

THE FIRST MAN-CARRYING AEROPLANE CAPABLE
OF SUSTAINED FREE FLIGHT: LANGLEY'S
SUCCESS AS A PIONEER IN AVIATION

BY

A. F. ZAHM, Ph. D.

FROM THE SMITHSONIAN REPORT FOR 1914, PAGES 217-222
(WITH 8 PLATES)



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THE FIRST MAN-CARRYING AEROPLANE CAPABLE OF SUSTAINED FREE FLIGHT—LANGLEY'S SUCCESS AS A PIONEER IN AVIATION.

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It is doubtful whether any person of the present generation will be able to appraise correctly the contributions thus far made to the development of the practical flying machine. The aeroplane as it stands to-day is the creation not of any one man, but rather of three generations of men. It was the invention of the nineteenth century; it will be the fruition, if not the perfection, of the twentieth century. During the long decades succeeding the time of Sir George Cayley, builder of aerial gliders and sagacious exponent of the laws of flight, continuous progress has been made in every department of theoretical and practical aviation—progress in accumulating the data of aeromechanics, in discovering the principles of this science, in improving the instruments of aerotechnic research, in devising the organs and perfecting the structural details of the present-day dynamic flying machine. From time to time numerous aerial craftsmen have flourished in the world's eye, only to pass presently into comparative obscurity, while others too neglected or too poorly appreciated in their own day subsequently have risen to high estimation and permanent honor in the minds of men.

Something of this latter fortune was fated to the late Secretary of the Smithsonian Institution. For a decade and a half Dr. Langley had toiled unremittingly to build up the basic science of mechanical flight, and finally to apply it to practical use. He had made numerous model aeroplanes propelled by various agencies—by India rubber, by steam, by gasoline—all operative and inherently stable. Then with great confidence he had constructed for the War Department a man flier which was the duplicate, on a fourfold scale, of his successful gasoline model. But on that luckless day in December, 1903, when he expected to inaugurate the era of substantial aviation, an untoward accident to his launching gear badly crippled his carefully and adequately designed machine. The aeroplane was repaired, but not again tested until the spring of 1914—seven years after Langley's death.

Such an accident, occurring now, would be regarded as a passing mishap; but at that time it seemed to most people to demonstrate the futility of all aviation experiments. The press overwhelmed the inventor with ridicule; the great scientist himself referred to the accident as having frustrated the best work of his life. Although he felt confident of the final success of his experiments, further financial support was not granted and he was forced to suspend operations. Scarcely could he anticipate that a decade later, in a far away little hamlet, workmen who had never known him would with keenest enthusiasm rehabilitate that same tandem monoplane, and launch it again and again in successful flight, and that afterwards in the National Capital it should be assigned the place of honor among the pioneer vehicles of the air.

When in March, 1914, Mr. Glenn H. Curtiss was invited to send a flying boat to Washington to participate in celebrating "Langley Day,"¹ he replied, "I would like to put the Langley aeroplane itself in the air." Learning of this remark Secretary Walcott, of the Smithsonian Institution, soon authorized Mr. Curtiss to recanvas the original Langley aeroplane and launch it either under its own propulsive power or with a more recent engine and propeller. Early in April, therefore, the machine was taken from the Langley Laboratory and shipped in a box car to the Curtiss Aviation Field, beside Lake Keuka, Hammondsport, N. Y. In the following month it was ready for its first trial since the unfortunate accident of 1903.

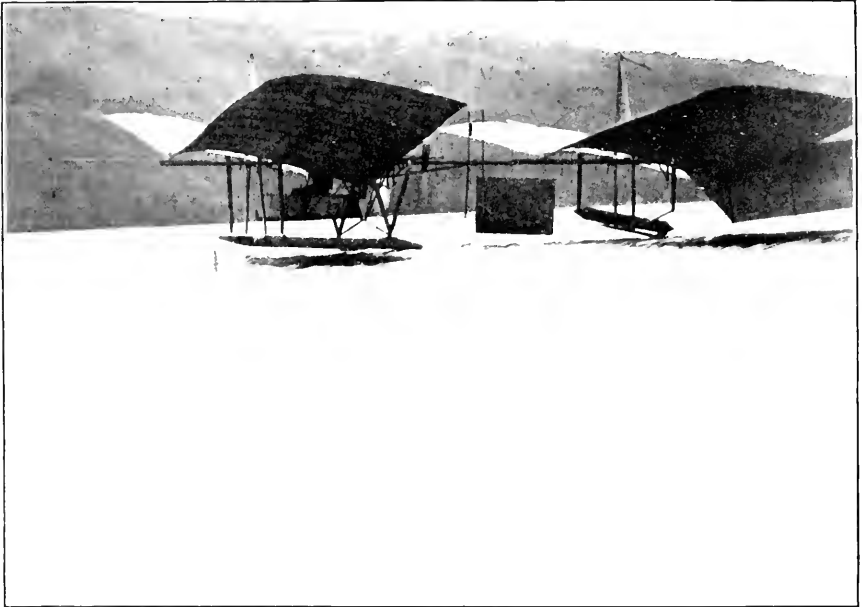
The main objects of these renewed trials were, first, to show whether the original Langley machine was capable of sustained free flight with a pilot, and, secondly, to determine more fully the advantages of the tandem type of aeroplane. The work seemed a proper part of the general program of experiments planned for the recently reopened Langley Aerodynamical Laboratory. It was, indeed, for just such experimentation that the aeroplane had been given to the Smithsonian Institution by the War Department, at whose expense it had been developed and brought to completion prior to 1903. After some successful flights at Hammondsport the famous craft could, at the discretion of the Smithsonian Institution, either be preserved for exhibition or used for further scientific study. To achieve the two main objects above mentioned, the aeroplane would first be flown as nearly as possible in its original condition, then with such modifications as might seem desirable for technical or other reasons.

Various ways of launching were considered. In 1903 the Langley aeroplane was launched from the top of a houseboat. A car supporting it and drawn by lengthy spiral springs ran swiftly along a track, then suddenly dropped away, leaving the craft afloat in midair with

¹ May 6, the anniversary of the famous flight of Langley's steam model aeroplane in 1896, is known in Washington as "Langley Day," and has been celebrated with aerial maneuvers over land and water.



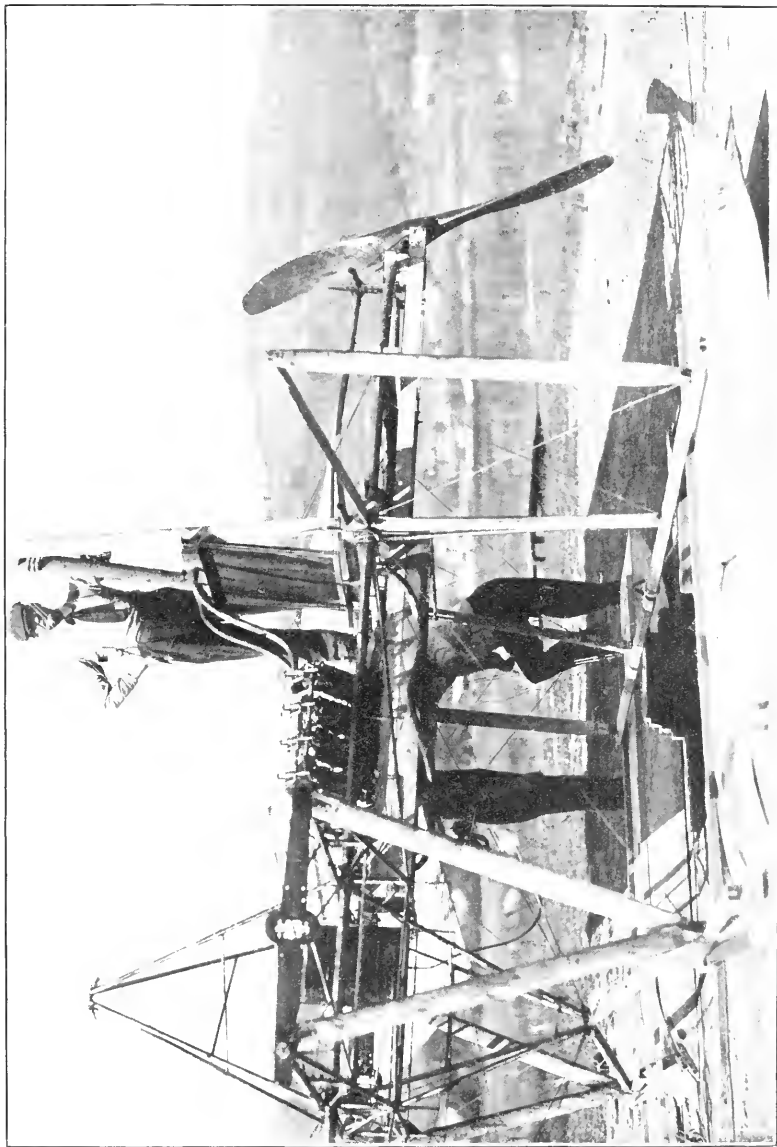
LANGLEY AEROPLANE (BUILT 1898-1903) READY FOR LAUNCHING AT HAMMONDSPORT, N. Y., MAY 28, 1914.



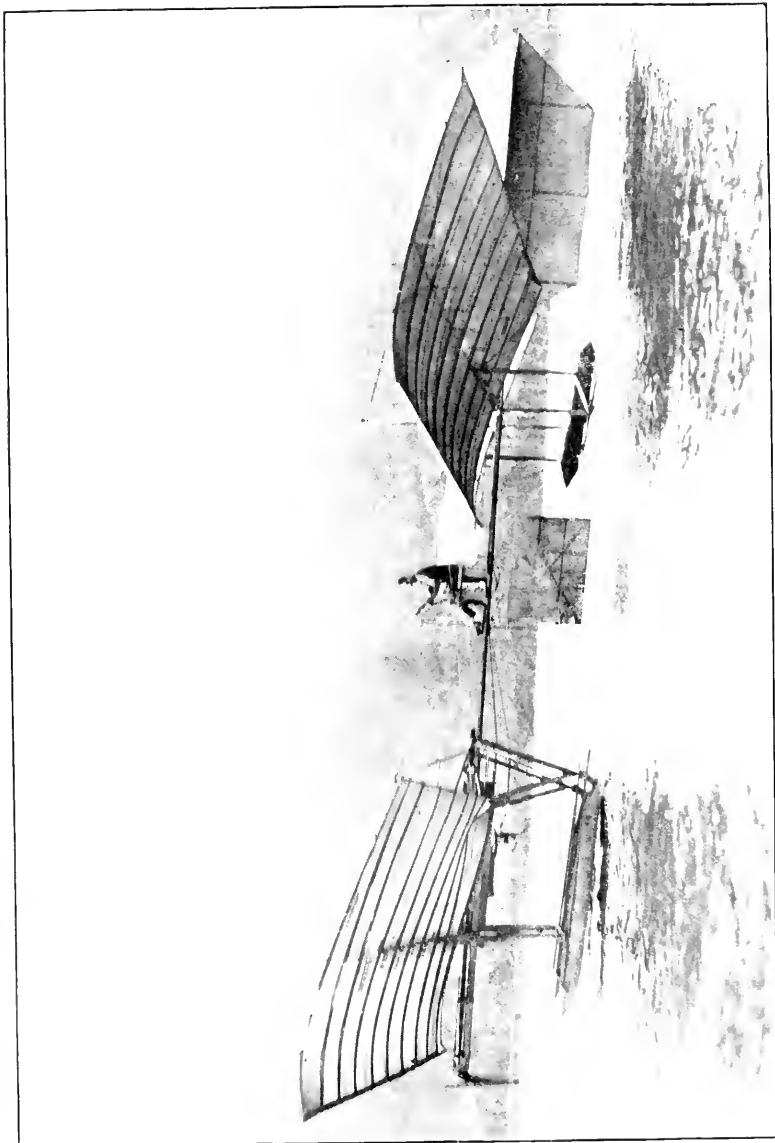
LANGLEY AEROPLANE JUST RISING FROM WATER, JUNE 2, 1914, PILOTED BY CURTISS.



FLIGHT OF LANGLEY AEROPLANE WITH ITS OWN POWER PLANT OVER LAKE KEUKA,
JUNE 2, 1914, PILOTED BY CURTISS.



CURTISS 80-HORSEPOWER MOTOR AND TRACTOR SCREW MOUNTED ON LANGLEY AEROPLANE.



ELWOOD DOHERTY CLEARING THE WATER SEPTEMBER 17, 1914, IN THE LANGLEY AEROPLANE DRIVEN BY A CURTISS 80-HORSEPOWER MOTOR AND A TRACTOR SCREW.

its propellers whirling and its pilot supplementing, with manual control, if need be, the automatic stability of the machine. This method of launching, as shown by subsequent experimentalists, is a practical one and was favorably entertained by Mr. Curtiss. He also thought of starting from the ground with wheels, from the ice with skates, from the water with floats. Having at hand neither a first rate smooth field nor a sheet of ice, he chose to start from the water.

In the accompanying illustrations, plates 1 and 2 show the appearance of the Langley flying machine after Mr. Curtiss had provided it with hydroaeroplane floats and their connecting truss work. The steel main frame, the wings, the rudders, the engine and propellers all were substantially as they had been in 1903. The pilot had the same seat under the main frame, and the same general system of control as in 1903. He could raise or lower the craft by moving the big rear rudder up and down; he could steer right and left by turning the vertical rudder. He had no ailerons nor wing-warping mechanism, but for lateral balance depended upon the dihedral angle of the wings and upon suitable movements of his weight or of the vertical rudder. And here it may be noted that Langley had placed the vertical steering rudder under and to the rear of the center of gravity. So placed, it served as a fairly good aileron by exerting a turning movement about the longitudinal axis of the machine.

After the adjustments for actual flight had been made in the Curtiss factory, according to the minute descriptions contained in the Langley Memoir on Mechanical Flight, the aeroplane was taken to the shore of Lake Keuka, beside the Curtiss hangars, and assembled for launching. On a clear morning (May 28), and in a mild breeze, the craft was lifted onto the water by a dozen men and set going, with Mr. Curtiss at the steering wheel, ensconced in the little boat-shaped car under the forward part of the frame. Many eager witnesses and camera men were at hand, on shore and in boats. The four-winged craft, pointed somewhat across the wind, went skimming over the wavelets, then automatically headed into the wind, rose in level poise, soared gracefully for 150 feet, and landed softly on the water near the shore. Mr. Curtiss asserted that he could have flown farther, but, being unused to the machine, imagined the left wings had more resistance than the right. The truth is that the aeroplane was perfectly balanced in wing resistance, but turned on the water like a weather vane owing to the lateral pressure on its big rear rudder. Hence in future experiments this rudder was made turnable about a vertical axis, as well as about the horizontal axis used by Langley. Henceforth the little vertical rudder under the frame was kept fixed and inactive.

After a few more flights with the Langley aeroplane, kept as nearly as possible in its original condition, its engine and twin propellers were replaced by a Curtiss 80-horse motor and direct-connected

tractor propeller mounted on the steel frame, well forward, as shown in the photographs. It was hoped in this way to spare the original engine and propeller bearings, which were none too strong for the unusual burden added by the floats. In 1903 the total weight of pilot and machine had been 830 pounds; with the floats lately added it was 1,170 pounds; with the Curtiss motor and all ready for flight it was 1,520 pounds. But notwithstanding these surplus additions of 40 per cent and 85 per cent above the original weight of the craft, the delicate wing spars and ribs were not broken, nor was any part of the machine excessively overstrained.

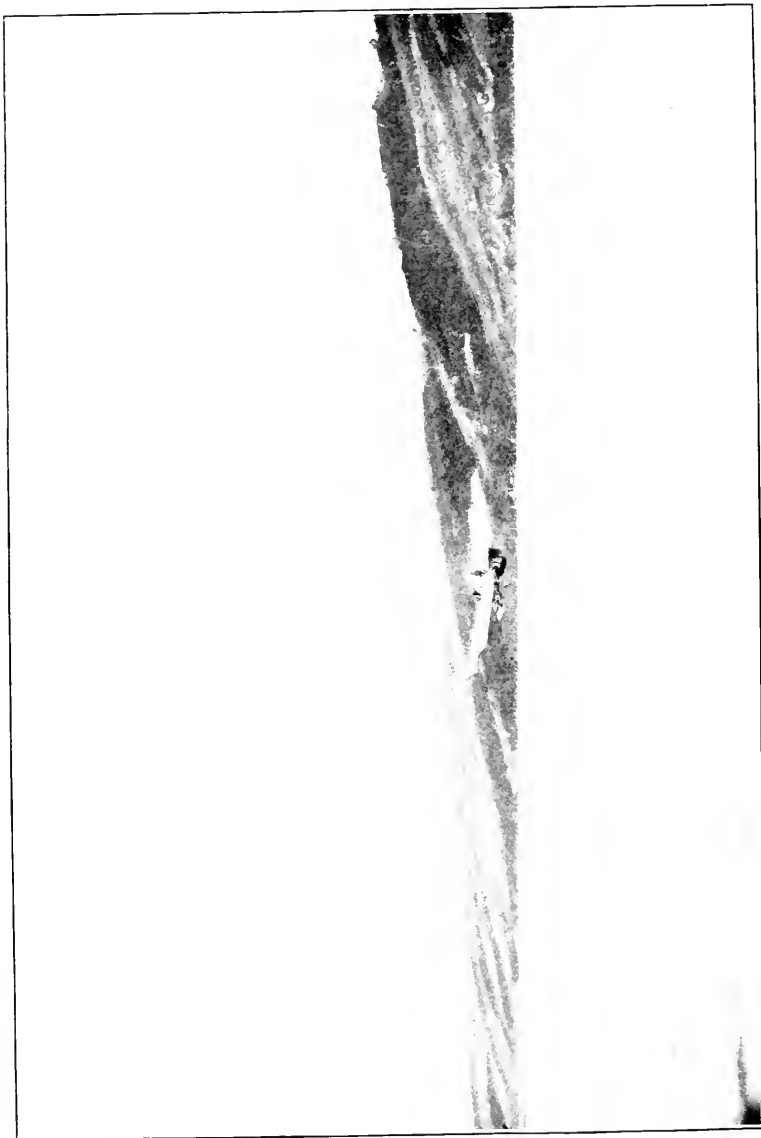
Owing to the pressure of other work at the factory, the aeroplane equipped with the Curtiss motor was not ready for further flights till September. In the absence of Mr. Curtiss, who had gone to California in August, a pupil of his aviation school, Mr. Elwood Doherty, volunteered to act as pilot.

During some trials for adjusting the aeroplane controls and the center of gravity, Mr. Doherty, on the afternoon of September 17, planed easily over the water, rose on level wing, and flew about 450 feet, at an elevation of 2 or 3 yards, as shown by the accompanying photographs of that date. Presently two other like flights were made. Mr. Doherty found that with the forewings at 10° incidence, the rear ones at 12° , and the pilot's seat on the main frame about midway between the wings, the flier responded nicely to the movements of the pilot wheel. A slight turn of the wheel steered the craft easily to right or left, a slight pull or push raised or lowered it. The big double tail, or rudder, which responded to these movements, was the only steering or control surface used. The breaking of the 8-foot tractor screw terminated these trials for the day. The waves indicate the strength of the wind during the flights.

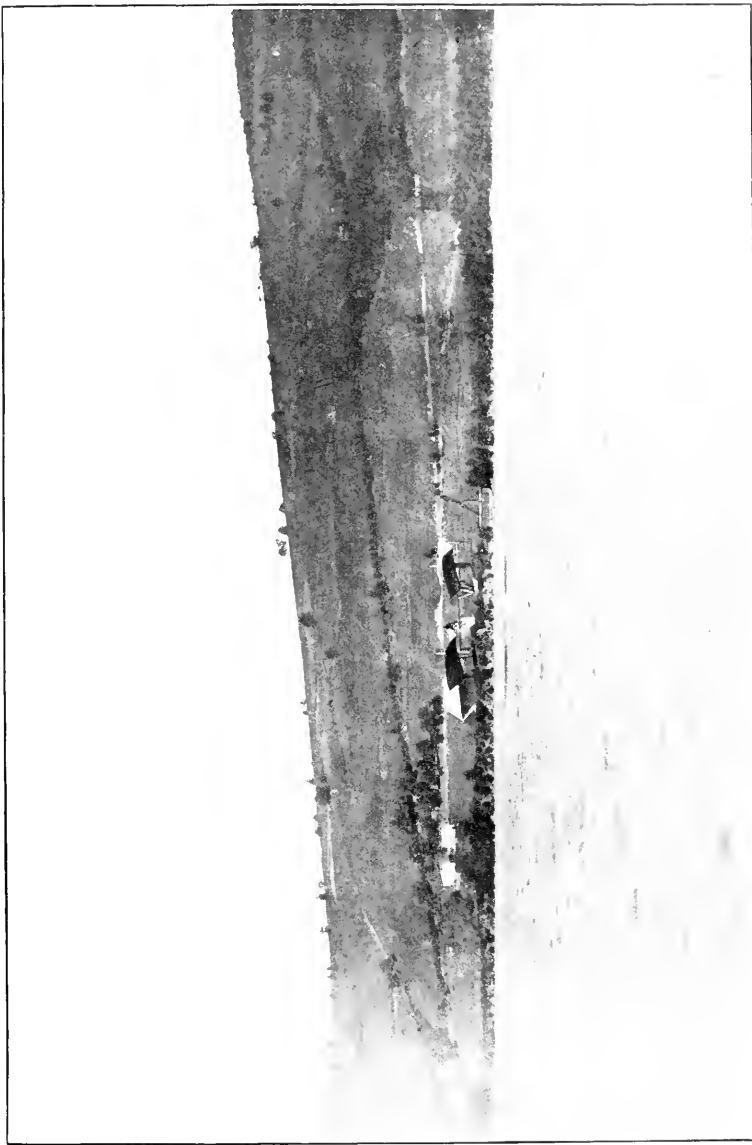
On September 19, using a 9-foot screw, Mr. Doherty began to make longer flights. A pleasant off-shore breeze rippled the water, but without raising whitecaps. A dozen workmen, lifting the great tandem monoplane from the shore, with the pilot in his seat, waded into the lake and set it gently on the water. A crowd of witnesses near at hand, and many scattered about the shores, and on the lofty vine-clad hills, stood watching expectantly. When some of the official observers and photographers, in a motor boat, were well out in the lake, a man in high-top boots, standing in the water, started the propeller, and stepped quickly out of the way. Then with its great yellow wings beautifully arched and distended, the imposing craft ran swiftly out from the shore, gleaming brilliantly in the afternoon sun. At first the floats and lower edges of the rudders broke the water to a white surge, then as the speed increased they rose more and more from the surface. Presently the rear floats and the rudders cleared the water, the front floats still skipping on their heels, white



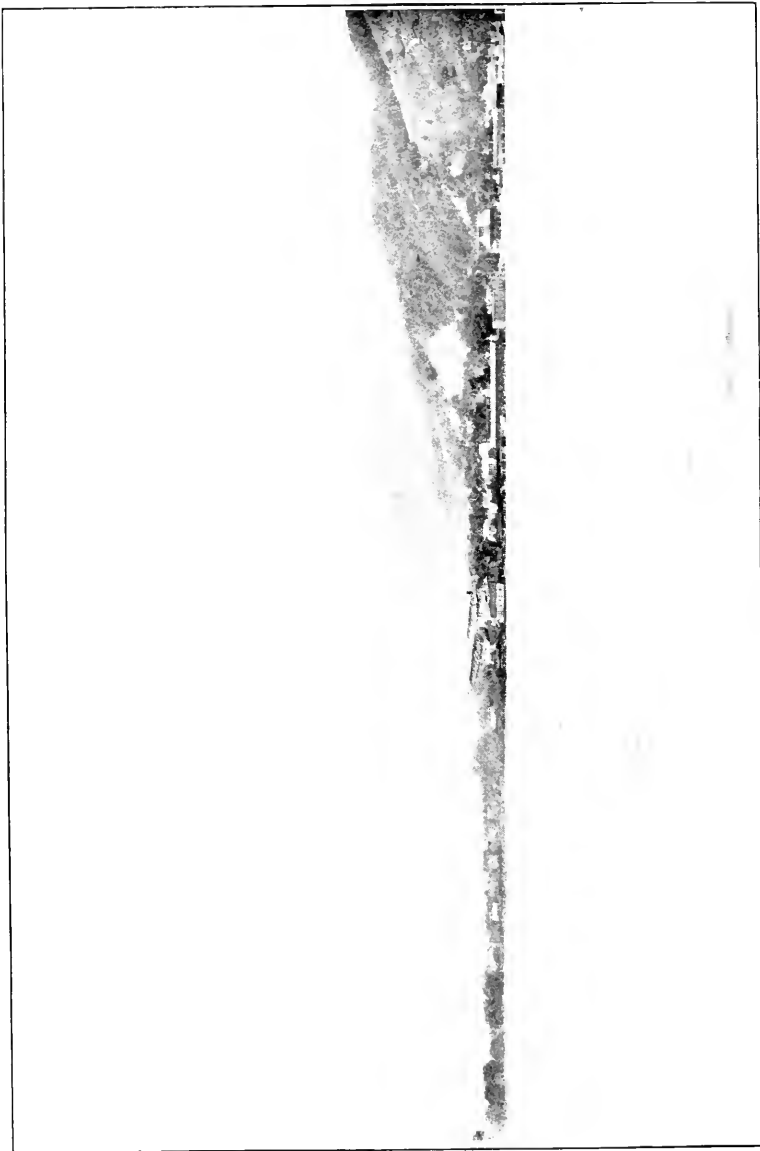
FLIGHT OF LANGLEY AEROPLANE ABOVE LAKE KEUKA SEPTEMBER 17, 1914, PILOTED BY E. DOHERTY AND DRIVEN BY A CURTISS MOTOR AND TRACTOR SCREW.



LANGLEY AEROPLANE IN FLIGHT SEPTEMBER 19, 1914; CLIMBING.



LANGLEY AEROPLANE IN FLIGHT OCTOBER 1, 1914; NATURAL POISE.



LANGLEY AEROPLANE IN FLIGHT OCTOBER 1, 1914. HAMMONDSPORT, N. Y., IN BACKGROUND.

with foam. The whole craft was now in soaring poise. It quickly approached the photographers, bearing on its back the alert pilot, who seemed to be scrutinizing every part of it and well satisfied to let it race. Then it rose majestically and sailed on even wing 1,000 feet; sank softly, skimmed the water, and soared another 1,000 feet; grazed the water again, rose and sailed 3,000 feet; turned on the water and came back in the same manner; and, as it passed the photographers, soared again nearly half a mile. The flights were repeated a few minutes later, then, owing to squally weather, were discontinued for 11 days.

On October 1, 1914, the aeroplane was launched at 11 a. m. in an off-shore breeze strong enough to raise whitecaps. Hovering within 30 feet of the water, and without material loss of speed, it made in quick succession flights of the following duration, as observed by four of us in a motor boat and timed by myself: 20 seconds, 20 seconds, 65 seconds, 20 seconds, 40 seconds, 45 seconds. As the speed through air averaged about 50 feet per second, the through air lengths of these flights were, respectively, 1,000 feet, 1,000 feet, 3,250 feet, 1,000 feet, 2,000 feet, 2,250 feet. As the aeroplane was now well out from shore among the heavy billows and white caps, Mr. Doherty landed it upon the water and turned it half about for the homeward flight. Thereupon the propeller tips struck the waves and were broken off, one casting a splinter through the center of the left wing. The pilot stopped the engine, rested in his seat, and was towed home by our motor boat. The flights were witnessed and have been attested by many competent observers.

As to the performance of the aeroplane during these trials, the pilot, Mr. E. Doherty, reports, and we observed, that the inherent lateral stability was excellent, the fore-and-aft control was satisfactory, and the movement of the craft both on the water and in the air was steady and suitable for practical flying in such weather. Apparently the machine could have flown much higher, and thus avoided touching the water during the lulls in the breeze; but higher flying did not seem advisable with the frail trussing of wings designed to carry 830 pounds instead of the 1,520 pounds actual weight.

At the present writing the Langley aeroplane is in perfect condition and ready for any further tests that may be deemed useful. But it has already fulfilled the purpose for which it was designed. It has demonstrated that, with its original structure and power, it is capable of flying with a pilot and several hundred pounds of useful load. It is the first aeroplane in the history of the world of which this can be truthfully said.

If the experiments be continued under more painstaking technical direction, longer flights can easily be accomplished. Mr. Manly, who designed the Langley engine and screws and who directed the con-

struction and tests of the large aeroplane up to December 8, 1903, reports that he obtained from the propulsion plant a static thrust of 450 pounds, and that he once ran the engine under full load for 10 hours consecutively. This thrust is nearly 100 pounds more than that commonly obtained at Hammondsport with the same plant, and 20 pounds more than the static thrust obtained with the Curtiss motor on the day when it flew the aeroplane with 1,520 pounds aggregate weight. Hence, by restoring the engine and propellers to their original normal working condition they should be able to drive the aeroplane in successful flight with an aggregate weight of nearly 1,600 pounds, even when hampered with the floats and their sustaining truss work. With a thrust of 450 pounds, the Langley aeroplane, without floats, restored to its original condition and provided with stronger bearings, should be able to carry a man and sufficient supplies for a voyage lasting practically the whole day.

Dr. Langley's aerotechnic work may be briefly summarized as follows:

1. His aerodynamic experiments, some published and some as yet unpublished, were complete enough to form a basis for practical pioneer aviation.
2. He built and launched, in 1896, the first steam model aeroplane capable of prolonged free flight, and possessing good inherent stability.
3. He built the first internal-combustion motor suitable for a practical man-carrying aeroplane.
4. He developed and successfully launched the first gasoline model aeroplane capable of sustained free flight.
5. He developed and built the first man-carrying aeroplane capable of sustained free flight.



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