



The AMA History Project Presents: Biography of CHARLES ALPHONSE PÉNAUD 1850-1880



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Pénaud Planophores

Little known and little remembered today, this early French pioneer of flying models opened doors to both modeling and full-size aviation. His story still makes fascinating reading today.

By Bill Hannan

The story of Charles Alphonse Pénaud (pronounced pay-know), an early pioneer of model airplanes, deserves to be better known. In fact, this 19th century Frenchman may have been the most influential modeler of all time.

Born in 1850 in Paris, Pénaud expected to carry on the family tradition of career maritime service. However, complications from a severe hip injury rendered him physically unfit for naval service. Obligated to walk with crutches from a young age, he was plagued by discomfort for most of his short life.

Mild and modest by nature, Pénaud was also something of a wunderkind and as inquisitive as Leonardo da Vinci. His interests included bird flight, balloons, ballistics, mathematics, meteorology, high-speed photography, hydrodynamics, rocketry, aerodynamics, and much more. Unlike many theoreticians, Alphonse had the ability to reduce complex, abstract ideas to simple terms and demonstrate them with practical hardware.

In 1876, Pénaud and his partner, Paul Gauchot, designed and patented an innovative full-size aircraft. A flying wing, it also featured such astonishingly advanced concepts as retractable landing gear, enclosed cockpit, extensive instrumentation, and automatic pilot.

Pénaud made frequent use of models in his aerodynamic experiments and conclusively proved their low-risk, low-cost advantages. So successful were his models, in fact, that Pénaud was rather resented by some of his contemporaries, who were unable to equal his results. Although he experimented with kits as well as model helicopters and ornithopters, this discussion will concentrate of Pénaud's model airplanes. He called them planophores. Unfortunately, the brilliant Frenchman was never able to gain financial support, or even that encouragement to carry out his ideas so vital to any inventor. His frustration, compounded by failing health, drove Pénaud into deep depression. In 1880, at only 30 years of age, he ended his own life, depriving the aeronautical world of one of its most talented experimenters.

Tragic as this was, Alphonse Pénaud's lifework in aviation at least was not lost. His original concepts and designs had influence beyond his generation, surviving in the achievements of other path breakers whom it inspired. Among the scions of Pénaud's aeronautical genius were two young fellows named Wilbur and Orville Wright.

Pénaud's experiments in model aviation were wide-ranging. In addition to the category of models, which he named "planophores," the young Frenchman designed and flew ornithopters and helicopters. Although I have been unable to locate any illustrations of them, Pénaud also flew kites. (I would welcome assistance from readers who may know of the existence of any illustrations of Pénaud's kites.)

The helicopters were among Pénaud's earliest aeronautical experiments. Historical accounts suggest that he first constructed or reconstructed a model helicopter of the vintage Launoy and Bienvenu type. This device employed a bow-and-string arrangement to power contra-rotating silk-covered wire rotors. Its duration was extremely brief, but performance was impressive for the era. Though an Englishman, Sir George Cayley had produced a similar model featuring bird feather rotors in 1795; Pénaud didn't learn about it until years after his own experiments.

Other experimenters had tried clock-spring-powered helicopters with disappointing results. Their machines "...partook more of the character of an aerial somersault than true flight; for they had no sooner commenced to ascend than the spring had run down, and the screws stopped."

After investigating these existing concepts, Pénaud conceived his single most far-reaching idea, the wound rubber motor. It's important to note that he made no claim for having invented rubber power – and correctly so.

Indian rubber ("caoutchouc" in French) was employed for flying models by Pierre Jullien in 1858, and had been proposed by Sir George Cayley even earlier. However, these mechanisms depended upon rubber strip stretched lengthwise, *in tension* around a revolving spool or spindle. While capable of storing tremendous power, the method offered only brief duration and exerted considerable strain on the machinery, which consequently needed to be strong and heavy.

By contrast, Pénaud's innovation employed rubber strands *in torsion* (twisted), allowing simpler, lighter airframes and extended duration.

Although moderate in performance by today's standards, Pénaud's little helicopters were sensational in 1870, yielding flight durations of 15 to 26 seconds and even demonstrating some hovering ability. Delighted audiences applauded the clever models, which soon were adapted for commercial manufacture as playthings and widely marketed. Among those who eventually received such a flying toy were young Wilbur and Orville Wright.

The planophores. When Alphonse turned his attention to fixed-wing flight, he was fortunate in knowing Joseph M. Pline, who was skilled in the design of tiny paper oiseaus (birds) and papillons (butterflies). Pline had painstakingly determined principles of balance, incidence, and dihedral angles in providing the automatic equilibrium so essential to Free Flight models.

By combining improved variations of Pline's self-stabilizing features with his own rubber-in-torsion motors, Pénaud created the series of simple model airplane designs that he called planophores.

He experimented with contra-rotating propellers to minimize torque influences, but soon discovered much easier ways of achieving similar results. Simply adding a small amount of ballast to the model's wing tip, and/or setting one wing panel to a slightly greater incidence angle than the other, worked effectively in counteracting torque. Pénaud also tried tractor (front-mounted) propellers, though he favored a single pusher for propeller protection in the event of collisions.

Although Pénaud tested multiple blades, he preferred two-bladed arrangements for simplicity and damage resistance, since they could lie flat during landing. He didn't want to complicate his models or increase their weight with landing gear.

The educational and entertainment value of Pénaud's models was resoundingly proven during his 1871 outdoor public demonstrations in Paris' famous Gardens of Tuileries and inside the beautiful Horticultural Hall. These demonstrations brought much favorable publicity for both the planophores and their creator.

Although planophores were constructed by Pénaud and his associates "in various forms of different styles with diverse results," the most successful fliers seem to have spanned from 18 to 24 inches. One 18-inch-span example had about a 4-inch wing root chord, a 20-inch-long fuselage stick, and an 8-inch-diameter propeller. The blades generally were made of paper, but sometimes of bird feathers, and the front and rear motor hooks were steel wire.

The wings were constructed from bird feather quills, pinned together and covered with goldbeater's skin. Dihedral was either in shallow V form or achieved simply by curving the wing tips gracefully upward. The wing assembly could be slid along the fuselage stick to adjust balance, and the incidence angle of the individual wing panels could be altered. The similarly constructed horizontal tail was also adjustable for incidence, and its tips could be raised for added stability.

Some planophores were equipped with a vertical tail plane, which Pénaud likened to the steering function provided by a ship's rudder. The tail plane was rarely, if ever, shown in early illustrations.

The late Charles Dollfus, renowned French aviation historian, noted in his description of Pénaud's planophores that "One could add a vertical rudder..." which seems to imply that it was provided as an optional accessory. An account in *Progress in Flying Machines* by Octave Chanut confirms that assumption in at least one case. Pénaud's Garden of Tuileries demonstrator, Chanute tells us, "...guided horizontally by a small vertical rudder, not shown in the figure, flew several times in a circle, falling gently to the ground near its starting point when the power of the rubber was exhausted."

Total weight of an 18-inch-span planophore was 16 grams, with a little under a third –five grams– supplied by the rubber motor. Flight durations ranging from 11 to 13 seconds were documented, with distances of 130 to 200 feet. Considering that the year was 1871, that’s not bad.

Illustrations of planophores in aviation history books are so commonplace that they’re seldom examined carefully. Though at first glance they may all seem to look alike, I have encountered an amazing variety of such illustrations in the course of my research for this article. When arranged together, the differences among them are obvious. A partial explanation is that, after all, there *was* a variety of planophores configurations built. Individual interpretations by different artists probably added more variation still.

The oldest published planophore drawings of which we are aware appeared in the January 1, 1872 issue of *l’Aeronaute*. Drawn by Pénaud himself, the sketches are obviously freehand and simplified, intended only to provide readers with the general idea rather than to convey technical accuracy. For example, the top view omits the wing and stabilizer ribs as well as a vertical tail (although Pénaud specifically mentions the latter in his written description). In addition, the side view proportions don’t exactly correspond to those in the top view; but then again, this criticism can be leveled at many modern three-view drawings.

Possibly the earliest artistic planophore illustration was published in *la Nature* of April 17, 1875. This engraving credited two artists, Albert Tissandier and a second whose name is illegible. Two different planophores are depicted. The first, seen in direct top view, features gracefully curved trailing edges and inner wing roots. The other model is shown in distorted perspective, with heavily scalloped trailing edges and straight wing roots. The background of this engraving was so muddy that it was deleted in later copies for greater clarity.

It would seem that the majority of subsequent planophore drawings were simplified rehashes of this 1875 engraving. The variety of subtle and not so subtle changes made in the copying process probably reflected the individual artist’s talent (or lack thereof!), as well as the degree of his technical orientation. Note, for instance, that propeller hooks are missing on some of these illustrations.

Latter-day planophores. Interest in Pénaud’s fascinating flying machines has continued to the present. Many reproductions of Pénaud Planophores have been built – some for actual flying, and others for museum displays or as conversation pieces. Let’s take a look at some of the models and people that have helped to sustain interest in these unique airplanes.

Aerodromes. Samuel Pierpont Langley, the third secretary of the Smithsonian Institution and an accomplished scientist and astronomer, became interested in aerial navigation around 1886. During 1887, only six years after Pénaud’s death, Langley embarked upon the study of free-flying models. He collectively termed them “aerodromes.”

That he did not initially know of Pénaud’s planophore designs is clearly documented in *The Langley Memoir on Mechanical Flight*: “This device attracted little notice, and I was unfamiliar with it when I began my own first constructions at Alleghany in 1887.” When Langley did learn of Pénaud’s 1872 *l’Aeronaute* article, he adopted Pénaud’s concepts in some of his own

aerodrome models. One of Langley's planophore-type designs, identified as Aerodrome No. 11, is illustrated by both a drawing and a photograph in the *Memoir*.

Curiously, Langley seems to have employed twisted rubber for power in his earliest models. Perhaps he may have learned of it from some Francois Dandrieux butterflies, which were widely marketed as early as 1879. If so, this would be poetic justice indeed, since these butterflies were commercial adaptations of Pénaud's helicopters. Two examples of the Dandrieux models were in the Smithsonian collection for many years. Might Langley have brought them there?

Although he constructed nearly 40 rubber-powered models before 1893 and experimented with a wide variety of configurations, Langley achieved only limited success. We can share his frustration as he recalled, "The wings in general were flat, but in some cases curved. The rubber was usually wound to about 100 turns, and trouble continually arose from its kinking and unequal unwinding, which often caused most erratic flights."

Langley also encountered frequent breakages. After reading of Pénaud's 13-second duration planophore flight, he candidly wrote, "I have never obtained so good a result as this with any rubber motor." He then added, "the longest flights obtainable did not exceed six or eight seconds in time, nor 80 to 100 feet in distance, and were not only so brief, but owing to the spasmodic action of the rubber and other causes, so irregular that it was extremely difficult to obtain even the imperfect results which were actually deduced from them."

In what would certainly appear to have been a retrogressive move, Langley turned, during 1895, to models powered by rubber *in tension*. Not surprisingly, this gave poor results. The complex and weighty mechanisms of these models still exist in the Smithsonian collection.

Langley also considered and rejected power plants employing gunpowder, hot water, compressed air, electricity, and carbon dioxide before achieving some success with steam, and finally gasoline. His 1896 steam-powered Aerodrome, identified as No. 5, suggests a revised numbering system unrelated to the rubber-driven model series.

The Langley planophore type. During the 1820s, Paul Garber, now historian emeritus and Ramsey Fellow of the National Air and Space Museum, was touring Langley's long-dormant shop building at the Smithsonian Institution. Among the paraphernalia was an old model of planophore configuration. Garber asked his escort, Mr. Cole, of its origin. Cole didn't know, but surmised that Langley might have obtained it during one of his visits to France.

From Langley's own account in *The Langley Memoir on Mechanical Flight*, we can establish that he was unaware of planophores until at least 1887, some seven years after Pénaud's death. That rules out the possibility that he bought the model from Pénaud himself, as some have suggested. We do know, however, that Langley brought back an internal combustion engine from Paris in the 1900s, years after his rubber-powered model experiments. It's plausible that he might have purchased this unidentified model at the same time.

Another possibility is that the model may have been Langley's own, similar to Aerodrome No. 11 in the long series tested. In a letter written to your author on May 16, 1988, Paul Garber

commented, “The detail that may determine whether it’s an original Pénaud, or a copy made by Langley or a member of his crew – he had about a half-dozen expert craftsmen working with him – is it’s longitudinal. It is of tubular metal, but Pénaud may well have chosen that material. I want to say it’s an original Pénaud, but I can’t authenticate it.”

Among the people who worked for Langley during 1895 was Augustus Moore Herring, known to have successfully designed and flown rubber-powered models as early as 1893. Might he have fabricated the planophore type? Although strong personality differences prevented the two men from working together in harmony, Herring is said to have designed and built steam engines, which powered two of Langley’s aerodrome models. More information on this tantalizing subject may eventually surface. Whatever the origin of the Smithsonian planophore type, it’s a fascinating artifact, and photos of it have been widely published.

The Christy Magrath planophores. One of the most dedicated and talented model builders of modern times was Christy Magrath. Christy personally examined the Smithsonian planophore type and documented it with drawings and descriptions. Inked by (Walt?) Schroder, the illustrations were published in an article entitled “After You Alphonse,” in the May 1955 *Model Airplane News*. According to Magrath, the model has bamboo surface members covered with rice paper. The horizontal tail features a wire incidence adjustment device not seen in other planophore illustrations. It also has a triangular vertical tail. The wing has no ribs and is of distinctive configuration, as is the bent wood propeller.

A notation on the drawing states, “Purchased by Dr. S. P. Langley in Paris in 1871.” That, of course, is at odds with Langley’s own record in the *Memoir*, and Magrath must have been unaware of the discrepancy.

On the same page of the *Model Airplane News* article are sketches of a more traditional planophore, making comparisons exceptionally easy.

Christy also constructed a number of planophore reproductions, some of which were flown. One of his display models was donated to the Air Force Museum at Dayton, OH. Another half-size planophore was presented to former *Model Airplane News* and *Model Aviation* editor Bill Winter, who kindly supplied me with a photograph.

Del Gatto’s planophores. Also featured in the May 1955 *Model Airplane News* was an article by Paul E. Del Gatto, which featured construction drawings for two planophores, one of 1871 configuration and a second employing modern techniques and materials. The vintage version, in which the rubber was winder-wound, exceeded 45 seconds’ duration, while the updated planophore achieved 80-second flights indoors.

Reg Parham’s planophore. In 1964, Englishman Reg Parham constructed a planophore type for his model aviation history demonstrations. The model features bamboo flight surfaces with flat-plate airfoils and shellacked silk covering. The motor stick is spruce, and the propeller blades are turkey tail feathers. Weighing the same as Pénaud’s original, the model has achieved outdoor flights of 40-second duration.

Bill Hannan's planophore. My own reproduction, constructed during 1978, was inspired by a Southern California Antique Model Plane Society (SCAMPS) contest for pusher models of pre-war design. Certainly Pénaud's planophore qualifies on that score! Balsa seemed contrary to the spirit of historical modeling, and so my model was constructed primarily of basswood. However, Japanese tissue was employed for covering, since my neighborhood hobby shop was fresh out of goldbeater's skin. The finished product weighed 16 grams, approximately equal to one of Pénaud's planophores. The small effort involved in construction was amply rewarded, not only by the enthusiastic comments from fellow competitors, who also helped adjust the model, but also by garnering a third-place trophy.

To satisfy my curiosity, this planophore was also flown a few times without its vertical tail. And yes, it did fly, however much greater care in launching was required.

During a Flightmasters West Indoor contest, the model was proxy flown by Curtiss and Walt Mooney for an officially timed flight of 58 seconds. This was especially satisfying, since Pénaud himself had sent a planophore to England during 1874 to be flown by his friend, Thomas J. Bennett. Truly, history does repeat itself.

The name of Charles Alphonse Pénaud has not been forgotten. Not only does his remarkable contribution to model aeronautics live on in the pages of history books, but a street in the 20th district of his native city also bears his name. Additionally, the FAI committee for international aeromodeling presents an award in Pénaud's honor. This diploma, originally proposed by Hans J. Meier of Germany, is presented to outstanding national and international modelers.

With characteristic modesty- and not a little poetry- Pénaud prophesied, "My planophore demonstrates the possibilities of stable equilibrium in the heart of the air and promise for great machines of considerable swiftness." If he could see the life in the "heart of the air" today!

References

My research into the life and work of Alphonse Pénaud has been a long, ongoing study. Numerous books and periodicals have been consulted, many of which yielded only fragmentary information. The most useful references were:

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If anyone has been overlooked, my sincere apologies!

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