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(With Three Plates)

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Museum Aide, National Air Museum, Smithsonian Institution; and
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(Publication 4424)

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Two previously unpublished letters written in 1902 by Samuel Pierpont Langley, third Secretary of the Smithsonian Institution, have recently been uncovered in the "Langley Documents on Aerodromics" held by the National Air Museum, Washington, D. C. These letters not only anticipated the development of powered flight, which Langley considered a certainty, but also demonstrated that Langley's far-ranging mind had foreseen even the development of the modern rocket.

Plagued by many problems, including the need to obtain a gasoline engine of sufficient horsepower in relation to its total weight, Langley had suffered innumerable delays in constructing an "aerodrome" or flying machine intended to carry a man. After several years of disappointment, and with some hesitation, he permitted his young assistant, Charles M. Manly, to undertake the rebuilding of an unsuccessful Balzar engine.[1] Using a revolutionary principle of placing steel jackets around cast-iron cylinder walls, Manly soon built an engine which produced over 52 horsepower, the net weight of the engine proper being only 2.4 pounds per horsepower. The success of the "aerodrome" seemed assured.

Langley's spirits revived, and his correspondence during the spring and summer of 1902 indicated a renewed interest in the construction of his large flying machine. A whole new realm of aeronautical possibilities formed in his mind, and he discussed these ideas among the small group of friends and associates in whom he could confide. Fortunately for history, it was Langley's custom to record the

* This article was completed with the cooperation of the staff of the National Air Museum.

[1] Built by Stephen M. Balzar of New York, it failed to meet the specifications of producing 12 horsepower while weighing less than 100 pounds.

essence of his ideas and conversations in "Waste Books," and he would occasionally confirm these by letters to the persons involved.

On one occasion after visiting with Manly, Langley returned to his office and there on March 9, 1902, wrote:

Dear Sir:

It occurs to me to take a note of what I said to you on Saturday, the 8th instant, in the upper shop of the South Shed,[2] though it is of no immediate practical use. It is that the ultimate development of the flying machine is likely to be an affair of very small wings or no wings at all, and that it may depend for its velocity on what Mr. Bell [3] calls 'its momentum' in the same way that an arrow or any other missile flies. It is known that the arrow derives its energy from the bow which projects it and that when this is spent the arrow will drop. We have, however, only to renew this energy and when renewed the source is immaterial and the result is the same, wherever the energy originates, for the arrow may still be heading upward without limit, as in the case of a rocket which has no wings but goes very much better without them, renewing its energy by recoil. Here is an additional analogy for the success of the greatest soaring birds with small wings. In any case it is a thing which deserves thinking over.

Very respectfully yours,
(signed) S. P. Langley,
Secretary.

Mr. C. M. Manly
Aid in Aerodromics
Smithsonian Institution [4]

Did experimenters in aeronautics turn first to the development of the wrong types of aircraft? For centuries the graceful flight of the birds had called men like a Lorelei. While the balloon and airship offered a cumbersome solution to the age-old search for a device with which men might rise into the air, it was the secret of lift on sustaining surfaces, the secret of the soaring birds, which gave men the clue for the airplane. In 1902 Langley, while developing the large aerodrome, was also engaged in a project of photographing birds in flight and preparing a study based upon information obtained. Then this concept of a rocket thrust itself into his versatile mind. Now we know that scientists have developed the idea of a rocket beyond the stage of "thinking over" and into the stage of practical use. As

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[2] The South Shed is a small frame building in which the Langley Aerodromes were constructed. It is on the Independence Avenue side of the Smithsonian Institution Building and is now used as a cabinet shop.

[3] Alexander Graham Bell, a Regent of the Smithsonian Institution, and supporter of aeronautical activities, using his fortune amassed through the invention of the telephone.

[4] Langley to Manly, March 9, 1902, "Board of Ordnance and Fortification Correspondence Book No. 4, October 15, 1901-October 9, 1906," p. 26; *Langley Documents on Aerodromics,* vol. 30. National Air Museum.

Langley viewed the solution of an aeronautical problem, the answer was to be found in the power-plant and the application of that power. This factor of power is more than ever a part of scientific rocket research. The development of flight had awaited the development of a light-weight engine which could be harnessed to propellers and pull or push sustaining surfaces or wings through the air to create lift and, hence, flight. Langley designed and built his "aerodrome" using sustaining wings. Then on September 25, 1902, while on a trip to Boston, he again opened his mind to Manly. Langley acknowledged a telegram from Manly and noted that Maxim [5] would not enter his engine for the prize offered by the St. Louis Exposition of 1904. He then concluded with this paragraph: [6]

> I have been thinking of something so paradoxical that I hesitate to enunciate it even as a mere possibility. The very idea of the aerodrome as we have always conceive [sic] it, has been to obtain support from sustaining surfaces driven against the air. I seem to see my way to dispensing with the surfaces absolutely and altogether so long as the engine works. I do not mean that this is a hypothetical possibility, but something apparently practical and perhaps within our actual means, or very near it. It is one of the very simple things which we both know are the last to be seen, but I will write to you or better talk to you about this later.

If Langley had any further thoughts on the possibility of wingless aircraft he must only have spoken of them to Manly; there is apparently no further correspondence between them on this subject. Upon his return to Washington Langley did, however, pursue the subject one step further. In a memorandum dated October 14, 1902, he recorded the conversation in which:

> I submitted to Professor Newcomb [7] today the following question, using concrete values "to fix our ideas."
>
> A spherical rocket head, which weighs 20 pounds, is initially maintained in place by a vertical pressure of 20 pounds caused by reaction and due to a force which we may suppose, for illustration, to be 1 horsepower.
>
> Next, let us suppose the axis of the reactive jet still to be directed to the centre of gravity of the head, but at some acute angle α with the horizon.
>
> I understand that the rocket will advance indefinitely in a horizontal line with accelerated velocity under the impulse of a constant force $\frac{1}{\sin}\alpha$ being 2 horsepower producing 40 pounds.[8]

---

[5] Sir Hiram Maxim, who had conducted aeronautical experiments in England in 1894.

[6] Langley to Manly, Boston, Mass., September 25, 1902, *op. cit.*, p. 152.

[7] Prof. Simon Newcomb, mathematician and astronomer who for many years was associated with the Nautical Almanac and the U. S. Naval Observatory.

[8] Added to the original copy, in handwriting believed to be Langley's, "in case $\sin \alpha = \frac{1}{2}$."

Am I right in supposing that it would move with a constant acceleration in this horizontal line until the resistance of the air caused the motion to be constant, and what would this velocity approximately be when it became so? [9]

Was this only a theoretical problem to help solve a problem concerning the construction of the "aerodrome," or was this new problem an insight into the development of aviation or astronautics as power-plant efficiency increased? The historian may only speculate upon what new experiments Langley would have begun had the "aerodrome" proved to be successful, but its failure and the resultant criticism crushed an inventive soul.

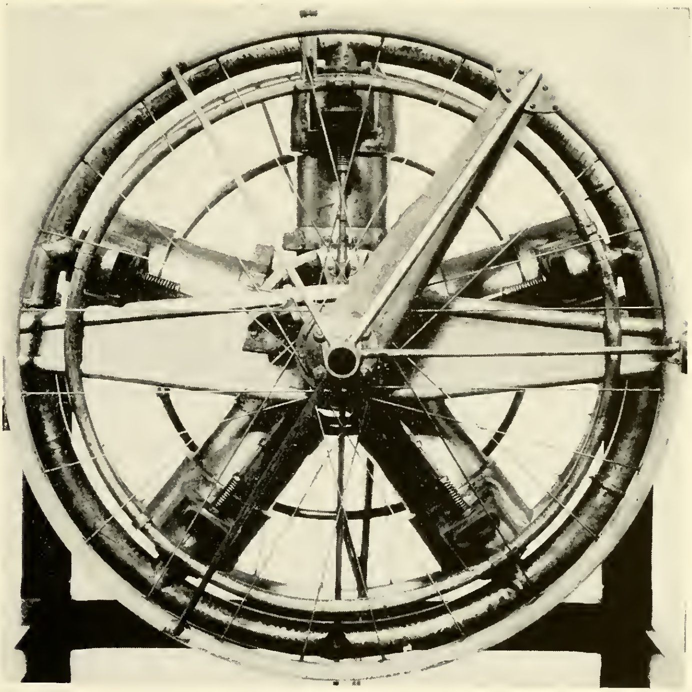
Today, the occupant of the office where Langley once spent so many hours can look out of his window and see two new sentinels standing watch at the Smithsonian. Beside the old Arts and Industries Building a United States Army Jupiter C and an Air Force Atlas remind the constant stream of visitors of new accomplishments in the story of aeronautical and astronautical progress. In the morning sun the shadows of these towering monuments point like an arrow to the gray-shingled South Shed only a short distance away. Dr. Langley's paradox has been fulfilled.

[9] Memorandum, October 14, 1902, Smithsonian Files; Letters Written; Aerodromics 20, vol. 9 (May 25, 1902, to Feb. 9, 1904), p. 35.

PLATES

The successful launching of Langley's unmanned "Aerodrome No. 5" on May 6, 1896. Driven by a 1-horsepower steam engine, the "Aerodrome" had a wingspan of nearly 14 feet. This experiment proved the practicability of powered flight.

Professor Langley (at right) and Charles M. Manly, just before launching the "Aerodrome," October 7, 1903.



1. The Manly engine.

2. The engines of a U. S. Air Force Atlas launching vehicle, photographed as the vehicle arrived for display at the Smithsonian Institution, 1960.