite of the same overall dimensions, the pressure center would move by a comparable fraction of the whole kite's length and therefore many times as far by absolute measure. So a smaller cell unit gave Bell's kite more stability."

Bell never relinquished his faith in the potential of a "powered tetrahedral cell aerodrome," despite the fact that the large kites created more air resistance, or drag. (Added drag required more power—an engine of heavier weight—to overcome; a heavier engine added even more drag, requiring even more power, and so on, an equation that could not be solved with engine technology at the time.) On seeing one of his kites flying, Bell said, "It really was a beautiful sight to see the fine structure at rest in the air, supported apparently as immoveable as though glued in the sky. We had here a good illustration of the wonderful stability exhibited by large tetrahedral kites of full construction when flown in a fully supporting breeze; and the exhibition of stability rammed home the conviction that we should not depart from this form of construction without good and sufficient cause."

Only toward the end of his series of experiments did Bell accept the point, argued by his younger collaborators in the Aerial Experiment Association, that a form of "hollow" construction, with some of the interior cells in a large kite removed, could provide reliable stability. He conducted simultaneous tests of different designs, and admitted that the kite with a full complement of cells behaved in the air like "a water logged vessel," while the "hollowed" version acted like "a cork dancing upon the waves."



But by this time aeronautical design had moved ahead, leaving Bell behind, stymied by the lack of an engine that was light, compact, reliable, and powerful enough to lift his kites. Younger members of the AEA understood that a certain amount of instability, which a pilot could learn to control, would be necessary for manned flight to progress. One of Bell's colleagues, Glenn Curtiss, through his experiences with motorcycles, brought knowledge of current engine technology to the experimental mix, and successful airplanes soon followed. In 1908 and 1909, the AEA built four pioneering aircraft: the Red Wing, White Wing, June Bug, and Silver Dart, making step by step improvements in aircraft design.

Despite the fact that Bell's powered tetrahedral cell aerodrome did not develop into the airplanes of today, kite makers continue to value "tetras" for the same aesthetic qualities that Bell appreciated in his creations. Kite maker Scott Skinner has said of the tetra he built, "What I really like about my tetrahedral is its personality. You can put it together in dozens of different ways. If you were not happy with its shape the day before, today you can assemble it differently. It's an amazing structure. Artistically, it is lovely to see a tetra flying. As it moves in the sky, one sees the sun shining through the panels, or the complex frame may be highlighted. Viewers' perspective completely changes the nature of the kite."

Sources

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