AIAA JOURNAL
Vol. 35, No. 5, May 1997

Historical Review Paper

Octave Chanute and the Indiana Glider Trials of 1896

Tom D. Crouch*
National Air and Space Museum, Washington, D.C. 20560

During the critical years 1885–1903, Octave Chanute served as the focal point of an international community of flying machine experimenters. One of the leading civil engineers in the United States, he corresponded with virtually every major figure in the field, from aging and inactive pioneers like Francis Herbert Wenham to such promising newcomers as Wilbur and Orville Wright. He personally linked his correspondents into an informal network, providing them with information, encouragement, and, on occasion, financial assistance. Chanute organized sessions of aeronautical papers for the professional engineering societies to which he belonged, gave lectures that attracted fresh talent and new ideas into the field, and produced critically important publications that helped to establish a baseline of shared information. In addition, working with Augustus Moore Herring, Chanute designed and built one of the most significant aircraft of the pre-Wright era, the famous "two-surface" glider of 1896. On the occasion of the 100th anniversary of that machine, and of the Chanute glider trials in the Indiana Dunes, attention is focused on the role of Octave Chanute in shaping the community of engineers/experimenters who gave birth to the airplane.

Introduction

IT is not certain how Octave Chanute (1832–1910) learned of Otto Lilienthal's death. Short accounts of the glider accident suffered by "the flying man" on Aug. 9, 1896, began appearing in American newspapers during the week after the event. Chanute spent much of late August 1896 away from his Chicago home, however, living in the relative isolation of his glider camp pitched in the sand dunes ringing the southern shore of Lake Michigan. It is possible that he first heard of the tragedy through two letters that Wilhelm Kress[1] and Hermann Moedeboeck,[2] friends and correspondents, had mailed from Berlin on Aug. 13. (Unless otherwise indicated, all Chanute letters are included in Ref. 3. This 13-volume set of typed transcripts includes virtually all of Chanute's aeronautical correspondence. All letters are presented alphabetically by the name of the individual with whom Chanute was corresponding. A good index is provided at the front of the first volume. The preparation of the transcripts was apparently the work of A. F. Zahm, Chief, Division of Aeronautics, Library of Congress, after receipt of the Chanute papers. The National Air and Space Museum set was once held by the Institute of Aeronautical Sciences. The Library of Congress holds a second set. It is not clear how many other sets of this marvelous resource exist or where they are located.)

Kress had spent the week of July 18–26, 1896, in the Berlin suburb of Lichterfelde, where Lilienthal, "... a tall, slender, sympathetic personality," had invited him to witness his glider trials:

> We went direct to his experimenting hill, 15 meters high, situated in a field. After he had shown me the half dozen flying machines that were housed at the top of the hill, and he made his flying toilet, he began his interesting experiments, and flew down, with two different apparatus, five times. The weather was very favorable, and Lilienthal himself said he had never flown better; but I must confess that, from the photographs I had seen, I expected more, and that I felt somewhat disappointed. He landed, in the most favorable instances, 26 to 30 paces from the foot of the hill. The longest flight was at most 325 meters horizontally; most of them were shorter.[1]

"The flight and landing were steady and gentle," Kress reported to Chanute, "but the construction of the apparatus disturbed me in many ways...." He was especially troubled by the control system and the way in which the two wings of the biplane glider were trussed together. "I warned Lilienthal very carefully," Kress remarked, "and he promised me that he would soon put it in order." A week later he was dead.

Received Sept. 7, 1996; revision received Nov. 15, 1996; accepted for publication Nov. 17, 1996.

*Chairman, Department of Aeronautics.

The news of Lilienthal's death came as a shock to Chanute, who regarded the German pioneer as the world's leading aeronautical experimenter. He had carried on an extended correspondence with Lilienthal, attempted to represent his interests in America, celebrated his courage, publicized his achievements, and encouraged other enthusiasts to make use of the German's information and experience.

At the same time, Chanute, like Kress, was not completely surprised by Lilienthal's death. He knew that Lilienthal's system of hang glider control was positively dangerous. Moreover, the inherent weakness of the bat-like Lilienthal wings and shaky wing trussing system was perfectly clear to one of the nation's most distinguished bridge builders. The desire to correct both the structural and control deficiencies of the Lilienthal aircraft had been a critically important factor in Chanute's decision to build and test gliders of his own design.

Early Years

A native of France who, at the age of six, emigrated to the United States with his father, Octave Alexander Chanute (1832–1910) went to work in 1849 as a chainman on a Hudson River Railroad surveying crew (Fig. 1). Over the next four decades, he built a reputation as one of the most experienced and successful civil engineers working in America. He had supervised track-laying operations for railroads that opened the American West; constructed a variety of important structures, from the first bridge over the Missouri River to the Chicago and Kansas City Stockyards; been employed as chief engineer by the Erie Railroad; and served as president of leading engineering professional organizations.

His interest in flight began as a hobby and grew to become a consuming passion. During the critical years 1885–1903, he emerged as the creator and focal point of an international community of flying machine experimenters. Chanute corresponded with virtually every major figure in the field, from aging and inactive pioneers like Francis Herbert Wenham to such promising newcomers as Wilbur and Orville Wright.

He drew geographically isolated pioneers like the Australian Lawrence Hargreave, Louis Mouillard, a resident of Algeria and Egypt, and the Californian John Montgomery into an international dialog and communicated the latest bits of news from leaders in the field, such as Lilienthal and Langley. He played a key role in attracting Langley into the field in the first place. Through literally thousands of letters, he personally linked his correspondents into an informal, worldwide network, providing them with information, encouragement, and, on many occasions, financial assistance.

Chanute organized sessions of aeronautical papers for the professional engineering societies to which he belonged, attracted fresh talent and new ideas into the field through his lectures at universities, and produced critically important publications that helped to

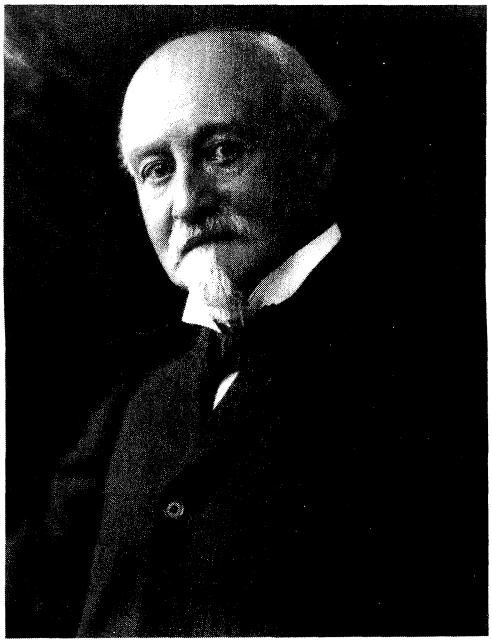

Fig. 1 Octave Chanute (1832–1910).

establish a baseline of shared information. The publication of his classic in 1894[4] was a milestone in the early history of aviation. (For bibliographical treatments of Octave A. Chanute, see Refs. 5–10. Other major collections of Chanute manuscripts and biographical materials are found in the John Crerar Library, Chicago, Illinois; Manuscript Division, Denver Public Library, Denver, Colorado; and American Heritage Research Center, University of Wyoming, Laramie.

Chanute's Early Interest in Gliders

Having accomplished all of that, Chanute decided to join the ranks of the active aeronautical experimenters. Working with a handful of young associates, Chanute produced variations on two classic glider designs during the decade 1894–1904.

Chanute was always perfectly clear about the reasons for his decision to begin active experimenting after having spent a decade as an armchair aviator. As he explained to his fellow members of the Western Society of Engineers: "The intention was mainly to study . . . the maintenance of equilibrium—which it was hoped to gain automatically":

> *This it was expected to do by reversing the method of* Lilienthal, who moved his bodily weight to bring back the *center of gravity under the center of pressure. It had occurred* to Mr. Chanute that it might be preferable . . . to shift the surfaces [of a glider] so as to bring back the varying center of pressure over a fixed center of gravity, and that in such a case the operator need not move at all, except for the purposes of steering.[11]

In addition to dealing with the problems of stability and control, Chanute was determined to provide such aircraft with a trustworthy structure that could be analyzed and guaranteed to withstand the expected forces of flight.

From the outset, Chanute recognized the difficulty of providing sufficient lifting surface in a relatively weak, externally braced monoplane wing. Like Wenham, Stringfellow, and other 19th-century pioneers, he favored a multiplane arrangement in which a large amount of wing area could be provided with shorter, superposed surfaces. Chanute's unique contribution was the use of existing bridge trussing systems to bind the stacked wings of a multiplane or biplane into the lightest, strongest possible structure.[12] (Chanute expressed his earliest notions of heavier-than-air technology in Refs. 4 and 13–15. For complete coverage, see Ref. 16.)

His very first aircraft design, tested in 1895 as a hand-launched model glider, featured four pairs of biplane wings set in tandem on either side of an enclosed fuselage. Pivoted at the center, the wing pairs were free to rock back and forth to provide a measure of automatic stability in gusty conditions. Each of the eight biplane wing sets were linked together with a Howe bridge truss.[46]

Chanute, who had financed the construction of gliders designed by impoverished experimenters like Louis Mouillard, began the practice of hiring promising young engineers or experimenters of his acquaintance to build and test the gliders that he had designed. This approach freed Chanute from what he regarded as the onerous work of actually building a machine and served as yet another means of offering financial encouragement to deserving and talented younger technicians. He chose a New York engineer, Augustus Moore Herring, to build the 1895 hand-launched tandem biplane model.

Herring was no newcomer to aeronautics. Born to a wealthy Georgia family in 1865, he studied mechanical engineering at the Stevens Institute of Technology but did not graduate. After a consulting firm that he had established in New York fell victim to the panic of 1893, he worked at a variety of jobs. Herring's real love, however, was aeronautics. During the early 1890s he constructed several unsuccessful gliders as well as one very interesting biplane model powered by rubber strands.

In the spring of 1894, the New Yorker began work on the first of three successful gliders based on original Lilienthal plans obtained from Germany. Herring's short flights with these machines caught the attention of the New York press, and, as a result, came to Octave Chanute's notice. (For biographical material on Herring, see Refs. 5 and 17.)

Chanute's original association with Herring was short-lived. The two men corresponded during the period when Herring was building and testing the small, hand-launched glider incorporating Chanute's earliest notions of automatic stability. By May 20, 1895, however Herring had left Chanute's employ for economically greener pastures as Samuel Pierpont Langley's chief aeronautical aide at the Smithsonian Institution. Langley, hard at work attempting to develop large steam-powered flying models, could offer a much higher government salary, and the disappointed Chanute willingly, but unhappily, released his new employee.

Herring, talented, opinionated, and independent, found it very difficult to function under the strict conditions that Langley maintained at the Smithsonian. The Secretary insisted that he be kept informed of the most minute details of the aerodrome model project and refused to allow Herring the free hand that he believed was required if the program was to progress. Langley, on the other hand found Herring's attitude difficult to accept and came to believe that the young engineer was contributing very little to the success of the aerodrome effort. In fact, a comparison of the Langley model before Herring's appearance on the scene and after his departure suggests that he was responsible for many of the major changes in configuration that led to the successful aerodrome flights of 189 (see Refs. 5 and 18).

Herring and Langley reached a parting of the ways in December 1895, but the New York engineer did not remain unemployed for long. Chanute cabled him immediately, asking him to come to Chicago to supervise a crew of workmen assembling a series of gliders that were to be test flown the following summer in the isolated sand dunes bordering the southern shore of Lake Michigan. Chanute asked that Herring bring with him the best of his Lilienthal copies so that it could be tested as a control against which the quality of new designs could be gauged. Herring accepted.

During Herring's stay in Washington, Chanute had abandoned the tandem wing multiplane design of the previous spring in favor of a very different type of multiplane consisting of a wooden framework with a large vertical tail at the rear. Twelve wings, each with a 6-ft span and a 3-ft chord, were to be mounted on either side of the frame in pairs. As originally built, the craft featured four wing pairs (a quadraplane arrangement) at the front of the craft and two pairs (a biplane arrangement) between the forward wings and the tail.[19]

The wings and vertical tail were covered with oiled nainsook silk. Spruce and willow were the principal woods used in the construction. The finished craft was about 15 ft long and 14 ft wide weighed about 34 lb, and sported 180 ft^2 of wing surface. One reporter described the craft as "in appearance like six pairs of birds superposed."[19]

As noted, the multiplane was designed to test a method of obtaining automatic stability. Initially, this was to be accomplished by attaching all of the wing roots of the forward wing sets on the right and left sides of the aircraft to a pair of tall upright poles that were free to rotate fore and aft. The forward wing sets on either side were trussed together so they operated as a unit. They were held in place, fore and aft, with spring-mounted guy wires. When either side was struck by a gust, the outboard end of the wings could fold, or sweep, slightly to the rear, pivoting on the single upright to which the roots were attached. The spring-mounted guy wires pulled them back into place after the gust passed.

Chanute hired William Avery, a Chicago carpenter, to build the multiplane to his specifications. Avery was assisted by William Paul Butusov, an emigrant Russian seaman who had come to Chanute the previous summer filled with tales of having made fabulous, but secret, gliding flights in the wooded hills around Mammoth Cave, Kentucky. Chanute also paid for construction of a glider, to be known as the "Albatross," designed by Butusov. James Ricketts, a Chicago physician whom Chanute described as having "a slack practice and a taste for aeronautics," served as camp cook and standby to offer medical assistance if required. A. M. Herring and Chanute's pet dogs, Rags and Tatters, rounded out the party. The finest accounts of the 1896 trials are found in Refs. 20–22. References 5 and 23 offer solid secondary accounts of the 1896 trials.

Indiana Dunes: June 22–July 4, 1896

By June 22, 1896, all work was complete on both Herring's Lilienthal craft and the Chanute multiplane. The little band of would-be aviators loaded their disassembled gliders, camping gear, and tools onto a lakeshore train for the short trip to the little railroad station at Miller, Indiana. About 30 miles southeast of Chicago, Miller lay on the edge of the sand dunes that ringed the southern shore of Lake Michigan. With high dunes for takeoffs, soft sand for landings, and strong, steady winds blowing off the lake, the area was ideal for gliding.

Although the dune country had the feel of a remote wilderness, from the top of a tall dune on a clear night the bright lights of Chicago could be seen twinkling across the tip of Lake Michigan. The site had the advantage of enabling the men to travel home for weekends or whenever their presence was required by families and businesses in Chicago. The disadvantage was the concentration of reporters hungry for a story. Newsmen, alerted by reports of the strange equipment being unloaded at the Miller station, arrived in camp on the first day. Chanute, who had hoped to conduct his tests without the assistance of the fourth estate, was disappointed.

Herring and Avery began to test the gliders before the tents were fully pitched. The Lilienthal glider was first in the air and proved awkward, dangerous, and difficult to control. "The operator," Chanute noted, "had to shift his position as actively as a tightrope dancer... in order to avoid being overturned." The best flight obtained with the craft covered 116 ft on June 29 (Fig. 2). Glides of 80–100 ft were more common.[24,25]

The structure of the Lilienthal machine was weak and was frequently broken in hard landings. Chanute attributed the fact that no one had been injured flying the craft to the deep camber of the wings, the tips and edges of which touched the ground first, giving the operator some measure of protection. By June 29, the crew were having trouble keeping the machine properly rigged and balanced. An attempt to remedy the situation by cutting away a portion of the fabric made the situation worse. The craft was abandoned that afternoon. Chanute's judgment was short and to the point "Glad to be rid of it" (see Ref. 25, p. 643).

Herring made the first flight with the Chanute multiplane on June 24. Over the next two weeks, the craft was tested as both a kite and a glider. It was held on the ground while tufts of lightweight material were released at the leading edge to observe the flow of air around the wing. More important, the 12 wings of the craft were almost constantly reconfigured, restacked, and rearranged in what Chanute remembered as an "interesting and instructive evolution."

The multiplane machine was test flown with a total of six different wing configurations between June 24 and July 4 (see Table 1, which is based on information provided in Ref. 25). Things became so confusing that all of the wing sets were numbered to keep track of their positions in the arrangement.

The final, and most successful, configuration featured five superposed wing pairs at the front and only one pair at the rear (Fig. 3).

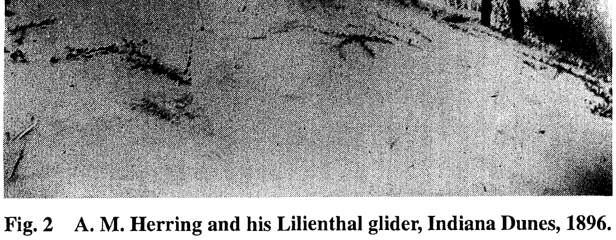

Fig. 2 A. M. Herring and his Lilienthal glider, Indiana Dunes, 1896.

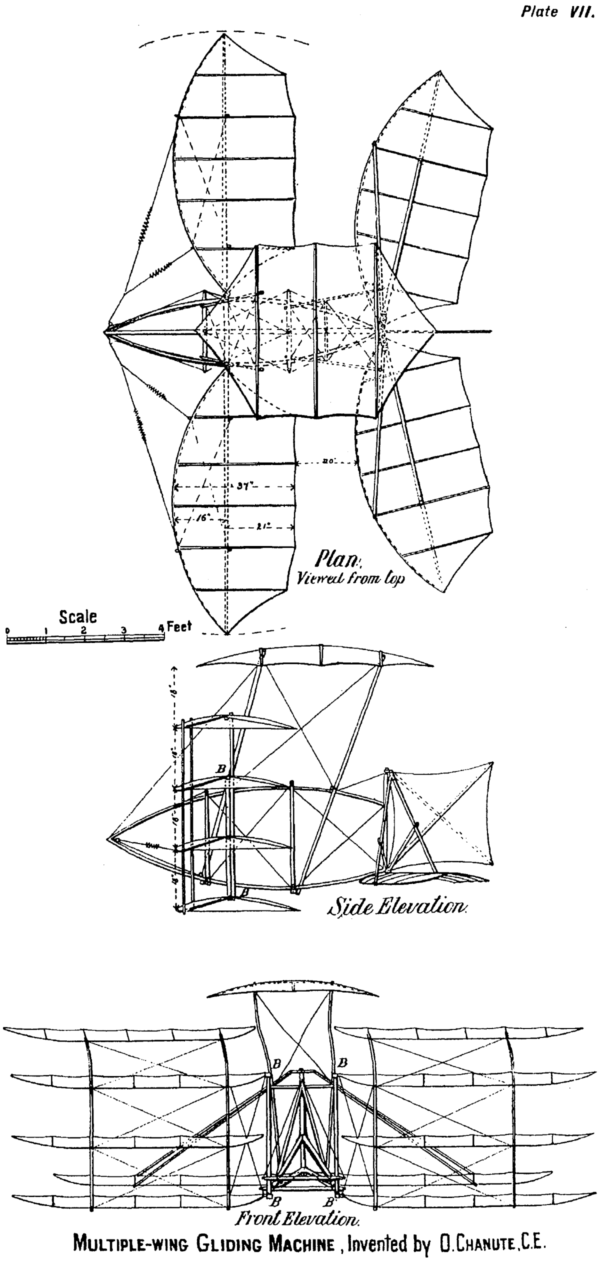

Fig. 3 Chanute multiplane in its final configuration.

Table 1 Chanute multiplane changes in wing configuration, June 23–July 4, 1896

Date	Configuration
June 23	12 wings: 8 in front, 4 in back
June 25	8 wings: 4 sets front
June 27	12 wings: 4 sets rear, 2 sets front
June 29	12 wings: 4 sets front, 2 rear
June 30	12 wings: 4 sets front, 2 rear; upper front wing raised 3 ft above wing beneath it
July 1	12 wings: 5 sets front, 1 set rear

First tested on July 1, this insect-like version, with its confusing stack of wings trapped in a web of crossed wires, was immediately dubbed the "Katydid." By July 4, Herring and Avery were routinely making flights of from 50 to 80 ft in very light winds. "Winged machine is more compact and handy than Lilienthal's," Chanute noted in his diary, and it promises to be safer and steadier" (Ref. 25, p. 644).

Chicago: July 4–Aug. 21, 1896

Somewhat disappointed by bad weather, the mixed performance of the gliders, and the plague of reporters that had descended on the camp in the dunes, Chanute decided that a break was in order. The members of the party quit flying at 2 p.m. on July 4, packed up their gear, and caught the 6:41 p.m. train for Chicago at the Miller station. They remained in the city for a month and a half, rebuilding the multiplane Katydid into its seventh and final configuration and finishing work on Butusov's glider, the Albatross. Far more important, however, they also designed and built the first version of the most successful and best-known of all pre-Wright gliders, the Chanute–Herring "two-surface machine," during the hiatus in Chicago.

During his spare time on the dunes, Herring flew a small monoplane kite with a flexible cruciform tail that very much impressed Chanute. As Chanute later recalled, he and Herring had discussed the possibility of building yet another glider loosely based on the kite and some other ideas that Herring had been toying with related to the use of a cruciform tail unit that was free to give in any direction when struck by a gust, thus, he hoped, maintaining the stability of the craft. Having witnessed the frailty of the Lilienthal glider for himself, Chanute was also interested in providing the new craft with a carefully designed structure that would provide maximum strength for minimum weight.

In view of the importance of this glider in the evolution of the flying machine, the credit for its design is a matter of some importance. Four years later, Chanute and Herring attempted to sort things out in a sharp exchange of letters. In publications describing the 1896 glider trials, Chanute was always scrupulously careful to give his young associate credit for the regulating tail, suggesting that he himself had been responsible for the rest of the design.

Herring disagreed, arguing that what would become known as the two-surface machine was inspired by a small asperating (soaring) kite that he had built and flown during the first period on the dunes. Moreover, he regarded the regulating tail of the glider as the key to its success, as he explained[26] in a 1901 letter to Chanute (also included in Ref. 3):

> I have never understood why you should appear to claim the whole credit for the invention of the two surface gliding machine, since its success depends wholly upon the efficiency of the regulating mechanism which was my work and furthermore I made the designs for the original two surface machine alone and at my home. I put them on paper as a scale drawing in the course of one afternoon in your study.

Chanute[27] had a very different view (also included in Ref. 3):

> While we were still in camp, I made and gave you [Herring], on cross section paper, a sketch of the two surfaced machine with a Penaud tail to serve in building the 1896 machine. This you assigned as the reason why I should join you in applying for a British patent, at the time that I disclaimed any share in the design of the propelling [stability] arrangements.

For the rest of his life, Herring continued to point to what he regarded as a striking resemblance between the 1896 glider and some model aircraft that he had flown in New York in 1892 and three years later in Washington, D.C. A. F. Zahm, a Catholic University professor who had witnessed flights of the model at the Smithsonian in 1895, agreed with Herring. He commented (quoted in Ref. 28) in 1908:

> It is sometimes said that the best French airplanes are copied from the Americans.... Farman's aeroplane resembles the Wright brothers'; their's resembles Chanute's glider of 1896, and this in turn resembles Herring's rubber driven model....

But Zahm ultimately proved to be a less than fully trustworthy witness. In truth, it does not seem difficult to apportion credit for the design between the two men. Herring was responsible for the use of the spring-mounted cruciform tail unit and for the detailed design work. Chanute provided financial support, suggested the original triplane form, and insisted on the Pratt truss bracing system and other structural elements that represent the most important features of the machine and were certainly responsible for its success. In short, the glider was a joint venture, with Herring deserving primary credit for the stabilizing tail and Chanute for the elegantly braced structure. For a discussion of the contributions of Chanute and Herring to the two-surface machine, see Refs. 29 and 30, both of which are included in Ref. 3; see also Refs. 5 and 31–33.

The new glider was finished in Avery's Chicago workshop and ready for shipment back to the dunes by mid-August 1896. As originally constructed, the craft that became famous as the Chanute–Herring two-surface machine was actually a triplane. Each wing had a span of 16 ft with a chord of 4 ft 3 in. The wings and tail surfaces were covered with varnished silk. The complete machine weighted about 31 lb.

Two support bars passed beneath the operator's arms, and a braced wooden pole supported the tail, which was of special interest. Both Cayley and the French experimenter Alphonse Penaud had observed that a properly positioned fixed cruciform tail would provide a useful degree of inherent stability in the pitch axis. In the case of the 1896 glider, such a tail was placed on a universal joint (actually a flexible wooden member), guyed by wires that ran forward to the wings, where they were attached through springs.

Indiana Dunes: Aug. 21–Sept. 26, 1896

The new triplane was simple and elegant, quite a contrast to the studied complexity of the rebuilt Chanute multiplane or Paul Butusov's enormous Albatross, which resembled a cross between a gigantic bird and a sailing schooner. All three machines were shipped back to the lakeshore aboard the steamer *Scorpion* on Aug. 21. This time the members of the party established their camp 5 miles farther down the beach, where, Chanute noted: "the hills were higher, the solitude greater, and the path more obscure to the railroad, which it reached at a sand-pit station consisting of a single house, and called Dune Park." The reporters, he hoped, would have to work a bit harder to locate this camp (see Ref. 21, p. 39).

Bedeviled by late-summer storms blowing off the lake and by the need to begin work on the launching apparatus for Butusov's Albatross, the crew did not get flight testing under way until Aug. 29, 1896. Early trial flights with the Chanute–Herring glider convinced the party that the triplane wings provided too much lift at the front of the structure. Avery suggested removal of the bottom wing to produce the final, classic, two-surface configuration. With this step accomplished, glides of over 150 ft became commonplace. Eventually flights of up to 359 ft, lasting as long as 14 s, were made[24] (Fig. 4)

The rebuilt multiplane was not flight tested until Sept. 5. Four of the original wings were mounted at the front with two wings behind, flanking the vertical tail. The entire craft was capped by a large, horizontal kite surface mounted over the top set of wings. Total wing area in front was 143.5 ft^2, as opposed to 29.5 ft^2 at the rear. The finished craft weighed 33.5 lb. One of the rear wing sets had been removed by the time the first substantial flights were made on Sept. 11.[20,21]

The forward wings were still free to fold toward the rear, pivoting on the tall rods to which the wing roots were attached. The rods themselves were mounted, top and bottom, in ball bearings that enabled the wings to swing more freely. Repeated testing demonstrated that

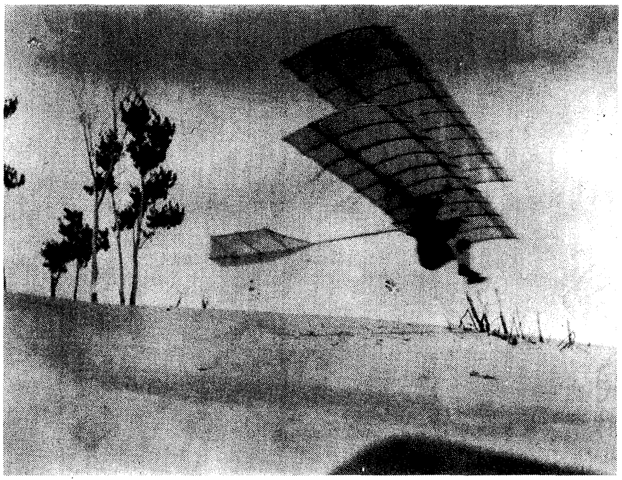

Fig. 4 Two-surface glider in the air.

the operator was still required to move his torso to exercise control, although not to the extent required by a Lilienthal glider.

Moreover, Chanute had taken an important step toward transforming the mechanism designed to provide automatic stability into something approaching an active control system. The pilot of the rebuilt multiplane now rested on a swinging board seat, which freed his arms to some extent. Also provided with stirrups and a brace for his legs, he could actively swing the wings fore and aft by means of light lines operating through pulleys. Chanute was pleased with the results (see Ref. 21, p. 45):

> It was found, as was expected, that by thrusting the wings forward the machine was tossed up, and *vice versa* that by thrusting one wing forward the machine turned towards the opposite side, and that these would be effective ways of directing the apparatus when under flight, either up or down or in a circling sweep.

Chanute's inability to profit from the lessons of flight testing is striking. To the end of his life, he remained convinced that the original triplane configuration of his most famous glider was superior to the two-surface version. Moreover, as intriguing as the experiment with active controls for the multiplane may have been, Chanute quickly abandoned them and returned to the pursuit of automatic stability.

The rebuilt multiplane was flown repeatedly but was never able to cover distances as great as those attained by the two-surface glider at its best: the performance of the multiplane on Sept. 11, when Herring and Avery covered distances between 148 and 183 ft in a 22.3-mile wind.[26]

The multiplane was also beginning to show its age. As a result of repeated episodes of rebuilding, rearranging, and shifting, the wings were warped and deformed. By Sept. 23, Chanute had decided to cease flying the machine before someone was injured.

W. P. Butusov's Albatross, so named because of its resemblance to an earlier glider of that name designed, built, and flown in France by Jean Marie LeBris (1868), had a 40-ft wingspan and an empty weight of 190 lb. Unlike the Lilienthal, the multiplane, and the two-surface machine, Butusov's elephantine craft obviously could not be launched by running down a boardwalk laid in the sand and leaping into the air. The glider would gather momentum (and, hopefully, flying speed) by running down a large inclined trestle (Fig. 5).

Initially rigged and tested as a giant kite, the Albatross was launched into the air from the trestle on Sept. 17 and was flown with four lines from the ground. After some additional testing and repairs to damage suffered in a storm, the giant craft was first sent down the trestle, unmanned and weighted with ballast, on Sept. 26. Demonstrating unsatisfactory gliding characteristics and suffering additional damage in landing, the Albatross was abandoned.[25]

Although the rebuilt multiplane and the Albatross proved less than fully satisfactory, the little group of pioneer birdmen was overjoyed with the performance of the biplane, which surpassed that of every other glider flown in the world to date. Moreover, Chanute was confident that the little craft was relatively safe.

Table 2 Flights of Sept. 11, 1896

Pilot	Distance, ft	time, s	Angle, %	Fall, ft
Herring	148	7		
Avery	174	7.6		
Herring	166	7.5		
Avery	188	7.9		
Herring	172	7.8		
Avery	199	8	10	34.6
Herring	234	8.7	7.5	30.4
Herring	220	9		
Herring	235	10.3		
Avery	256	10.2	8	35.5
Herring	359	14	10	62.1

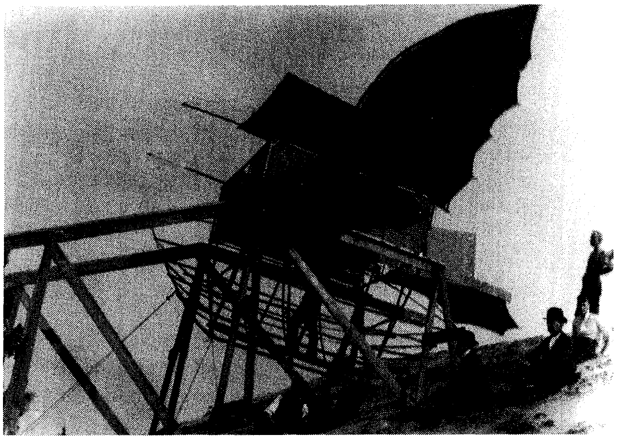

Fig. 5 W. P. Butusov's Albatross on the launch ramp.

Chanute[25] kept a better and more complete record of the performance of his multiplane and biplane gliders on Sept. 11, 1896, than for any other day of the dune trials. He recorded five flights with the multiplane that morning in a wind averaging 22.3 mph. Chanute recorded even more information on six flights of the biplane made in a 31-mph wind that afternoon (see Table 2).

Flights continued into late September. Chicago newsmen, who located this camp as easily as they had the first, spread word of the activities of the Chanute party across the nation. Chanute, long famous among the small circle of international aeronautical enthusiasts, was now elevated to the position of a public celebrity. It was a role in which he was by no means comfortable.

In spite of the success of the biplane, Chanute remained unconvinced that the little craft could serve as a stepping stone to the airplane. Too many problems, he believed, remained to be solved. He would not sponsor the construction of a copy of the two-surface machine for another 8 years, preferring to spend his time offering encouragement to a new generation of talented young researchers, notably, Wilbur and Orville Wright.

Afterward

Herring, however, could scarcely be restrained. He was convinced that the little biplane was a sort of "proto-airplane." All that was required, he reasoned, was to do some fine tuning of the design, add an engine and propellers, and proceed to unveil the machine to a wondering world. Herring, recognizing that Chanute did not agree with his desire to rush ahead toward the construction of a powered version of the biplane, left the camp before the end of the experiments.

"Mr. Herring did not prove satisfactory," Chanute explained in a letter to his friend James Means, editor of the *Aeronautical Annual* (Ref. 34; see also Ref. 3):

> He left me ... giving as his reason that he did not want to countenance by his presence the pending test of a third machine, designed by Wm. Paul [Butusov].... I think the real reason is that he knew I would never consent to apply a motor to a full sized machine, believing this to be entirely premature, while he was at the time so elated by our joint success and the unwelcome (to me) advent of the newspaper

reporters, that he thought success within his grasp. He told me that he intended at once to build a full sized machine with a gasoline motor of his invention, with the assistance of a syndicate of newspapers or from the proceeds of public exhibition. I understood that he had applied to Barnum and Bailey's circus, but had been unable to make an arrangement.

His failure to interest the circus notwithstanding, Herring constructed a new version of the original triplane on his own and returned to Dune Park in October 1896, a month after Chanute, Avery, Butusov, and Ricketts had abandoned the site. Herring's October triplane featured a compressed air automatic control system operating on the otherwise standard cruciform tail. In addition, the two pilot support bars, which had extended straight down from the center section of the original machine, were angled slightly in to give the operator a bit more leverage on his craft. These angled support bars remained a standard feature of future Herring biplane gliders.

In his own reports of his solitary trials in the dunes in the late fall of 1896, offered in James Means' *Aeronautical Annual* and in court testimony given many years later, Herring spoke of flights of more than 900 ft, with quartering turns in the air permitting Herring to angle across the slope of the dunes. In view of Herring's later experience, however, it scarcely seems reasonable to credit these claims. For accounts of A. M. Herring's later experiments, see Refs. 35–37. Additional information is to be found in Chanute's correspondence with Herring, James Means, and others in Ref. 3. The Cornell University Library also holds a small but important collection of A. M. Herring papers.

Satisfied with the performance and sure that Chanute would refuse to assist him in adding power to the glider, Herring set out in search of a new patron. He found him in Matthias Arnot, an Elmira, New York, banker who was captivated by the possibility of flight and anxious to offer financial assistance to a talented experimenter. Arnot underwrote construction of a third Herring–Chanute glider, this one to be flown by Herring in the Indiana Dunes during the summer of 1897.

The 1896 Chanute–Herring and the 1897 Herring–Arnot glider bear such a strong resemblance to one another that Chanute used photos of the two machines interchangeably, always to Herring's chagrin. There are differences that permit us to distinguish the two, however. As noted earlier, the 1896 craft featured pilot support bars built perpendicular to the lower wing, whereas the 1897 glider featured support bars angled slightly in for better leverage. In addition, the wings of the 1896 glider continued a few inches beyond the outer struts. In the case of the 1897 glider, the outer wing struts were positioned precisely at the wing tips.

For the most part, the 1897 machine was constructed of black spruce. The wings and tail surfaces were covered only on the upper side. The tail unit was not fitted with the compressed air device tested on the October 1896 triplane.

Herring and Arnot did not pitch their 1897 camp on the dunes until September. Progress was rapid, however, and within a few days flights of up to 600 ft were being reported. Unlike Chanute, the previous season, Herring relished publicity and made certain that reporters not only knew where to find the camp but were specifically invited to attend the trials and, on occasion, were even allowed to fly the glider. Fortunately, one of these neophyte airmen described his brief foray into the sky[38]:

The machine weighs only twenty-three pounds, but it is as big as the bay window of a cottage.... Once underneath the machine one finds himself standing on a wide plank which rests on . . . a sand hill. The hill is about 100 feet high and steep enough.... You face the wind as squarely as possible and shift the machine to and fro until you feel that it is balanced fairly on your arms. You are suddenly aware that the broad expanse of varnished silk above your head is . . . trying to get away from you with each gust of the freshening wind. At the same time you remember the caution to keep the front edge of your machine depressed until the moment of your departure from earth.... Just at this time . . . one . . . sees a stump sticking out of the sand at the bottom . . . [and] wonders whether he will hit it or miss it in his downward flight. He sees a small tree and shudders at the thought of landing on its top. One of his friends . . . down the hill . . . is cautioned to move half a mile to one side. In the meantime a sickening fear comes over one that he may lose his balance and plow a long and deep furrow in the sand with his nose. . . .one takes four or five running steps down the plank, expecting to drop like a stone to the sand. To his surprise and pleasure, he experiences about the same sensation as a man making his first ascension in an elevator. There is a queer feeling of being lifted from underneath. . . . The wind rushes in the face of the operator like a hurricane and hums through the network of fine wires that forms part of the framework with a shrill note. All these things are noted in a moment of dread, for the earth is rising as if to strike one.

The 1897 season was a striking success and Herring was more than ready to forge ahead to the construction of a powered version of the biplane. Now residing in St. Joseph, Michigan, he convinced Arnot to fund the project. By October 1898, he had completed work on a new airframe and a small compressed air engine. On two occasions, Oct. 10 and 22, 1898, Herring was able to hop his machine off the ground for distances of up to 73 ft.[31,39–42]

Like so many other hang glider enthusiasts, he had assumed that once a stable, trustworthy glider was constructed, the step to powered flying would be relatively simple. He now discovered that this was not the case. His 1898 machine fell far short of what he had hoped, and there seemed to be no way of adding more power without further burdening a craft that was already overweight. The 1898 machine was destroyed in a fire that winter. Arnot's death soon thereafter left Herring without a patron to support a continued effort.

But the story of the 1896 Chanute gliders was far from complete. In 1902, Chanute shipped what remained of the 1896 multiplane to Herring and paid his old friend to rebuild the craft in its final configuration. Herring produced new wings and empennage, and traveled to Kitty Hawk, North Carolina, to test the Chanute machine at the glider camp established by Wilbur and Orville Wright. The multiplane did not perform well, and Herring was stunned by what these two relative newcomers had accomplished in a few short years.

Herring became determined to re-enter the field of aviation in competition with the Wright brothers. In point of fact, he was clearly not in the same league. The story of his 1908 bid to construct an aircraft for the U.S. Army is well known, as is his involvement with Glenn Curtiss, Starling Burgess, J. V. Martin, and other early aircraft builders. He died in 1926 a bitter man, convinced that he had never received the credit he felt he deserved for his role in the invention of the airplane. Reference 5 offers a solid secondary account of Herring's later years (see also Ref. 43).

The two-surface machine enjoyed a much longer career and had a much greater impact than the multiplane. Chanute patented a version of the biplane fitted with a swinging seat of the sort first tested on the multiplane glider in 1896. In 1904, he commissioned William Avery to build and fly one last model of the craft at the St. Louis Exposition. Once again, the new craft differed slightly from its predecessors. The airfoil of the other Chanute–Herring craft had been a simple arc, but aeronautical science had come a long way since 1896. The 1904 variant was the first to feature a parabolic wing with the high point of the arch set well forward of the center chord position it had occupied in the earlier versions. Avery made a number of flights in the new glider, towed into the air by a winch. The exhibition was finally canceled when Avery suffered a fall and injured his ankle. The 1904 glider was purchased on the spot and shipped to France, where it resides today in the collection of the Musée de l'Air.

The impact of the Chanute–Herring design on other aircraft builders is apparent. In the United States, the Wrights and virtually everyone else used the braced biplane structure as their starting point. The little biplane glider clearly influenced thinking in Europe as well. Chanute's lectures to the Aero Club de France in 1903 reignited French interest in heavier-than-air flight. Copies of Chanute–Herring gliders were among the first aircraft flown by Ferdinand Ferber, Gabriel Voisin, and other French pioneers.

Nor did the influence of the Chanute glider end with the invention of the airplane. *Popular Mechanics* and *Flight* magazines recommended variants of the Chanute–Herring craft to readers interested in a safe glider for training purposes. The Long Island-based Wittman company, and others, produced Chanute–Herring variants as flight trainers. In the United States, would-be aviators like Paul Edward Garber were still leaving the ground for the first time slung beneath the sturdy wings of a Chanute-type glider as late as 1915.

In building and flying their first classic biplane glider, Chanute and Herring prepared the way for the experimenters who made the first powered flights. Their notion of automatic stability proved to be a blind alley. The commitment of the Wright brothers to active pilot control of an essentially unstable aircraft was a critically important step toward realization of powered flight. Even Wilbur Wright,[44] however, recognized that Chanute's mechanisms for obtaining automatic stability represented a "great advance" over the hang glider control of Lilienthal, Pilcher, and others (reprinted in Ref. 25, pp. 99–118).

Wilbur Wright was quick to add, however, that Chanute's contributions to aircraft structures were far more important. "The double-deck machine," he noted, "represented a very great structural advance, as it was the first in which the principles of the modern truss bridge were fully applied to flying machine construction." Chanute's rigid, lightweight structure became the model for all externally braced biplanes. It was nothing less than the first modern aircraft structure.

As Wilbur Wright[45] remarked in a 1910 eulogy of his old friend, Chanute's "... labors had vast influence in bringing about the era of human flight" (reprinted in Ref. 25, p. 1015):

> His "double-deck" modification ... will influence flying machine design so long as flying machines are made. His writings were so lucid as to provide an intelligent understanding of the nature of the problems of flight to a vast number of persons who would probably never have given the matter study otherwise, and not only by published articles, but by personal correspondence and visitation, he inspired and encouraged to the limits of his ability all who were devoted to the work. His private correspondence with experimenters in all parts of the world was of great volume. No one was too humble to receive a share of his time. In patience and goodness of heart he has rarely been surpassed. Few men were more universally respected and loved.

References

[1]Wilhelm Kress to Octave Chanute, Aug. 13, 1896 (letter), Chanute Papers, Manuscript Div., Library of Congress, Washington, DC.

[2]Hermann Moedeboeck to Octave Chanute, Aug. 13, 1896 (letter), Chanute Papers, Manuscript Div., Library of Congress, Washington, DC.

[3]Chanute, O., The Correspondence of Octave Chanute, 1888–1910, Ramsey Room, National Air and Space Museum, Washington, DC.

[4]Chanute, O., "Progress in Flying Machines," *American Engineer and Railroad Journal*, 1894.

[5]Crouch, T. D., *A Dream of Wings: Americans and the Airplane, 1875–1905*, Norton, New York, 1981, pp. 21–26.

[6]Crouch, T. D., "Early Presidents of the Society: XI. Octave Chanute, 1832–1910, President of the Society, 1891," *Civil Engineering*, Vol. 7, No. 12, 1937, pp. 871–873.

[7]Williamson, W. H., *Octave Chanute: Aviation Pioneer*, Public Affairs, Chanute Field, Rantoul, IL, 1940.

[8]Crouch, T. D., "The Life and Work of Octave Chanute," *Aeronautics*, Jan. 1911, p. 2.

[9]Boyd, A. C., "Some Memories of My Father," Unpublished Manuscript, various copies in the Chanute biographical files, National Air and Space Museum, Washington, DC.

[10]Boyd, A. C., "Biographical Materials," Box 18, Chanute Collection, Library of Congress, Washington, DC.

[11]Chanute, O., "Gliding Experiments," *Journal of the Western Society of Engineers*, Nov. 1897, p. 600.

[12]Chanute, O., "The Origins of the Two-Surface Machine," *Aeronautics*, Vol. 3, Oct. 1908, pp. 9–10.

[13]Chanute, O., *Aerial Navigation: A Lecture Delivered to the Students of Sibley College*, New York, 1891.

[14]Chanute, O., "Aerial Navigation," *Transportation,*, Vol. 1, Oct. 1893, pp. 24–25.

[15]Chanute, O., "Aerial Navigation: Balloons and Flying Machines from an Engineering Point of View," *Cassier's Magazine*, Vol. 20, June, 1901, pp. 111–128.

[16]Young, P. I., *The Complete Writings of Octave Chanute (1832–1910): Consisting of Books, Periodicals, Newspapers, Patents, Letters and Notebooks*, Lancaster, PA, 1961.

[17]Martin, J. V., "The Aircraft Conspiracy," *The Libertarian*, March, 1924, pp. 120–127.

[18]Martin, J. V., Herring manuscript volumes, Langley Wastebooks, Ramsey Room, National Air and Space Museum, Washington, DC.

[19]Martin, J. V., "Men Fly in Midair," *Chicago Tribune*, June 24, 1896.

[20]Chanute, O., "Gliding Experiments," *Aeronautical Annual 1897*, 1897, p. 600.

[21]Chanute, O., "Recent Experiments in Gliding Flight," *Aeronautical Annual 1897*, 1897, pp. 30–53.

[22]Chanute, O., "Experiments in Flying," *McClure's Magazine*, Vol. 15, June 1900, pp. 127–133.

[23]Scamehorn, H. L., *Balloons to Jets: A Century of Aeronautics in Illinois*, Regenry, Chicago, 1957.

[24]Chanute, O.,1896 Notebook, Box 9, Chanute Papers, Manuscript Div., Library of Congress, Washington, DC.

[25]Chanute, O., "Appendix IV: Chanute Documents," *The Papers of Wilbur and Orville Wright*, edited by M. W. McFarland, Vol. 1, McGraw–Hill, New York, 1953, pp. 641–654.

[26]Augustus Moore Herring to Octave Chanute, March 17, 1901 (letter), Box 1, Chanute Papers, Library of Congress, Washington, DC.

[27]Octave Chanute to Augustus Moore Herring, March 24, 1901 (letter), Box 25, Book 37, Chanute Papers, Library of Congress, Washington, DC, p. 361.

[28]Crouch, T. D., "The Origins of a Classic: Octave Chanute, Augustus M. Herring and Their Two-Surface Glider of 1896–1897," *Bungee Chord*, Vol. 7, No. 1, 1981, pp. 7–10.

[29]Augustus Moore Herring to Octave Chanute, March 17, 1901 (letter), Box 1, Chanute Papers, Library of Congress, Washington, DC.

[30]Octave Chanute to Augustus Moore Herring, March 24, 1901 (letter), Box 25, Book 17, Chanute Papers, Library of Congress, Washington, DC, p. 361.

[31]Martin. J. V., "When Will Merit Count in Aviation: The Life Story of Augustus M. Herring, Inventor of the Airplane," *The Libertarian* (Greenville, SC), Oct. 1924, pp. 589–608.

[32]Dientsbach, C., "The Invention of the Chanute Glider," *American Aeronaut*, June 1908, p. 165.

[33]Chanute, O., "Evolution of the Two-Surface Flying Machine," *Aeronautics*, 3, Oct. 1908, pp. 9, 10.

[34]Octave Chanute to J. Means, Nov. 14, 1896 (letter), Box 24, Book 33, Chanute Papers, Library of Congress, Washington, DC, p. 464

[35]Herring, A. M., "Recent Experiments Toward a Solution of the Problem of the Century," *Aeronautical Annual 1897*, 1897, pp. 68–74.

[36]Herring, A. M., "Early Herring Correspondence," *American Aeronaut*, Vol. 1, Feb. 1908, pp. 154–157.

[37]Herring, A. M., "Herring's Airship Actually Flew," *American Aeronaut*, April 1908, p. 632.

[38]*Chicago Times–Herald*, Sept. 8, 1897.

[39]*Niles [Mich.] Mirror*, Oct. 28, 1898.

[40]*Elmira [NY] Advertiser*, Nov. 18, 1898.

[41]*Horseless Age*, May 1897, p. 7.

[42]*Chicago Evening News*, Nov. 17, 1898.

[43]Crouch, T. D., *The Bishop's Boys: A Life of Wilbur and Orville Wright*, Norton, New York, 1989.

[44]Wright, W., *Some Aeronautical Experiments*, Western Society of Engineers, Chicago, 1901.

[45]Wright, W., *Aeronautics*, Jan. 1911, p. 4.

[46]Octave Chanute to Augustus Moore Herring, Dec. 31, 1894 (letter), Box 23, Book 32, Papers of Octave Chanute, Manuscript Div., Library of Congress, Washington, DC, p. 436.

G. S. Sutton
Editor-in-Chief Emeritus