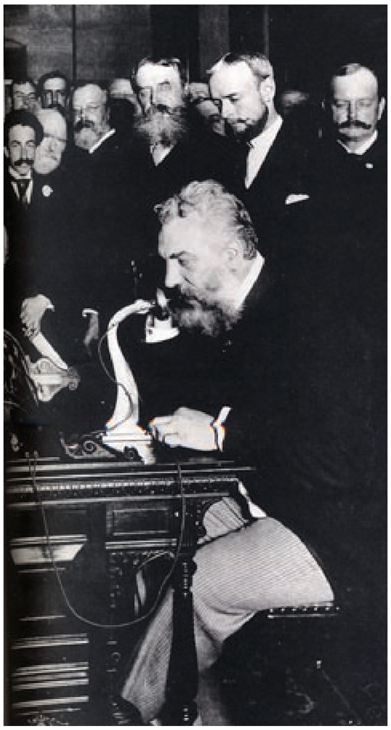
Meet the Kite Maker

Alexander Graham Bell



Most people know Alexander Graham Bell solely as the father of the telephone, an invention he patented in 1876 as a young man of only twenty-nine. Few are aware of Bell's many other inventions. Although he kept meticulous records in his research notebooks, Bell had earned so much money from his telephone patent—the single most valuable patent ever awarded—that he had no need to pursue commercial applications.

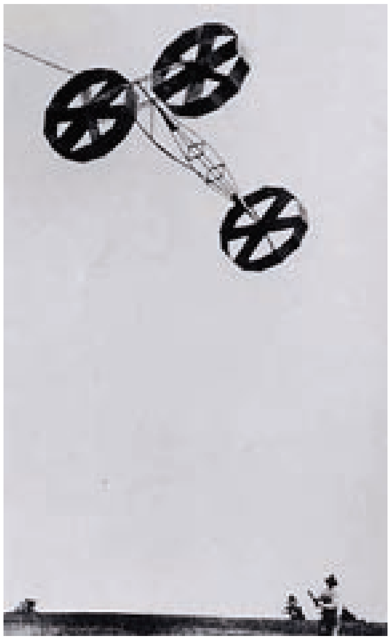
Among Bell's inventions were the graphophone (which became the first practical phonograph) and the flat record, the audiometer (to measure hearing), the metal detector, the respirator ("vacuum jacket" or "iron lung"), and the hydrofoil. He also created the telautograph (a rudimentary fax machine) and the photophone, a device to transmit the human voice via light waves, an idea that led, eventually, to fiber optics. Bell took the first X-rays in Canada, and was first to use the phrase "greenhouse effect" to describe global warming.

Bell was also a social and community activist. He worked on behalf of the deaf all his life (he introduced Helen Keller to her teacher, Annie Sullivan), and conducted experiments in genetics for thirty years. He championed civil rights, women's suffrage, and Montessori education. He co-founded the National Geographic Society with his father-in-law, and was instrumental in establishing the Smithsonian Institution.

Perhaps all these inventions and activities might be enough for one man—who was also a devoted husband, busy father, and active grandfather. But no! Bell also played an important role in the early history of aviation. He and his collaborators carried out 1200 carefully documented experiments over twenty years, despite widespread disbelief among scientists of the day that the difficulties of manned flight would ever be conquered.

For two years, from 1907 to 1909, Bell headed a partnership, the Aerial Experiment Association, whose five members (four young men, with Bell as chairman) conducted the first airplane flight in Canada and invented the aileron. (Peltérie and Blériot in France had also used this device, but the AEA received a patent.) The AEA carried out the first *public* airplane flight in the United States, at a time when the Wrights had flown only in private, and won a *Scientific American* prize for the first public airplane flight in the United States of more than a kilometer. In his detailed account of the AEA's experiments, J. H. Parkin ranks the significance of its work "in the history of effective flying" as "in precedence next to the Wright Brothers."

For Bell, the aeronautical adventure began with an ongoing curiosity about flight. All through his boyhood and young manhood, he had studied the soaring of birds and had tinkered with wings and propellers. He backed the experiments of his older friend, Samuel Langley, who by 1895 had achieved the first powered flight of a heavier-than-air machine. Bell declared, "Can't keep out of it [aviation]. It will be all UP with us someday!"



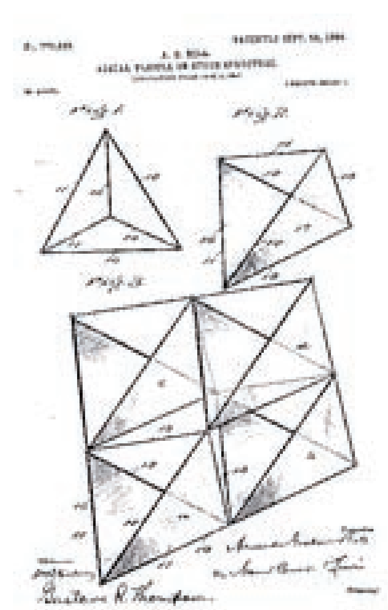
However, the accidental death of German aviation pioneer Otto Lilienthal in 1896 tempered Bell's enthusiasm for manned flight with a concern for safety. Being stable and safe in the air was Bell's overriding interest in all his aeronautical experiments. "How, he asked himself in a notebook, "can ideas be tested without actually going into the air and risking one's life on what may be an erroneous judgment?"

Kites allowed Bell to test his ideas without risk to human life, and he was not alone in using them. Orville and Wilbur Wright, for example, had begun their experiments with a large biplane kite, and first flew their man-carrying glider as a kite. In June 1898 Bell wrote to his wife Mabel, "the importance of kite flying as a step to a practical flying machine grows upon me." By 1899 he was testing many different kite designs: "spool kites" with cylindrical cells, "kites with radial arms"; box kites, invented by the Australian Hargrave in 1892.

Bell knew that his neighbors in Baddeck, Nova Scotia, as well as fellow scientists, thought he was "some kind of nut… foolish to spend so much time flying kites." Their attitudes are summed up in the comments of a local boatman, whom Parking quotes:

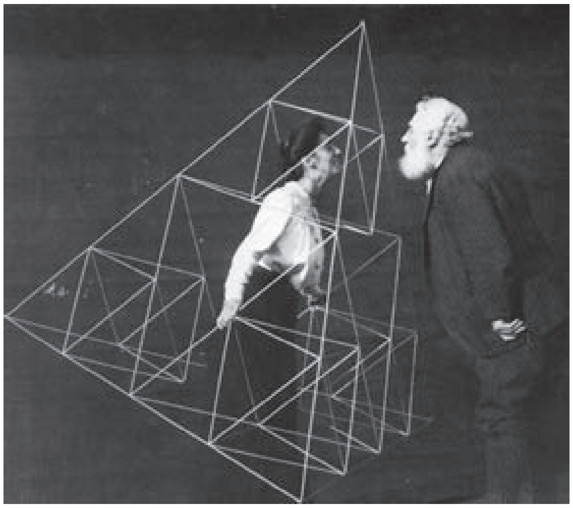
> "He goes up there on the side of the hill on sunny afternoons and with a lot of thing-ma-jigs fools away the whole blessed day, flying kites, mind you. He sets up a blackboard and puts down figures about these kites and queer machines he keeps bobbing around in the sky. Dozens of them he has, all kinds of queer shapes, and the kites are but poor things God knows! I could make better myself."

But Bell persevered, his concern always stability rather than speed.



Bell experimented with different sizes of box kites. One called "Jumbo" was as big as a room. But he discovered that the larger this kite, the poorer its performance in the air. Multi-celled kites allowed Bell to explore the concept that he could increase lifting surface and stability without a proportionate increase in weight. Finally Bell hit on the idea of a tetrahedron for each cell, a shape that was stronger and less resistant to wind than a rectangle. His notebook entry for August 25, 1902 records the excitement he felt as he linked perceptions gleaned from many months of tests. Frustrated that he could not draw the cell well, he described the shape as a "figure composed of 4 equilateral triangles having 4 triangular faces bounded by 6 equal edges. Wish I could describe this solid form properly, as I believe it will prove of importance not only in kite architecture—but in forming all sorts of skeleton frameworks for all sorts of constructing—a new method of architecture."

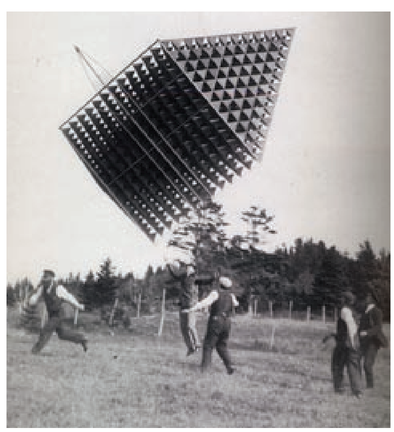
By 1903, in a paper he presented to the National Academy of Sciences, he characterized the tetrahedron as "not simply braced in two directions in space like a triangle, but in three directions like a solid. If I may coin a word, it possesses '*three-dimensional*' [italics are Bell's] strength; not 'two-dimensional' strength like a triangle, or 'one-dimensional' strength like a rod. It is the skeleton of a solid, not of a surface or a line."

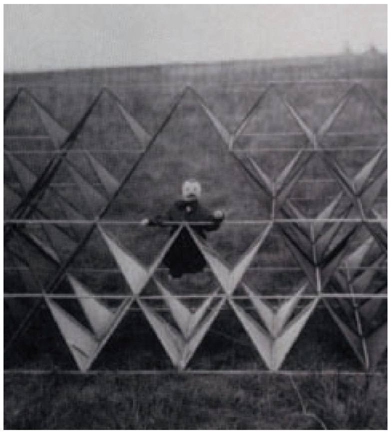


The basic cell Bell used had ten-inch edges, covered in a red silk, which Bell favored because the color showed up well in photographs. When kites crashed in the bay, little girls from the village salvaged the silk to make doll clothes. The silk was sewn over the frames with a buttonhole stitch by young women from Baddeck, who competed with each other to finish the most cells. The prize was an extra day off; one girl, who stole cells from the piles of other seamstresses in hopes of winning the prize, was dumped into the water by her co-workers.

Simple, strong, and light (especially after a change from spruce wood to aluminum tubing for frames in 1903), the tetrahedron could be combined into aerodynamically stable shapes. Crucial to its success was a device to connect the cells, fabricated for Bell by his laboratory foreman, Hector McNeil. (McNeil and Bell obtained a joint patent for the connector.) Bell applied to patent his tetrahedral structure in 1903, and was granted the patent one year later, for an "Aerial Vehicle or Other Structure, whose framework is composed essentially of skeleton tetrahedral elements combined with means whereby the adjacent elements are directly connected at two or more of their corners."

Bell tested these "tetrahedral elements" in different configurations and by different means of elevation. He pulled them by horse (a technique Mabel had suggested), by car, and by boat; he favored water take-offs and landing for reasons of safety. Cells in a ring tended to slip sideways and crash. The *Oionos* (Greek for a bird of omen) had a horizontal wingspan with a short tail. Bell called it "A Soaring Kite Adapted to Gliding Flight When Freed from its Cord" when he displayed it at the Aero Club in New York. The *Frost King* (pictured here) had 1300 cells and 440 square feet of lifting surface. On Christmas Day 1905 it accidentally carried a coachman's brother, Neil MacDermid, thirty feet into the air. This happy accident confirmed Bell's belief that a tetrahedral structure could be designed to carry both man and motor.





But Bell's dreams of a stable and safe tetrahedral airplane went unrealized. Before a light, compact engine of sufficient power and reliability could be developed, aviation technology took a different direction. For its first task, the Aerial Experiment Association did test Bell's most recent tetrahedral design, the giant *Cygnet*, made of 3393 cells. It flew first unmanned, then, on December 6, 1907, manned by AEA member, Lt. Thomas Selfridge, who lay in a small open area in the middle of the kite and shifted his weight to control its flight. The *Cygnet*, towed by a steamer, rose to 168 feet and stayed aloft for seven minutes. But this was to be its only flight. When the wind dropped and Selfridge landed on the water, smoke from the steamer obscured the kite line. Neither Selfridge nor the boatman cut the line, and the *Cygnet* was dragged through the water to its destruction.

The AEA next moved to test biplane gliders and the airplanes *Red Wing*, *White Wing*, *June Bug*, and *Silver Dart*. Bell participated in these experiments, and contributed the idea for the aileron. He also intermittently, for almost five more years, conducted trials of motorized versions of man-carrying kites—the *Cygnet II*, the *Cygnet III*, and a tri-plane version of the *Oionos*. None of them could get off the ground—at least for more than a foot. Bell then turned his attention to hydrofoils.

Although Bell's experiments with kites "would lead to nothing useful" (in the words of his official biographer, Robert Bruce), his discovery of the principle of tetrahedral construction did, as he had predicted, spawn a "new method of architecture." Buckminster Fuller independently rediscovered the principle of tetrahedral construction later in the twentieth century (he patented the geodesic dome in 1947), and his widely publicized designs led to the use of space frames in architecture, particularly for large roof spans, and in other structures, such as NASCAR race cars.

Kite makers continue to experiment with "tetras," made with different kinds of materials and connectors. Nick D'Alto, who has duplicated Bell's tetrahedrals from the original patents and drawings, says, "It's a thrill to see a tetra zoom into the air and hear the weird hum as the kite strains against its line. Spectators are always surprised to see one, and they're even more surprised to learn a new side of Alexander Graham Bell. I always tell spectators that it's a Bell kite—the kite that proved large aircraft weren't impossible after all."

Sources

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