Cycles and the Drive for Improvement

2.2

Pedaling Across the Sky: Hand-Cranked and Pedal-Powered Airships, 1875-1909

Tom D. Crouch, Ph.D., Senior Curator, Aeronautics, National Air and Space Museum, Smithsonian Institution

Human beings first took to the air aboard a free balloon on 21 November, 1783. In the weeks and months that followed, one balloon after another carried daring aeronauts aloft, sending waves of excitement sweeping across Europe. It was immediately apparent, however, that drifting with the wind left much to be desired. The real goal was to devise a method of navigating the air, taking off, flying to a predetermined destination and landing safely.

Jean Baptiste Meusnier designed such a craft in 1784, complete with a propulsion system in which the crew operated a crankshaft driving a propeller, but did not build it. Engineer Henri Giffard is credited with operating the first successful steam-powered airship in 1852, followed by the brothers Gaston and Albert Tissandier with a battery-powered craft in 1883. Until the development of the internal combustion engine, however, airships powered by prime movers would remain impractical curiosities.[1]

In the absence of a suitable lightweight propulsion system for small airships, experiments with hand-crank and pedal-powered aircraft began in the 1870s. The inspiration may well have come from

the application of pedal power to operate stationary machines and machine tools during the last quarter of the nineteenth century.

The era of human-powered flight began in the United States in 1878 with the work of Charles Francis Ritchel (22 Dec. 1844 – 21 Jan., 1911). A native of Portland, Maine, who lived most of his life in Bridgeport, Connecticut, Ritchel was a prolific inventor who claimed to hold 150 patents. In addition to the toys that he developed for the Ives Manufacturing Company, which included mechanical banks and walking dolls and animals, he is credited with the invention of the fun-house mirror, fire escape systems, employee time clocks, chemical mosquito repellant, a corset and a cockroach trap. "Whenever he wants money," one associate remarked, "he invents something, has it patented and sells the rights." He was best known, however, for producing the first successful man-carrying, powered airship in the United States.[2] **[see Fig. 1]**

Fig. 1. Charles Francis Ritchel (Dec. 22, 1844 – Jan. 21, 1911).

"The project of constructing a flying machine," *Scientific American* reported in 1878, "has been a favorite subject of contemplation with him [Ritchel] during the last ten years past..." In 1871, he moved from Maine to Corry, Pennsylvania, the home of his friend W.H. Lyman, where the two "...incubated the idea together." The pair relocated to Bridgeport, Connecticut, in November 1876, to take advantage of the "Yankee resources and skill" available in that industrial center. Their first craft was too heavy and the application of muscle power to propulsion ineffective. The second craft was finished by the spring of 1878.[3]

Ritchel unveiled his 'Flying Machine,' as it was known, in the spring of 1878. The craft consisted of a gas bag made of linen, coated with India rubber, measuring twenty-five feet in length and thirteen feet in diameter. Weighing only 66 lbs, the bag was constructed by the Goodyear's India Rubber Glove Company of Naugatuck, Connecticut. Because of its relatively small size, it was usually inflated with hydrogen, produced by the chemical reaction between sulphuric acid and iron filings, rather than city gas, which produced less lift. The finished gas bag was painted with white lead to minimize the effect of solar heating and the expansion of the gas.

Eight worsted wool bands passed over the top of the gas bag and supported a rod of mandrel-drawn nickel-plated brass tubing, measuring 1.5" in diameter and 23' in length. A brass framework hanging from the rod, which one reporter would describe as a "skeleton canoe," was produced by the Folanasbee Machine Shop of Bridgeport, Connecticut. The rear section included a rectangular base of brass tubing, measuring 2' wide by 5½' long. Two curved rods, drawn together at the top, 18" high at the center, supported the seated pilot, who operated a hand-crank driving a shaft that turned a 4-bladed propeller on the nose of the craft. Featuring white 120674917 holly blades measuring 24" in diameter, the propeller could be spun at up to 2,000 revolutions per minute. A second 22-inch propeller, set horizontally immediately beneath the pilot's feet, was driven by the same hand crank, but could be disconnected by the operator. The pilot's feet rested on two pedals used to angle the forward propeller to the right or left to direct the course of the machine.[4] **[see Fig. 2]**

The 'Flying Machine' was scheduled for its first public flight on 10-11 May, 1879, as part of the ceremonies celebrating the re-opening of the Permanent Exhibition Hall on the grounds of what had once been the Centennial Exhibition in Philadelphia. Senator James G. Blaine of Maine gave the keynote

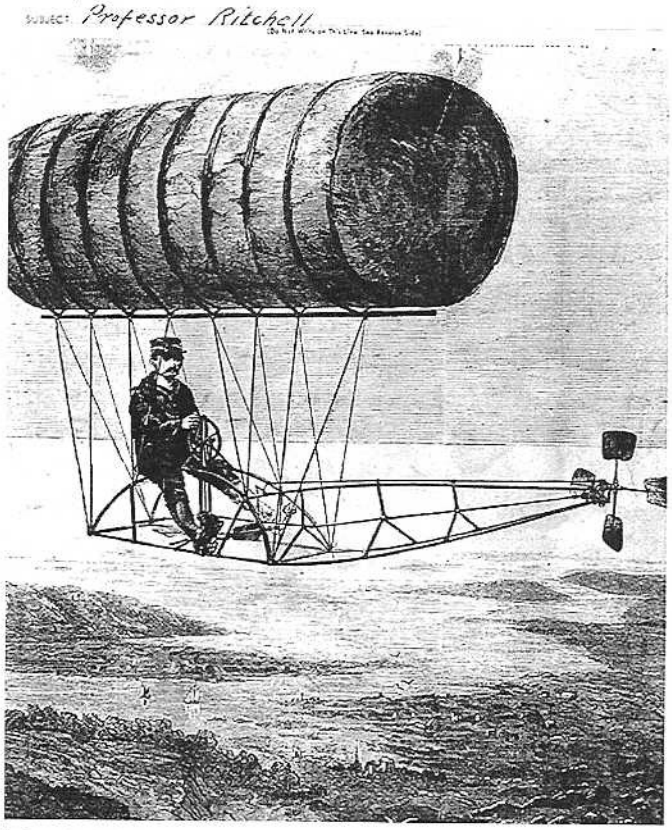

Fig. 2. The Ritchel Flying Machine.

address to an audience of two thousand. Following the formal presentations, the crowd was to be entertained with aeronautical performances, including a balloon ascent by John Wise, Jr. and the first public flight of Ritchel's Flying Machine. The thirty-four year-old Ritchel, who reporters described as "a tall, heavily built man," weighed too much to fly his own craft, so he hired two light-weight individuals to serve as operators. One, a Mr. Tuttle, was described as "a petit young man adorned with a shirt replete with frills and ruffles," the other was a "beautiful blond," named Mabel Harrington.

On Monday, 27 May 1878, the petit Mr. Tuttle and "the lovely young aeronaut," Miss Harrington, opened a one-week engagement in Philadelphia's Concert Hall. Admission was 25 cents for adults and a dime for children, with flights every hour from 10 a.m. to 11 p.m. "The pair alternately assisted each other," one newsman commented, "...in a merciless raid on the army of flies marshalled on the ceiling of Concert Hall...As if scorning to put their dainty feet on the ground provided for ordinary mortals, these two interesting beings have been gracefully floating through the air with all the poetry of motion imaginable, looking disdainfully down on the crowd of upturned faces."[5]

By the time Ritchel scheduled his first flight out of doors at Hartford, Connecticut, on Wednesday, 12 June, Tuttle and Miss Harrington had been replaced by 98-pound Mark Quinlan as aeronaut-in-chief. Quinlan rose to an altitude of just 250 feet, pedaled past the steeple of the Colt Memorial Church, then across the Connecticut River. Turning his aerial bike, he pedaled back into the teeth of a growing headwind, but managed to land safely on the ball park where he had begun the flight. Back in the air the next day, he was carried south by the wind and landed in Newington, nine miles from Hartford. Theodore R. Davis, an artist for Harper's Weekly, was on hand and prepared a drawing showing Quinlan, calm, cool and collected, high above Hartford.[6]

On 26 June, 1878, Quinlan began a well-advertised engagement flying the craft inside Boston's Tremont Temple, a Baptist church with a high, open sanctuary that was occasionally used for public events. With the Flying Machine operating indoors once again, the lovely Miss Mabel Harrington also made some flights inside Tremont Temple.[7]

Quinlan's most memorable flight came on 18 July, 1878, when he ventured aloft from Boston Common. Instead of the slow, smooth ascent to which he was accustomed, the Flying Machine, apparently operating a bit light, immediately shot 2,000 feet into the air. The sealed gas bag, not designed to operate at such altitudes, began to make a cracking sound as the worsted bands gave way. When Quinlan tried to turn the hand crank and nose the craft down, he discovered that something was binding the transmission gears.

He had two choices. Any attempt to cut a hole in the gas bag that was already so small that it was barely supporting his weight could be disastrous. Desperate, he tied his left ankle and wrist to the brass frame with hemp cord, got out of the saddle and made his way under the machine. The raised head of a loose screw was keeping one of the gears from turning. He tightened the screw with the blade of his jackknife, regained his seat and pedaled back to earth an hour after take-off.[8] **[see Fig. 3]**

Ritchel reported that he built five Flying Machines in all. He is reported to have supplied one to an operator in Cuba, and was said to have had orders from a Parisian circus and an American magician. He built one craft with a lovely reddish gas bag with yel-

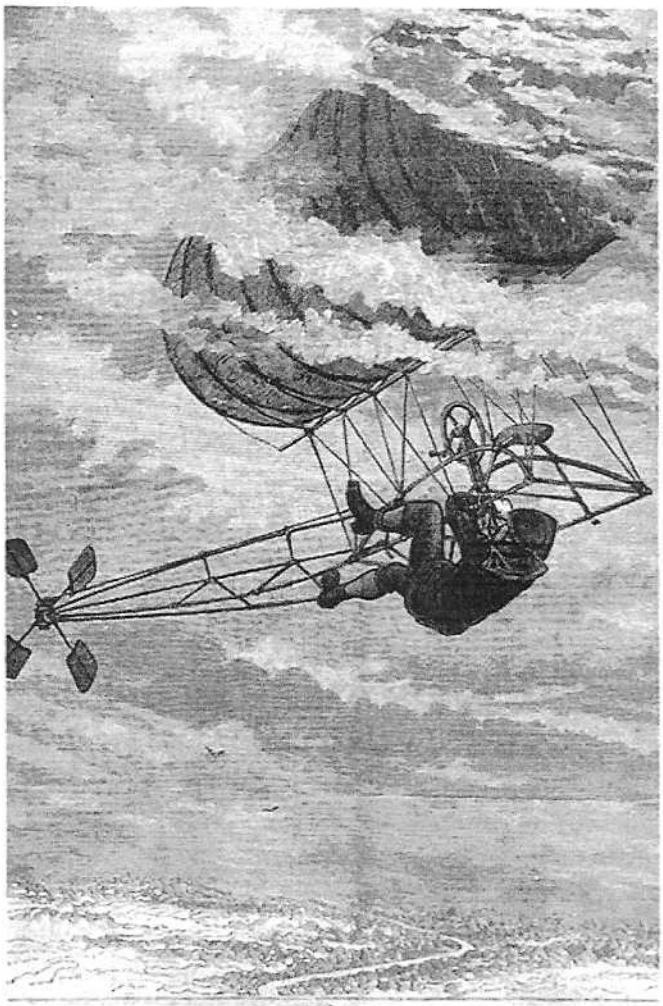

Fig. 3. Mark Quinlan struggles to repair his machine, July 18, 1878.

low and blue supporting bands for the W. C. Coup Circus, which traveled through the Middle West and upper South. At one point, Ritchel was reported to be in Louisville, Kentucky, ordering a new gas bag from Goodyear so that the show could go on. [9]

By the spring of 1880, Ritchel was back in Bridgeport, hard at work on his final machine, the Peerless. This time, he was building a two-person craft, limited to a total crew weight of 240 pounds. The new gas bag, once again the work of the Goodyear plant at Naugatuck, would contain 5,750 cubic feet of hydrogen, as opposed to the 3,200 of the original craft. He planned to operate the Peerless that summer at Coney Island.

In an effort to publicize the new venture, the inventor rented office space at 22 Chambers Street in New York. He visited the offices of the New York Times on 28 May, 1880, explaining that the gas bag of the new craft was constructed of "Scotch gingham" with a vulcanized rubber coating that reduced the weight by fifty per cent. Ritchel had invested $1,000 in his new machine. A reporter for the New York Daily Tribune visited Ritchel's new office that day, where he saw " a full-rigged 'machine' painted in gay colors and lacking nothing but the inflation of its balloon portion to make it complete." Ritchel went so far as to announce that he was prepared to build an even larger craft and fly to the North Pole, explaining that "...there is little or no rough weather in the extreme north. It is silently, intensely, cold there. The main difficulty to overcome is that of locomotion, and I have overcome that. My balloon reduces the actual work to a mere trifle. There is absolutely no danger."[10]

Things did not go as planned. After a short demonstration, apparently in New York, Ritchel shipped the 120674921 *Peerless* to Brighton Beach, east of Coney Island. While preparing for a demonstration flight from the local fair grounds, however, the airship was caught by a sudden gust of wind that broke its tether. As the craft rose into the air, the frame was torn from the gas bag and tumbled to earth, badly smashed. The balloon disappeared over the Atlantic. It was the last that C.F. Ritchel would see of the *Peerless.* [11]

"They said it couldn't be done," Ritchel remarked to a reporter the following year:

> *They said that a machine couldn't be constructed to go up and down without loss of power in the way of gas or ballast, but I did it, and I didn't get the credit for it that I deserve. I really took the first great step in the way of aerial navigation. In New Haven your papers gave me no credit for what I had done; we barely paid expenses. None of the college professors came to see it. I suppose they thought it was a sort of ghost show.*[12]

The aerial dreams of Carl and Mary Myers were far less grandiose than those of Charles Francis Ritchel. The proprietors of the famous Balloon Farm, near Frankfort, New York, they were the best-known and most successful aerial performers operating in the United States in the late-nineteenth and early-twentieth centuries. Carl Myers (1842-1925), a native of Fort Herkimer, New York, grew up on a farm in the Mohawk Valley. In 1867, 25-year-old Myers established himself as a photographer in Hornersville, New York. He prospered, traveling into the Adirondacks to

produce stereoscopic sets to sell in his shop. Her met and married Mary Breed Hawley in November 1871. Within a few years, Carl decided to move back to the Mohawk Valley, to devote himself to ballooning as a means of pursuing his long time fascination with meteorology. His first step was to develop a process for treating balloon fabric so that it would be light and gas tight without cracking or remaining gummy, as was the case with older treatments. [13]

Having spent several years building balloons for other people, Myers made his first flight in 1878. Mary took to the air two years later. By 1880, the tradition of aerial showmanship in the United States was over half a century old. But the days when simply showing up for the local Fourth of July celebration and selling tickets for an ascent from the town square were long over. Jaded Americans expected something more when an aeronaut showed up in town. Mary Myers, flying under the nom de l'air, "Carlotta," was that something new, as a Watertown, New York, newsman reported:

> *The spectacle will long be remembered as the finest occurring in the region. The lady was dressed in a jaunty suit of blue flannel trimmed with gold braid, her short skirt revealing neat fitting garters. A nobby sailor hat of plaited straw crowned the whole and gave her face a boyish piquancy. She stepped lightly into the frail conveyance which serves Carlotta in lieu of a basket. This consists of a thin wooden platform suspended by hammock twine to the connecting ring of the balloon, and as Aerial gently rose, the entire proportions of her youthful figure could be plainly seen, apparently standing on the air itself as she waved her hat in salute."*[14]

For the remainder of their long career, Mary, who gave birth to their only child, Elizabeth Aerial, in 1881, would perform most of the flights while Carl oversaw the construction of balloons, including a considerable number for both the U.S. Army Signal Corps and the U.S. Weather Bureau, and handled business arrangements. The Myers moved into new quarters near Frankfort, New York in 1888. The Balloon Farm, as it was known, often appeared as just that, with ten to twenty partially inflated balloons being tested or inspected, blossoming on the lawn like gigantic mushrooms.

Myers realized, of course, that the great dream was to navigate the air. As early as 1879, he began to investigate the ideal form for an airship, firing variously shaped projectiles from a spring-loaded gun into earth and sand embankments, measuring the depth of penetration for each shape. He determined "that the projectile which most adequately coincides with my ideas was that which sharply pointed at both ends." Within two years, the Myers were operating their first Skycycle.[15] **[see Fig. 4]**

Fig. 4. The Myer's Balloon Farm, Henderson, New York.

Describing one of their early Skycycles, Mary Myers commented that the machine seen from the side resembled "a canoe bottom up," and from the front, "like that of a half sphere or dome." The envelopes would evolve over time into rounded spindle shapes, 39 feet long and 16 feet in diameter, with a capacity of 4,000 cubic feet of hydrogen. Balloon netting over the entire gas bag supported an open framework. The pilot sat on a bicycle seat and operated two cranks, one for the hands, the other for the feet. The cranks were linked and drove a geared drive shaft turning a forward propeller. 15 feet in diameter, the propeller was "a huge screw of cloth....[that] lays flat ...until revolved, when it instantly twists itself into a screw. "[16] In the early versions, a large rudder was provided for yaw control and two forward planes to climb or descend.

The Myers patented the Skycycle in 1897. Between 1881 and the early years of the twentieth century, they made as many as 120 flights in eleven states and "...nearly every county in New York State, without damage to person or vessel." Unlike a gas balloon, Myers noted, "it usually sails at a low level

...and it is purposely balanced or weighted to come down if left to itself, only slight effort being necessary to keep it aloft, though speedy movement requires as much effort as to ride a bicycle uphill against the wind against a wind...." Steering the fully developed craft required only a shift of the pilot on the seat and a tug on the rudder, mounted forward, just behind the propeller. The operator climbed by pedaling faster. Myers noted that his craft operated so close to neutral buoyancy that he had many time "...tossed a balloon and aeronaut skyward" simply by pushing up with his hands. [17]

Myers himself flew a typical performance at the annualin St. Louis .... in September 1900. He performed in the Coliseum, a huge building seating 12,000 people, with an 85-foot ceiling. "I rode for half an hour around the arena," he told a reporter, "the vessel answering my movements with celerity that surpassed my anticipations...." [18]

The altitude record for a Skycycle was 11,880 feet, or 2 1/4 miles. The speed range was similar to that of a bicycle, averaging 11 mph, with an athlete capable of reaching over 20 mph in calm conditions. It is uncertain how many Skycycles the Myers produced. The price, an English source reported in 1901, was £40 sterling.[19] **[see Fig. 5]**

In addition, Carl Myers was also involved in the construction of pedal-powered airships designed by other experimenters. In August 1888, Peter Carmount Campbell contracted with Myers for three small working models and a full-scale, man-carrying envelop and net for a craft that Campbell and his investors planned to operate at the Sea Beach Palace, Coney Island. The aircraft was complete that fall, but James Allen, the experienced aeronaut hired to fly the machine, feared that cold weather would crack the fabric. The first flight came on a warm day, December 8th, when Allen pedaled up to 100 feet before returning to earth for a photograph. Then it was back up to 500 feet for a half-hour cruise over Brooklyn.

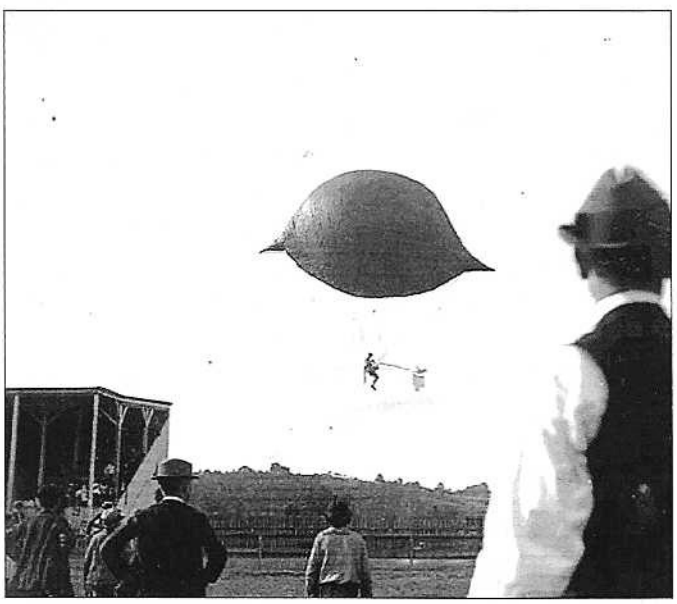

Fig. 5. A Myer's Skycycle in the air.

The publicity surrounding the Campbell airship was too much for Charles Ritchel. He believed that Campbell, particularly, was copying his own plans for a large airship. "I abandoned the machine," he noted, "because it was only a toy, and couldn't be made of any practical use but I want whatever glory there is in the invention and don't propose to let these people go on deceiving the public with a machine built after my ideas and which is just as useless and even more helpless than mine was."[20]

Campbell simply ignored the criticism. The airship was back in the air on 16 July, 1889 with a new pilot, E.D. Hogan, at the helm. The craft rose into the air at noon, filled with 15,120 cubic feet of city gas from the Nassau Gas works. One thousand feet up and moving toward Coney Island, Hogan tried to steer his craft without success. Roughly a mile from the take-off point, a large horizontal propeller beneath the operator's position fell off. Hogan was seen trying to climb into the net as the airship was blown out to sea. Late that afternoon, a pilot boat returning to harbor reported the envelop floating in the water 75 miles out to sea. Hogan's body was never found. Carl Myers complained that Campbell and his crew had altered the gas bag and netting, rendering them unsafe.[21]

Myers was also involved in the construction of a pedal-powered airship for Arthur W. Barnard, Director of Physical Training for the Nashville YMCA. It measured 46 feet long by 18 feet in diameter, with a propeller eight feet in diameter. Barnard took off aboard his 'Centennial Airship' from the Tennessee Centennial Exhibition grounds on 6 May, 1897, flew to Watkins, fifteen miles away, and started back, but developed a gas leak and was forced down to a safe landing four miles from Nashville. An interviewer reported that Barnard admitted that the craft was "... not perfect, nor could yet be perfectly controlled, but he believed that he could perfect it so that its course

could be controlled." Originally designed for use with a light motor, the craft made its one flight under pedal power.[22]

The attempt to achieve navigability with a pedal-powered airship was largely an American dream. There were exceptions, however. Two Canadians, Charles A. Pagé and Richard Cowan, and the American balloonist Charles Grimely, a veteran of forty-one ascents, developed a multi-passenger airship powered by two hand-cranked side-paddle wheels, with which they made a single flight during which they solved one problem after another to make a safe landing.[23] In 1893, Frau Katchen Paulus began demonstrating her Adler Rad (Eagle Bicycle), featuring pedal-powered side wheels, in front of admiring crowds at the Frankfort Zoo. She would become an airplane pilot in 1910 and was still demonstrating her Adler Rad as late as 1931.

Alberto Santos-Dumont, a Brazilian living in Paris, catapulted small airships into the headlines on 19 August, 1901, when he piloted his one-man Airship No. 6, powered by a small internal combustion engine, from his circus tent/hangar in Saint Cloud to the Eiffel Tower and back, to win the Deutsch de la Meurthe prize. Inspired by the achievement and the relatively simple design of the airship, American aerial showmen, beginning with Captain Thomas Scott Baldwin, began offering exhibition flights with their own copies of the Santos-Dumont original.

Thirteen year old Cromwell Dixon (9 July, 1892 – 2 October, 1911) was in the crowd when A. Roy Knabenshue flew an airship inspired by Santos-Dumont around the Ohio State House on 5 Sept., 1905. Following the death of her husband in California, Annie Dixon had brought her daughter and infant son home to her native Columbus, where she established a boarding house and took in sewing to make ends meet. Young Cromwell took an interest in mechanics at an early age, haunting local machine shops, motorizing his bicycle and building a mini-roller coaster in his backyard.

The sight of Knabenshue chugging along overhead inspired the youngster to come up with a new use for his bicycle. With the help of his mother, always a full participant in Cromwell's projects, he raised enough money to buy the silk for a small gas bag, "having the form of a huge lemon," as one newsman reported, and measuring 32 feet in length and 15 feet in diameter. A triangular frame dangled beneath the envelope. Young Mr. Dixon was positioned at the mid-point of the rail, seated on his bicycle frame, pedaling away to power the two-bladed propeller on the nose of the craft. A rudder at the rear was operated by two lines attached to his handlebars and an elevator behind the propeller gave him some small measure of control over his "Sky Cycle." He also designed and built the hydrogen generators that produced the lifting gas.[24] **[see Fig. 6]**

In June 1907, he persuaded his mother to let him make a trial flight from the Columbus Driving Park, a horse track on the near east side of town. Twelve volunteers manning tether lines ran across

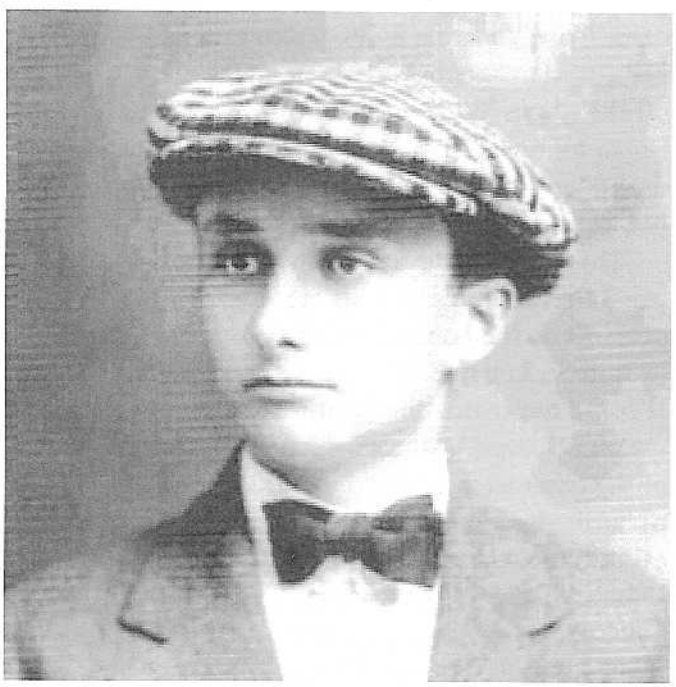

Fig. 6. Cromwell Dixon (1892-1911)

the ground as the boy aviator, dressed in a white shirt and knickers, pedaled his way around the track. The publicity savvy youngster alerted the city editors that he would be back in the air the following week. He made his first free flight that Sunday, climbing "...until he seemed almost a speck in the sky," a newsman remarked. "Then he soared like a great eagle, cut figure eights, and on a straightaway course made remarkable speed," landing safely five miles from the take-off point. "Just as long as I can pedal I can travel," Dixon explained to a reporter, "...and when I get tired I simply rest in the cool breezes. It's too easy. " He predicted that soon everyone would have an airship. "No dust, above the rain clouds – Oh, it's splendid!"[25]

After several additional flights, his first Sky Cycle was destroyed in a fire in the building where it was stored. Short of funds, young Cromwell travelled to Toledo to make a personal appeal to Roy Knabenshue for assistance. Roy was out of town, but Mable Knabenshue agreed to loan Dixon $1,300-worth of silk with the understanding that he would repay her when he could. Dixon and this mother quickly turned the material into an envelope and treated it with five coats of varnish, or sealant, inside and out.

Back in the air with his new craft in early August, he climbed to 2,500 feet and flew out of sight of the crowd gathered at the Driving Park. When the gas sleeve dangling from the bottom of the envelope came loose, allowing hydrogen to escape, Dixon left his seat, clambered along the frame until he could tie off the sleeve. With the loss of hydrogen, the airship began to lose altitude. The intrepid aeronaut began dropping non-essential items, including his coat and hat, before bringing the airship safely to earth.[26]

Dixon flew onto the national stage on 22 October, 1907, when he and his Sky Cycle put in an appearance at the James Gordon Bennett balloon races held in St. Louis. Dixon's pedal-powered Sky Cycle II could not match the breath-taking 10-15 mph speeds achieved by the single-cylinder power plants of the other airships, but he did turn in a creditable performance, completing several turns around the exhibition area before setting off for a flight over St. Louis. Unable to make headway against a rising wind, however, he was forced to land across the river in Bemis, Illinois. Photos of the now famous youngster and his scarcely less well-known mother were featured on newspapers across the nation. No longer satisfied with pedaling across the sky, Dixon joined the ranks of the powered airship pilots in 1909, and learned to fly an airplane the following year. He died in an airplane crash on 2 October, 1911. [27]

The death of Cromwell Dixon did not end the history of pedal-powered airships. In recent years several up-to-date versions have been developed. Moreover, pedal-powered heavier-than-air machines have demonstrated their ability to maneuver in the air and to fly the English Channel and considerable stretches of the Icarian Sea. **[see Fig. 7.]** But that is a topic for another paper. [28]

ENDNOTES

1 For a short history of the airship see, Tom D. Crouch, *Lighter-Than-Air: An Illustrated History of Balloons and Airships* (Baltimore: Johns Hopkins University Press, 2009).

2 Deleted ???????

3 Undated news article found in a microfilm copy of a C.F. Ritchel scrapbook in the collection of the NASM Archive, xxxx-0325. Hereafter cited as *Ritchel scrapbook.*

4 *The Fireside Almanac,* (1878), p.36. This and all other articles cited in this paper are to be found in a microfilm copy of a C.F. Ritchel scrapbook in the collection of the NASM Archive, xxxx-0325. Hereafter cited as *Ritchel scrapbook.*

5 "Gone," unidentified article in *Ritchel scrapbook.*

6 Undated news articles, *Ritchel scrapbook.*

7 Unidentified article, *Ritchel scrapbook.*

8 Fireside Almanac, p.35; "Voyages to Cloudland," *Frank Leslie's Popular Magazine*, July-December, 1883, Vol. XVI, p.377.

9 "Professor Ritchel's Flying Machine," *Louisville Courier Journal,* n.d., *Ritchel scrapbook*; assorted short articles, Ritchel scrapbook.

10 "A New Flying Machine," *New York Times*, 28 May, 1880, p.7; "Flying to the North Pole," *New York Daily Tribune*, 28 May, 1880.

11 Undated, unidentified article, *Ritchel scrapbook.*

12 "An Inventor's Dreams," *Columbian Weekly Register* (New Haven), 24 July, 1881.

13 Preston R. Bassett, "Carlotta, the Lady Aeronaut of the Mohawk Valley," *New York History,* April 1963, pp.145-172, is the best source of biographical information on Carl and Mary Myers. See also, Paul G. Preuss, *Tales From Aloft*, Zephyrus Press, Queensbury, New York, 2009.

14 *Watertown Daily Times* (New York) 4 July, 1882.

15 Frederick A. Talbot, "Cycling Through the Air," *Harmsworth Magazine* (Feb.-July 1901, Volume 6), pp.341-347.

16 Mary Myers, *Skylarking in Cloudland*, Mohawk, New York, 1883, pp.52-53.

17 Carl E. Myers, "Airship Experiments," *Scientific American, 21* Jan., 1899, vol. LXXX, no. 3, p.4.

18 Carl Myers quoted in, Talbot, *"Cycling Through the Air."* p. 343.

19 *"Cycling Through Air,"* p.345.

20 "The Airship wouldn't Ascend," *Ritchel scrapbook.*

21 "A Ship for the Skies," *Chicago Daily Tribune*, 23 Dec., 1888, p.2; "Plunged Into the Ocean," *New York Times,* 19 July, 1889; "Aeronaut Hogan's Fate," *New York Times,* 20 July, 1889, p.2;

22 *"Professor Barnard's Airship,"* Fredericksburg Star, 7 May, 1897, p.1; Myer, "Airship Experiments."

23 Crouch, *Eagle Aloft*, pp.501-504.

24 "A Fourteen- Year-Old -Boy Leads Aerial Navigators with a Bicycle Airship," *Washington Post*, 28 July, 1907, p.1; "A Successful "Sky Cycle," *Washington Post,* 11 Aug., 1907.

25 "Fourteen- --Year-Old Boy…", op. cit.

26 "Young Hero Wins in Bicycle Airship," *New York Times*, 11 Aug., 1907, p.SM5.

27 See for example," St. Louis Made Airship Center," *Los Angeles Times,* 27 Oct., 1907, p.12.

28 Robert J. Recks, *An Introduction to Muscle-Powered Blimps* (Chula Vista, California, Recks Publications, 1998) is light on history but offers a very strong introduction to the technology of pedal-powered airships.

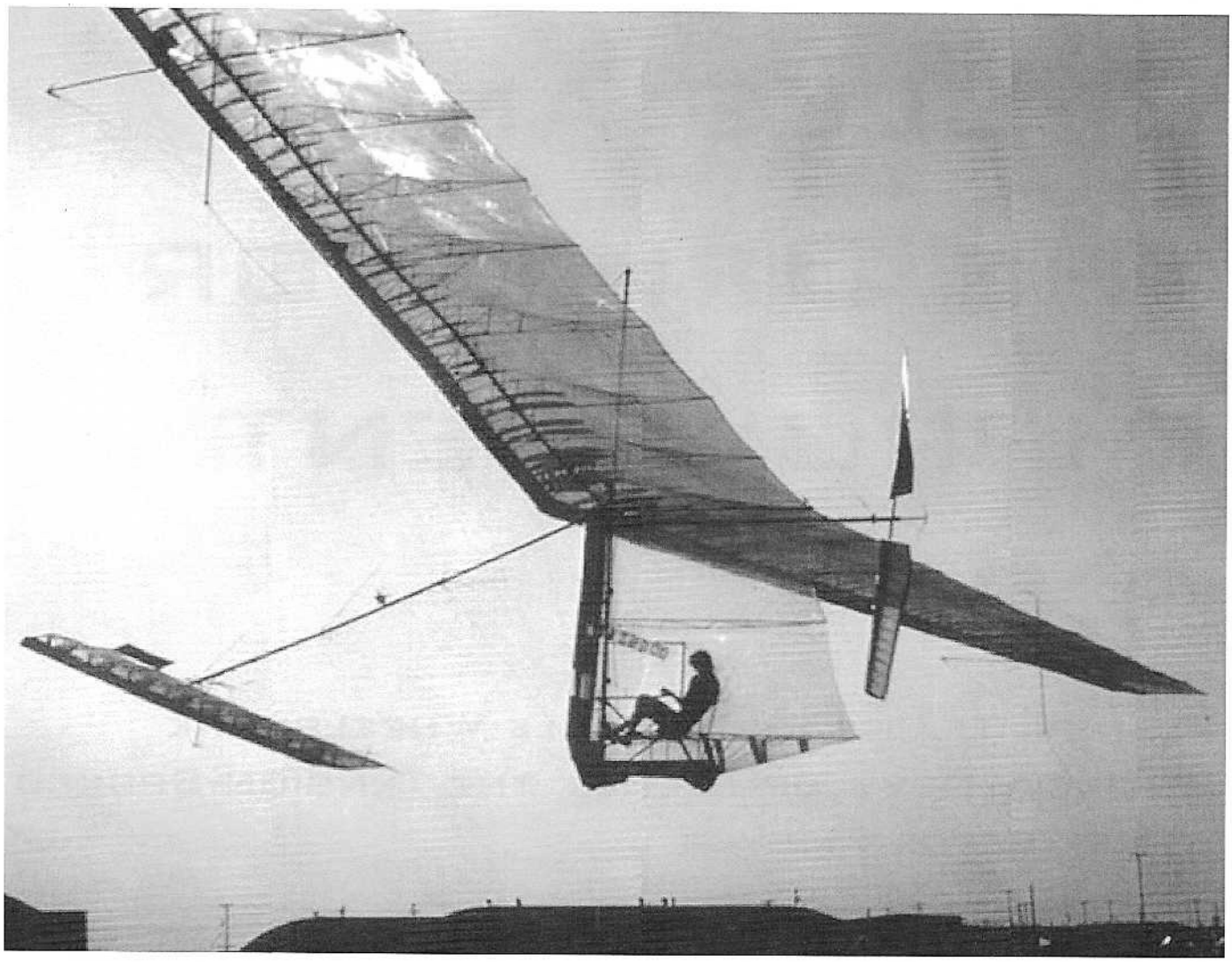

Fig. 7. Gossamer Condor was the first successful human-powered airplane. Designed and developed by Paul MacCready and Peter Lissaman of AeroVironment, Inc, it was piloted by competitive cyclist and hang-glider pilot Bryan Allen. Literally a flying bicycle, it won the £50,000 pound Kremer Prize as the first such craft to fly a figure-eight course measuring one mile, clearing a ten foot tall pole at each end. Now on display at the National Air and Space Museum, Gossamer Condor was the first in a line of aircraft powered by cycle technology that flew both the English Channel and the Icarian Sea and led the way to the development of solar-powered, energy-efficient flight systems.