

1908

A Cultural Shock in Aviation Development

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Foreword

- When I was asked to present this lecture, I thought it was an easy task, because I have some documentation at home.
- It was a **BIG MISTAKE** !
- Getting into books, I found lots of discrepancies due to: **errors, lack of exactness, factual dishonesty**, etc...
- But the most intriguing is the **lack of technical expertise** shown by most historians



The Transfer of Knowledge

- To understand the background of 1908, one has to trace how scientific and technical knowledge about aviation was transmitted
- History proves that aviation is so fascinating that, well before the Internet, smallest event were widely reported
- As early as 18th and 19th century, scientific communities of all developed countries were in very close contact and exchanged lots of information



My ambition: to show

1. A chronological list of events
2. Technical analysis of individual failures or successes
3. An attempt to trace the transmission of knowledge
4. No try: who invented what?
5. A technical Conclusion

Aerostats as Precursors of Precursors

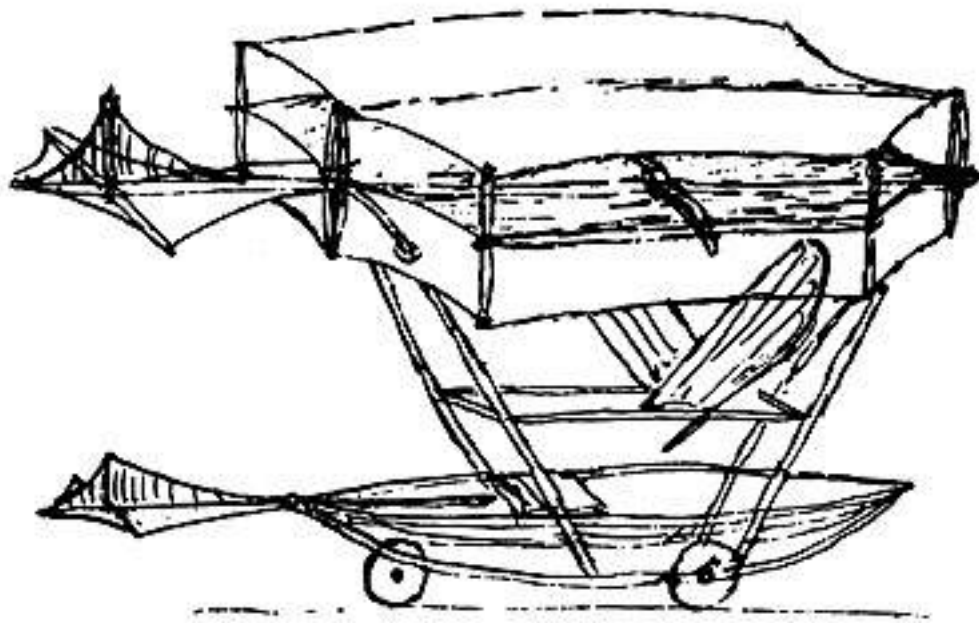
- 21/11/1783 first registered human flight with hot air balloon (gas- 10 days later) – Paris
- ★
- Balloon activity rapidly growing throughout Europe for ~three years
- 1793 first military use of a tethered balloon during the siege of Mainz
- 1797 first parachute jump by Garnerin – Paris
- 1803 Robertson & Lhoest reach 7280 m altitude over Hamburg
- 1830+ and civil war: american balloonists flew. John Wise invented rip panel
- Sept 1852: Giffard: first manoeuvrable airship – Paris
- ★
- 1872: Dupuy de Lôme: airship with propeller activated by human force - Paris
- 1883: Tissandier Bros: electrically propelled airship – Paris
- 1884: Renard & Krebs: first closed circuit by airship « la France » - Meudon
- 1900 + The magnificent Zeppelin story
- ★
- **Research on airships triggered the birth of a strong engine industry**



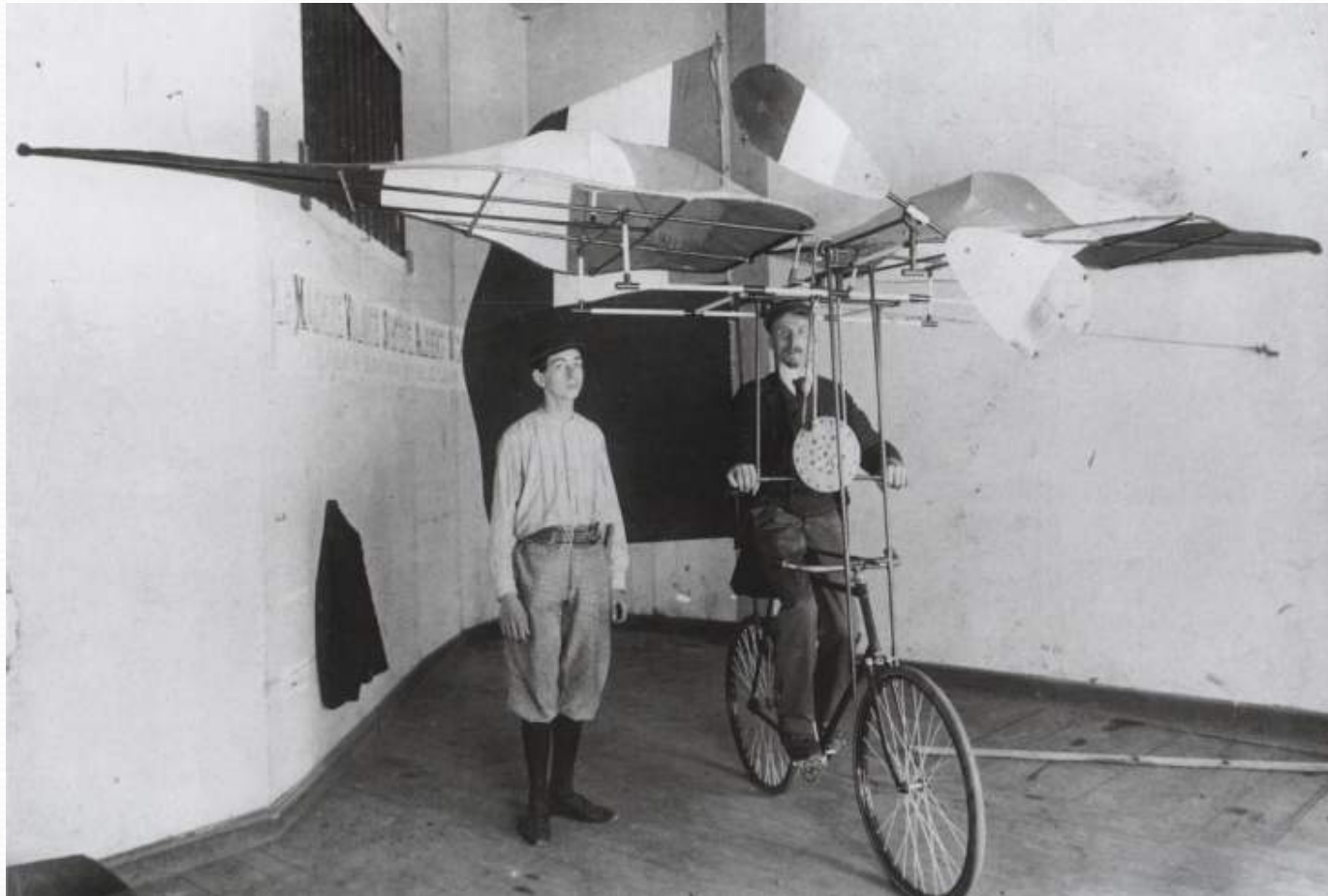
Some Effective Precursors

- 1799 George Cayley: initiator of the aeronautical science - London
- Throughout 19th century: intense research activity on flapping wings
- 1842 Henson: patent of a workable steam engine aircraft
- 1848 Stringfellow: public demonstration of a flying model
- 1868 Le Bris bird-shape towed glider (proba: effectively glided)
- 1871 Pénauud: demonstrates flying model with rubber engine prop
- 1871 UK: Wenham & Browning: first « wind tunnel »
- 1874 Lilienthal Bros: first measurements of aero forces on wings
- 1876 Pénauud patent: electrical aircraft with: dihedral, control stick and landing gear
- 1891/96 **Lilienthal** glides, invents polar curves, finds best wing profiles stability rules and demonstrates advantages of wing span.

Sir George Cayley



One of many flapping projects

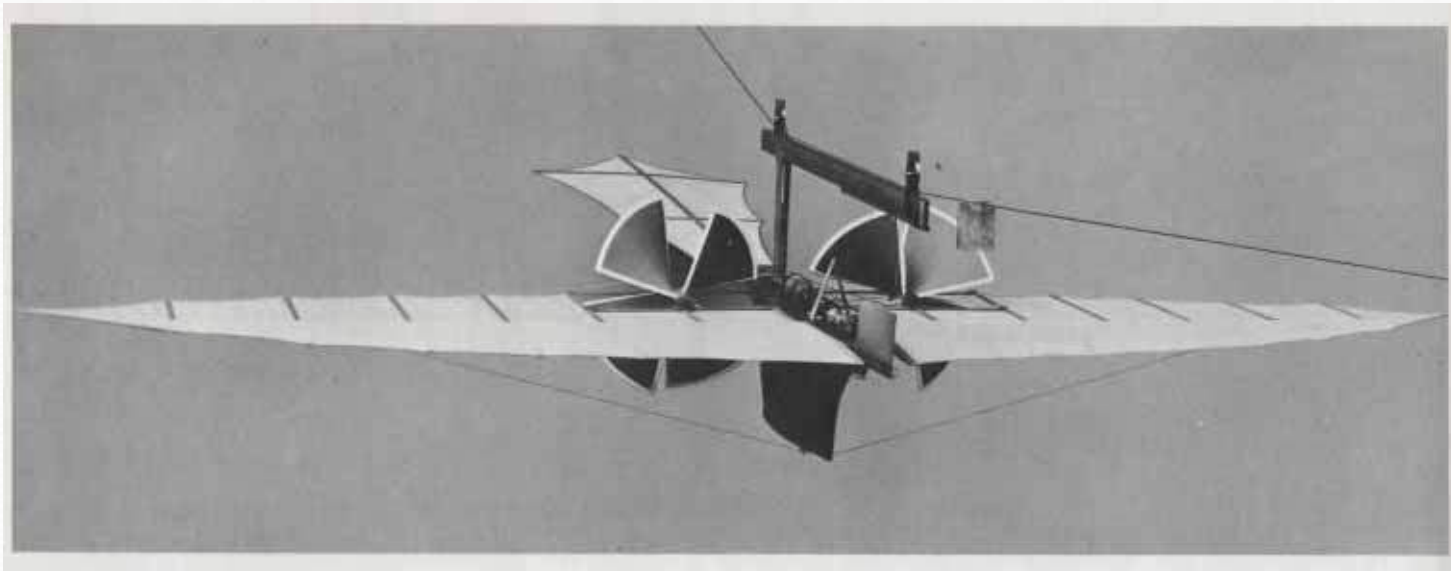


Henson 1842



LARGE VERSION HAS 13.5 IN WING SPAN

Stringfellow 1848



Le Bris 1868



Pénaud patent 1876

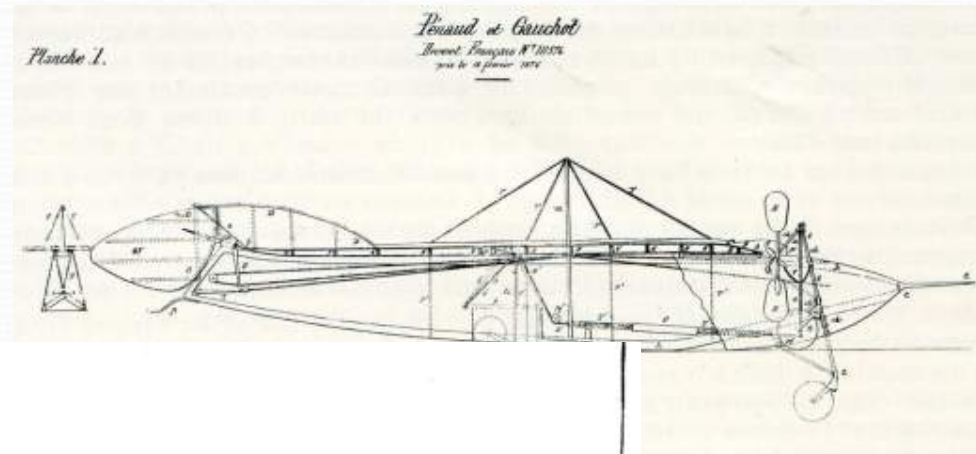
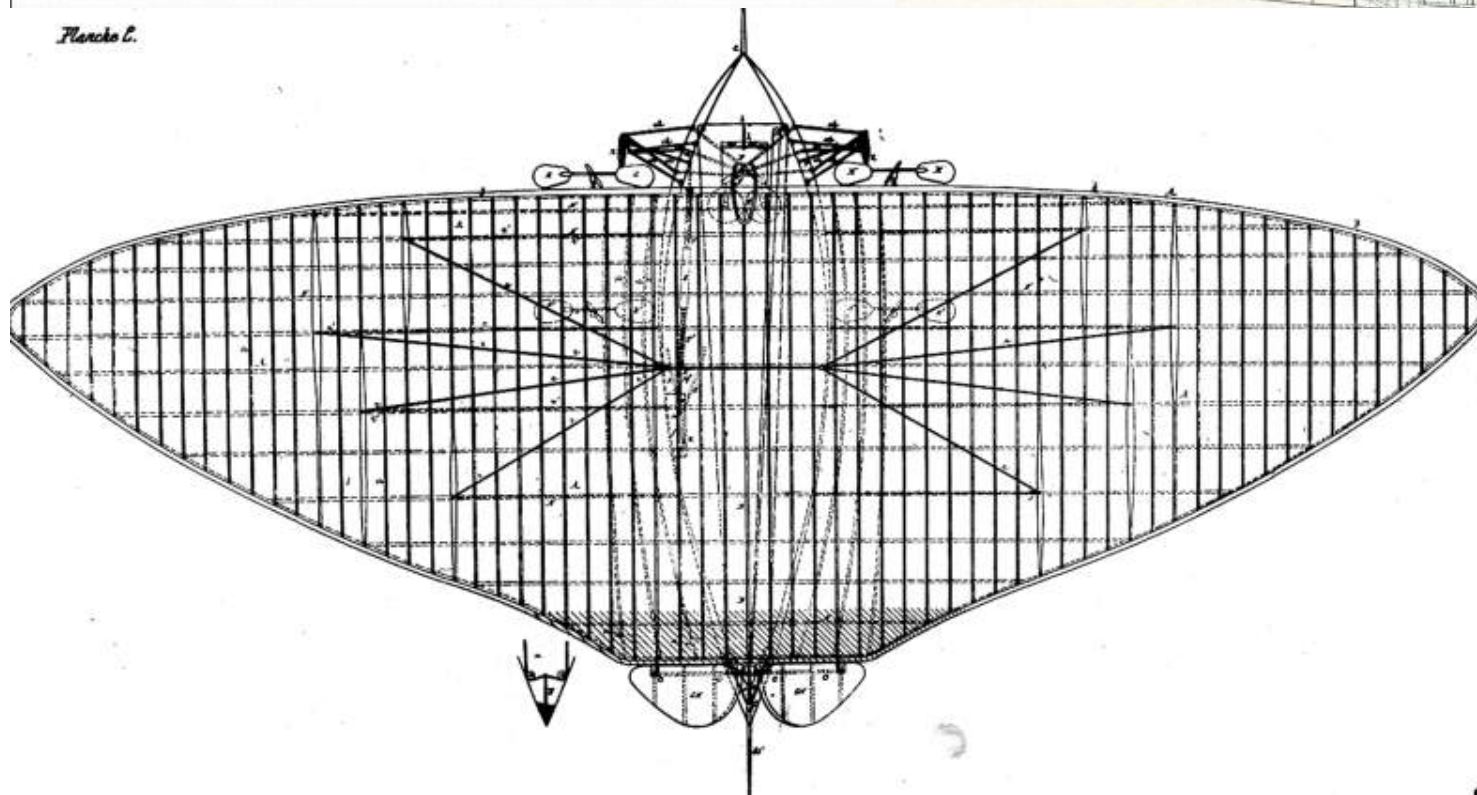


Planche 2.



One of Lilienthal's first gliders 1893

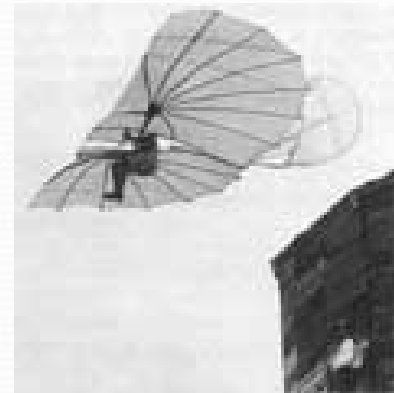


Lilienthal's development of H-gliders

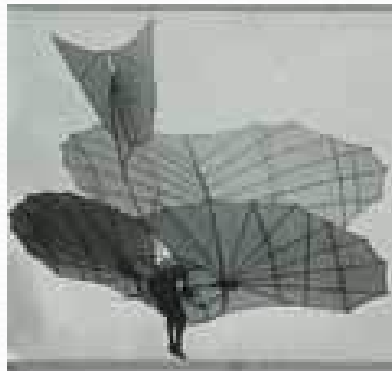
1891



1893



1895



1896

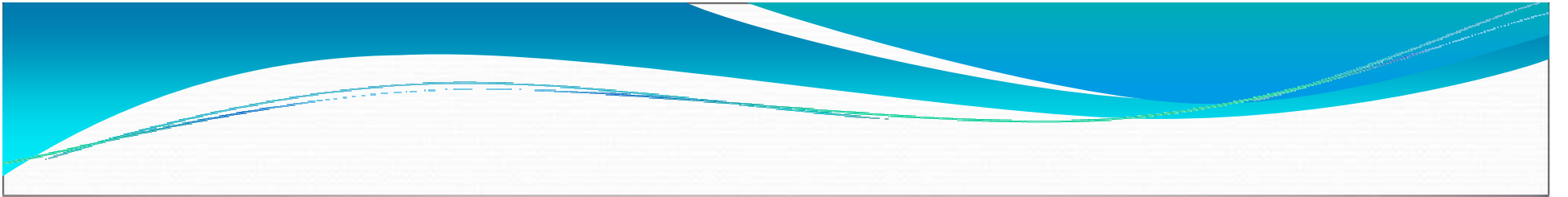


Pre-1908 significant events

- 1890 Ader's first hop EOLE
- 1891 Lilienthal's first glides
- 1893 Hargrave: kites and multiple kites – Sydney
- 1894 Maxim: large workable(?) aircraft - 2 x 180hp engines - destroyed during taxi – US
- 1894 Chanute: publishes collection of numerous articles about world aviation research - US
- 1895 Pilcher: demonstrates soaring and measures power necessary for sustained flight – UK
- 1896 Langley demonstrates a steam engined model
- 1896 Lilienthal hits ground and dies
- 1896 Chanute sets up a Pilot Training Camp in Michigan, using Lilienthal's glider and his own kite glider
- 1897 Ader's Avion III takes off by its own means
- 1900 Wright Bros: development of flying machines, from soaring kites to controllable aircraft . Used home made wind-tunnel
- 1903 Langley's workable aircraft ends into Potomac waters
- **1903 (17/12) Wright Bros: first catapulted « controlled flights » at Kitty Hawk**
- 1905 Orville Wright: flies 33 minutes Dayton
- 1905 Voisin measures 28hp as the power necessary for flight with towed glider – Paris
- 1905 Ferber ready with flyable machine, destroyed by a storm (will confirm with same machine in 1908)
- 1906 Santos-Dumont: first registered european flight – Paris. Canard aircraft, with Chanute-type wings, set at high dihedral angle, and Hargrave's cell for pitch/yaw control by canard
- 1907 Wilbur Wright travels to Europe trying to sell his aircraft

Ader's Eole, 1890





Hargrave Kites, 1893 +

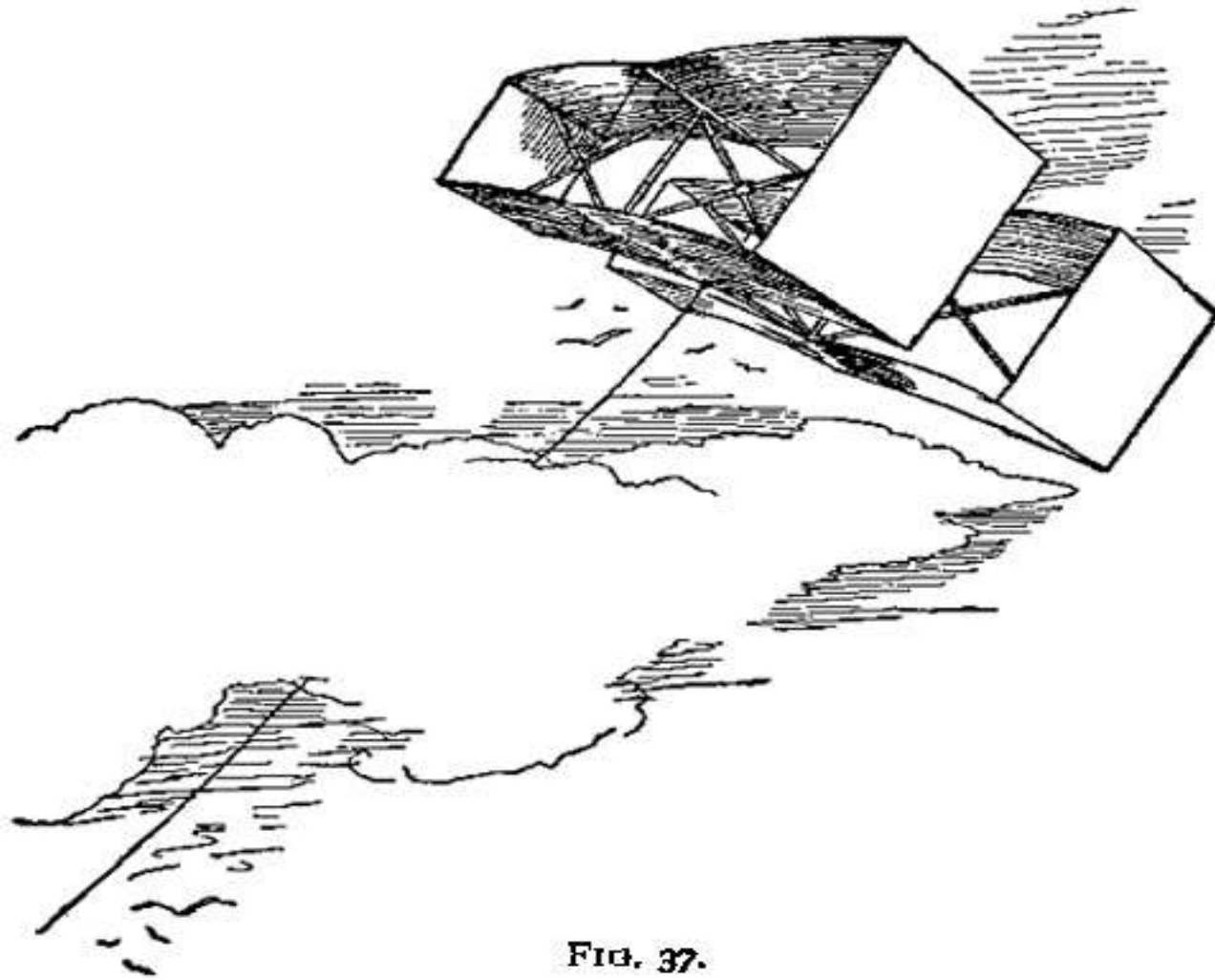
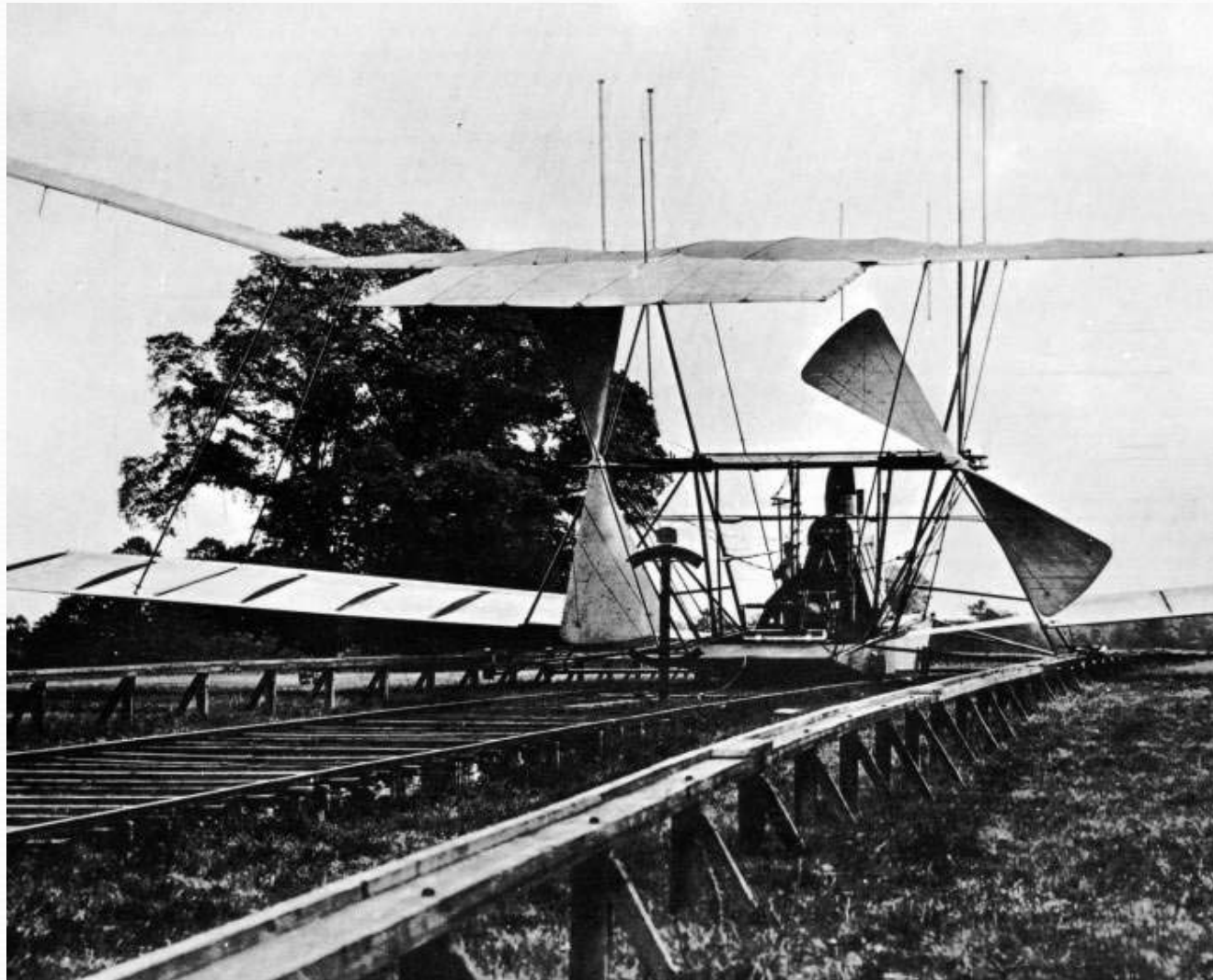


FIG. 37.

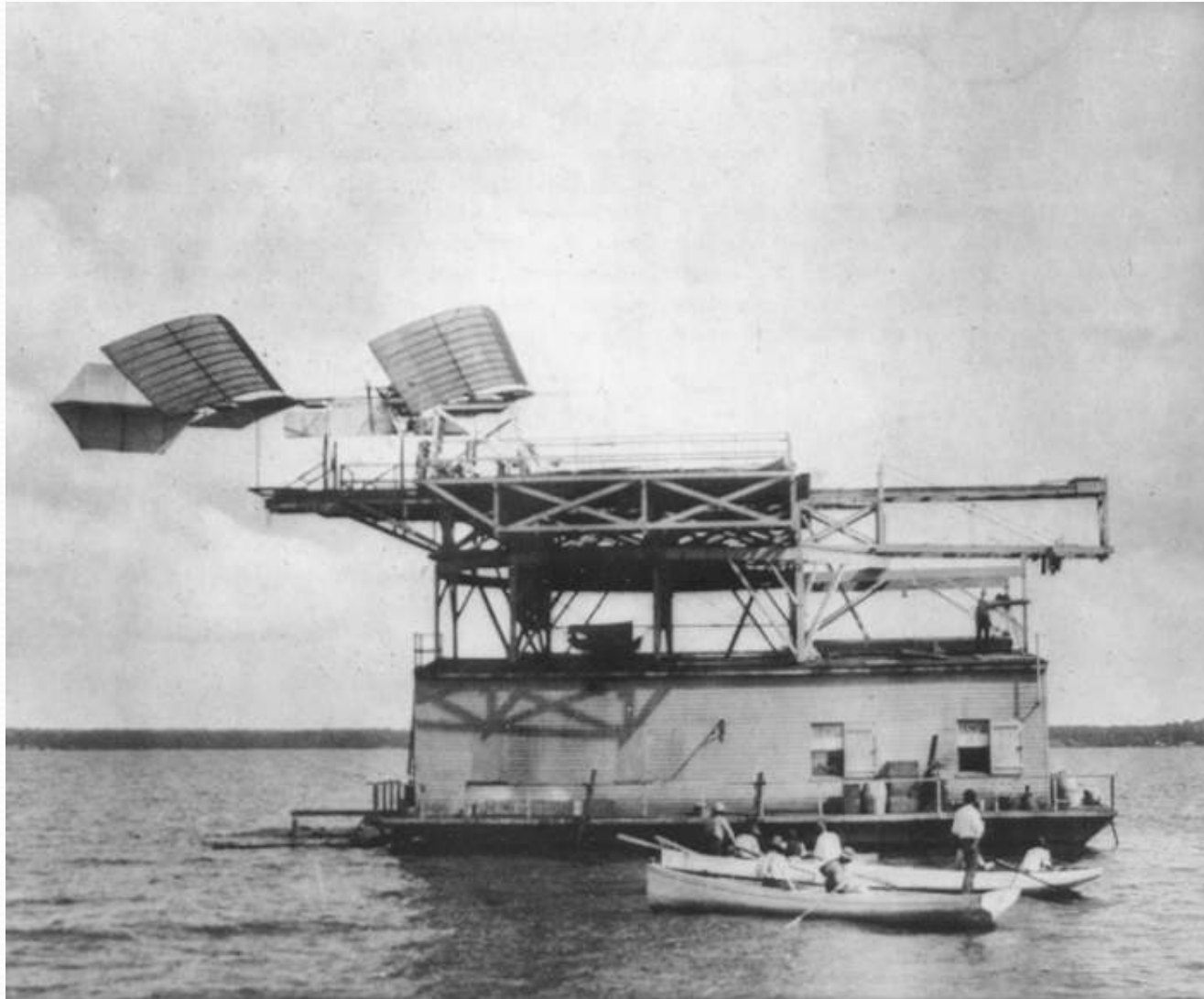
The Maxim monster, 1893



Chanute, Michigan, 1893



Langley failure in 1903



Langley: proof by Curtiss in 1914



Quote by Capitaine Ferber

- C'est en 1898 que je me suis aperçu que Lilienthal avait découvert une méthode pour apprendre à voler. C'est en 1902 que j'ai compris qu'en l'appliquant Wright allait toucher au but. Et tous mes efforts ont consisté à le faire savoir. C'est pourquoi tous les appareils qui ont volé en France ont un air de famille.

Wright glider 1900





Dec 13th, 1903

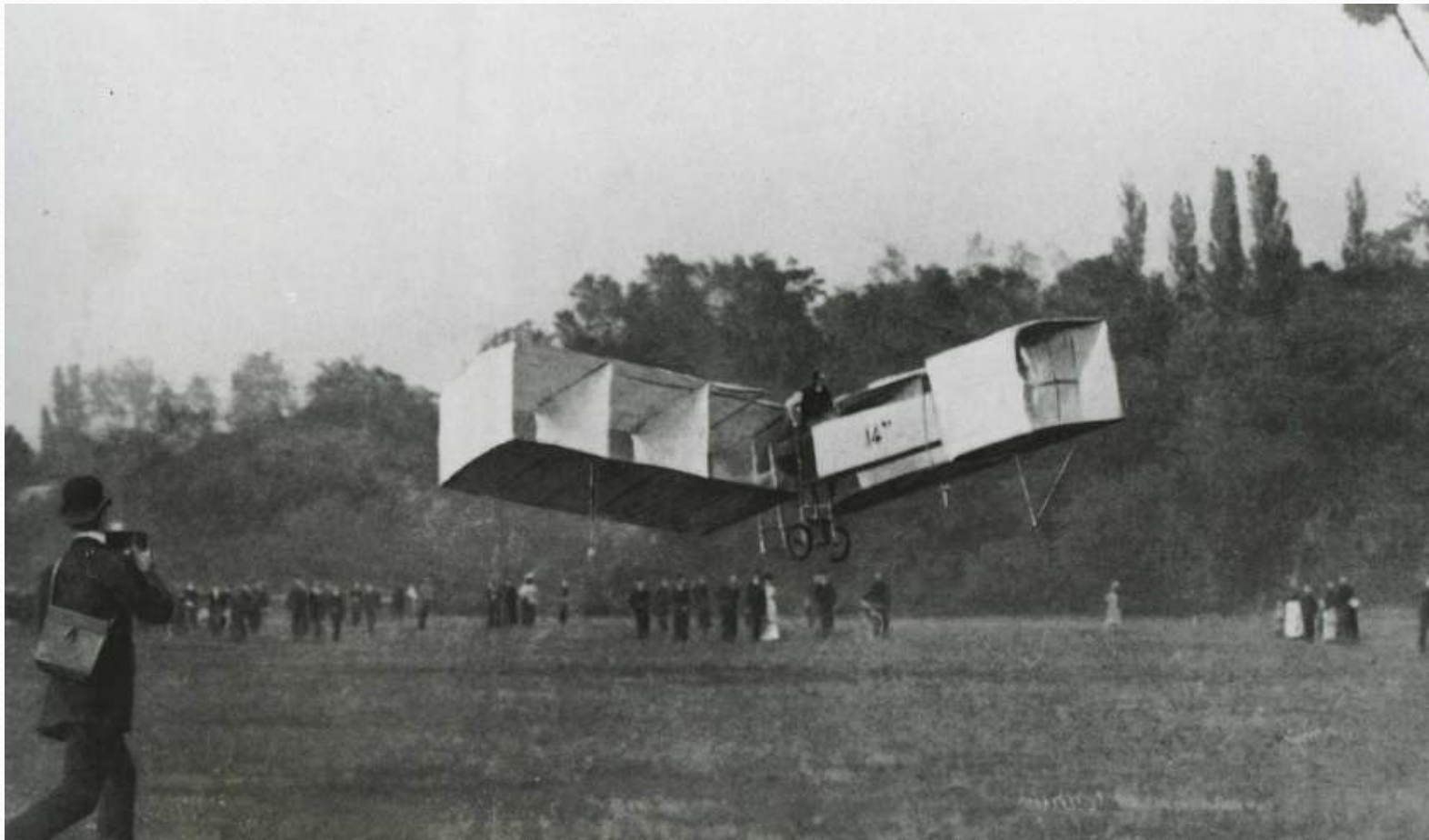
Wright's first flight in Kitty Hawk

- Aircraft was controllable in roll thanks to wing warping
- It was pilot-unstable in Pitch (not a learning effect)
- Engine could produce up to ~12 Hp
- Therefore, the need for headwind and catapulting

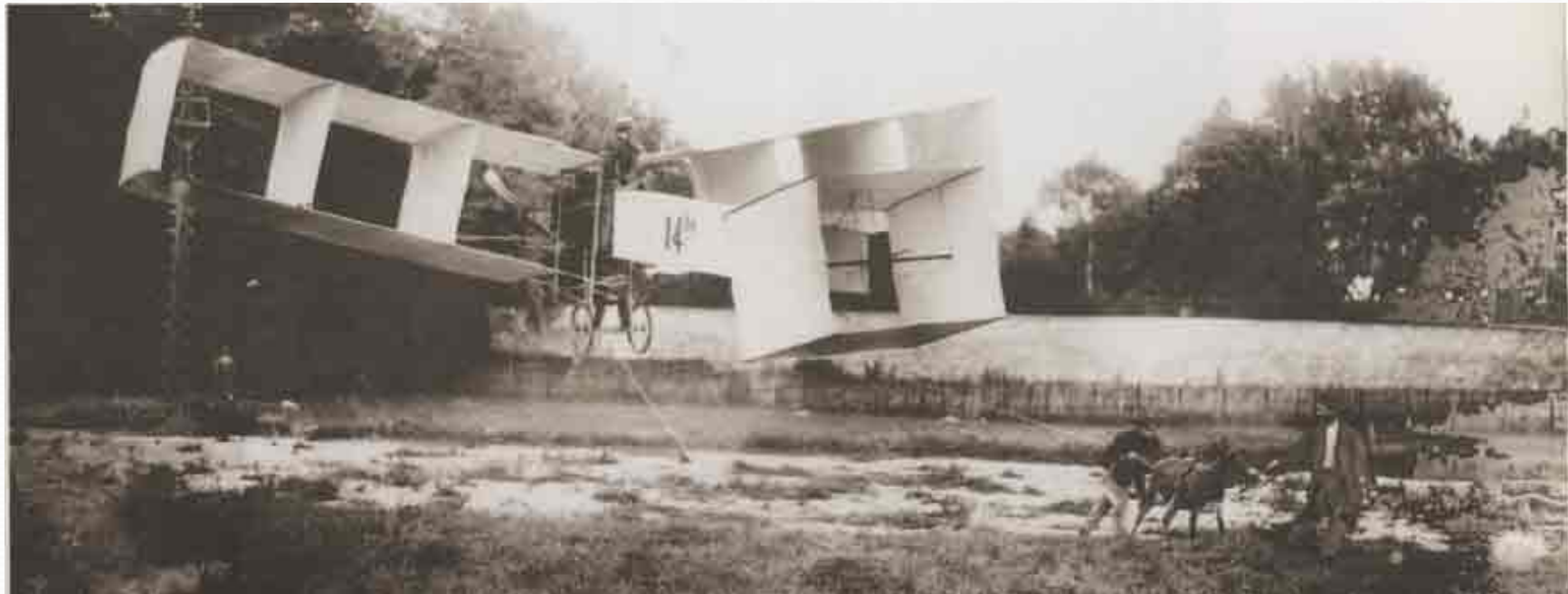
Catapult: 500kg / ~35ft

10/1906

Santos-Dumont: 1st in Europe



Santos-Dumont: Cable test 8/1906



The onset of 1908

- As of 1906, french/european aviators and journalists could not believe what they heard from the Wrights
- Chanute was advising about the progress made in France
- Wilbur came to France in 1907 and tried to sell his Flyer
- Wilbur established a Syndicate of french sponsors, but he had to demonstrate flight in France

1908: significant events

- 1906: Wright Flyer patent. Development work stopped
- 1907: Wilbur's visit to Europe. Many Europeans doubt
- European (French) aviators are very active
- January 8th: Farman closes first 1 km circuit
- May: Wilbur reaches France with his Flyer A and claims first
- August 8th: **the French are astonished** with first public demo
- Catapulting is considered unfair as well as the lack of u/c
- French sponsors offer a bigger engine for the Flyer
- October 1908: Cody: first flight in the UK
- Grade tri-plane in Magdeburg (no controls)

US/Europe: fierce competition

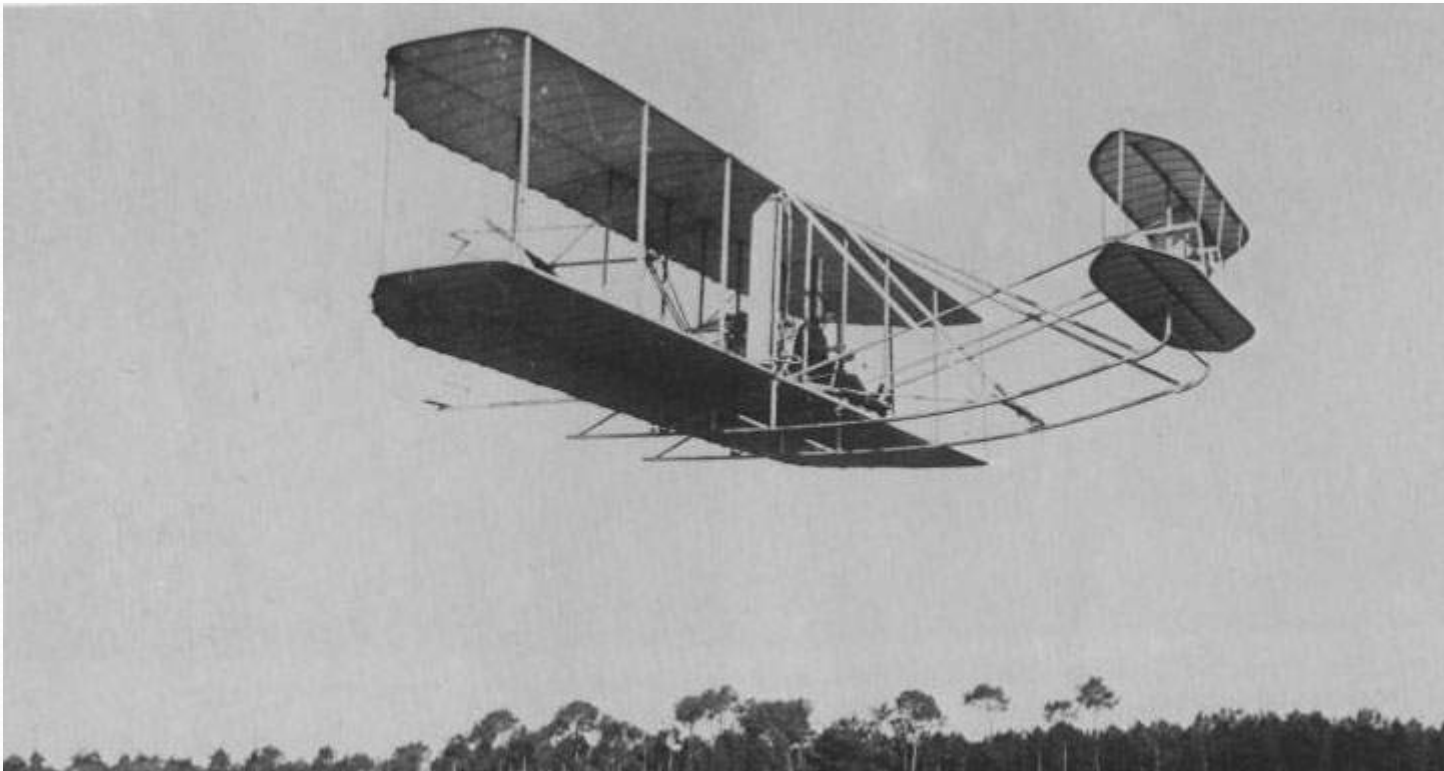
- Although the Wright brothers were welcome and celebrated, it is true that some french aviators had a lot of bitterness
- In 1904, the Deutsch-Archdeacon Price was set, for the first aviator who would close a 1 km circuit, after taking off by his own means (won by Henry Farman, 1/1908)
- Wright Bros claimed they had done it 2 years before and started with numerous juridical actions

Henry Farman, winner of the
Deutsch-Archdeacon price
First 1km closed circuit
Paris, January 13th 1908, Voisin



Le Mans, August 1908

First public demo, by Wilbur



Wright 1908: Wilbur at controls

Left hand: pitch by
canard

Right hand: 2 DOF

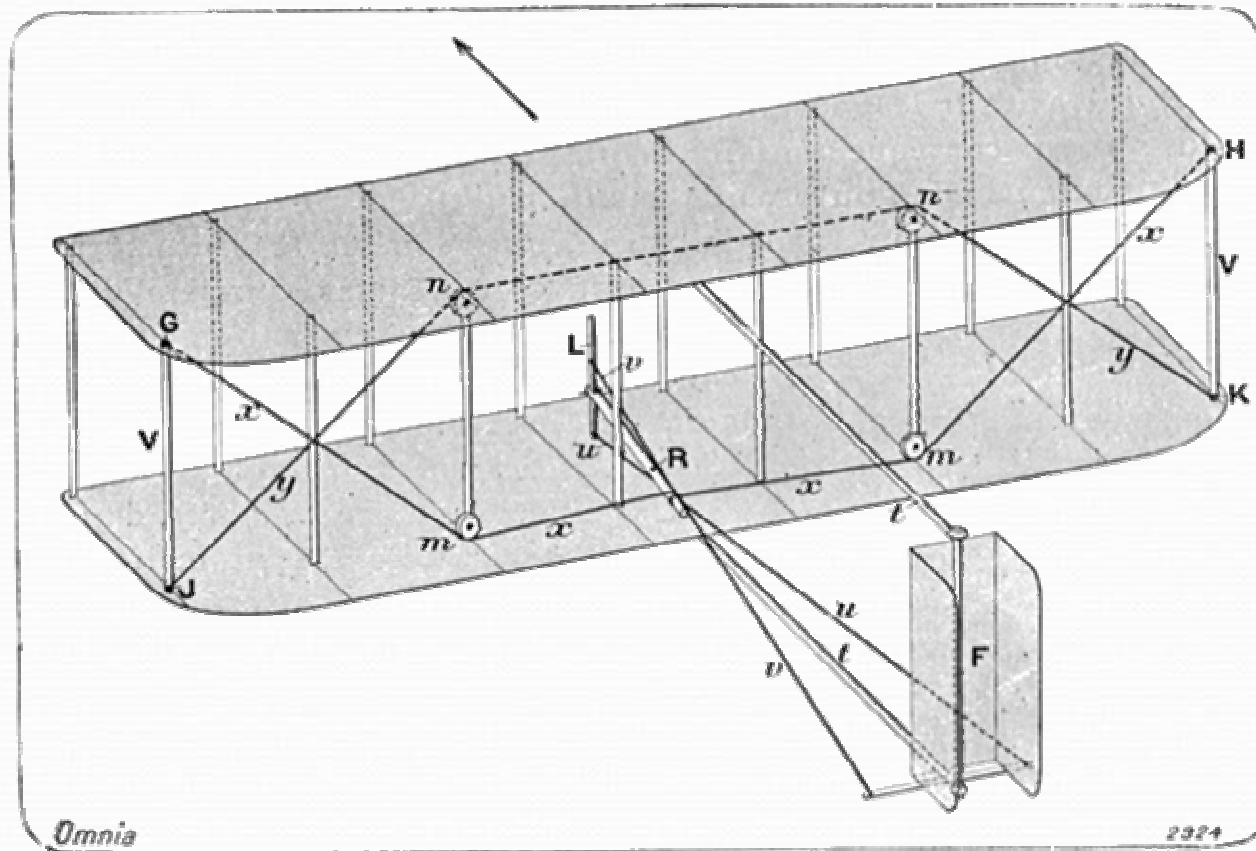
* fwd: rudder

* lat: 2 wings wharping

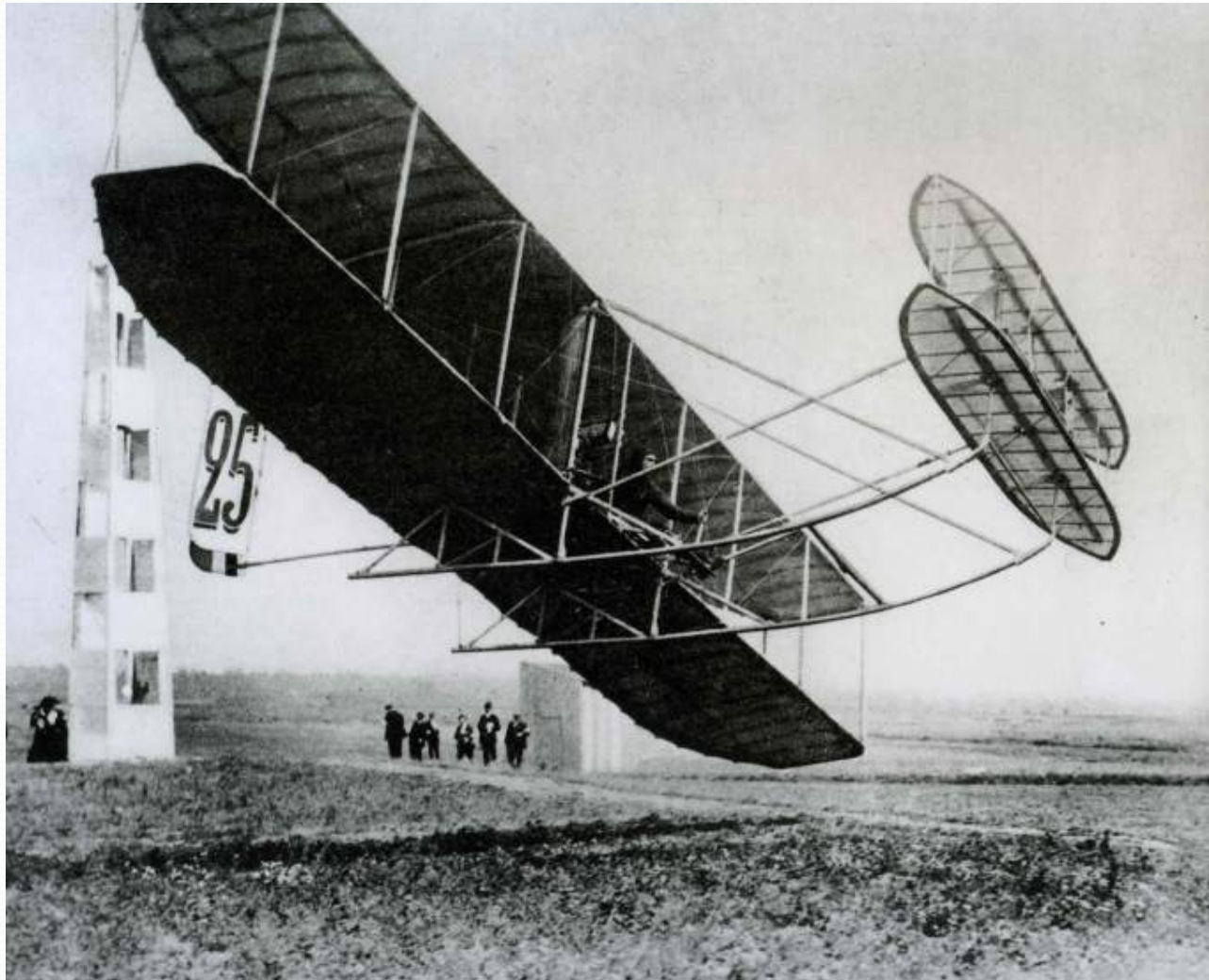
Feet: rest only !



Principle of wing wharping, 8/1908



Reims meeting August 1908 Pilot Lefevre.



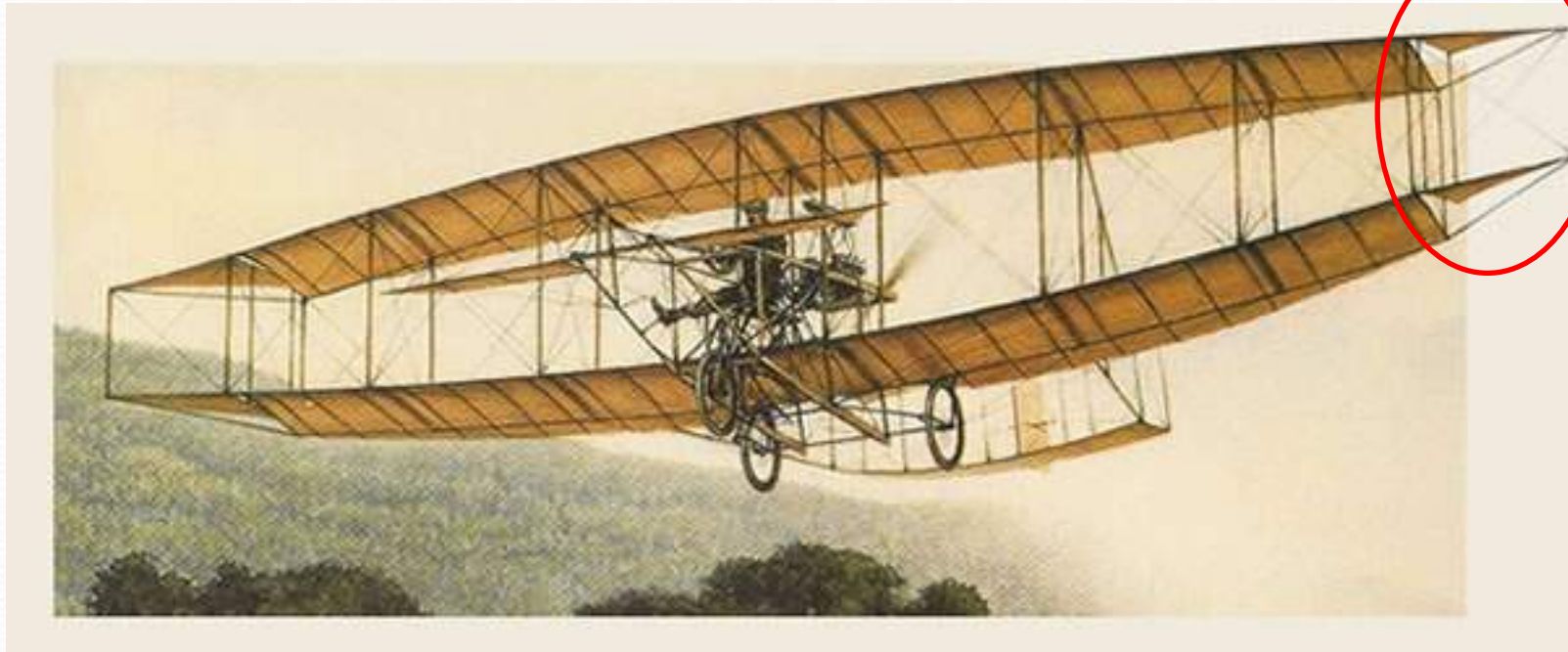
Flyer at Pau, with bigger engine



1908 - US Events

- On March 12, 1908, the A.E.A. "Red Wing" made the first public flight in America of a heavier-than-air machine with Casey Baldwin at the controls. The 20 seconds flight ended in a lateral crash.
- Two months later, the "White Wing" with Curtiss flying it, covered a distance of 1,017 feet in controlled flight.
- His success was made possible by the addition of "horizontal rudders" (Bell's term) to the wingtips, a precursor of the aileron.

Glenn Curtiss' White Wing 1908



Means for a technical analysis ?

- Matrix approach
- Flow chart approach
- Direct comparison on specific subjects

What is technically needed to fly ?

- A structure that is strong enough
- A wing with reasonable loading
- A correct CG for enough longitudinal stability
- A reasonable value for effective-power to weight ratio
- Enough longitudinal control
- Enough lateral-directional stability
- Control of the direction of flight

« Magic » Matrix – Researchers

	Cayley (M)	Stringfw. (M)	Penaud (M)	Ader T/O	Lilienth. Glid	Harg. Glid	Maxim Capab?	Chanut Glid	Langley Catap
Loads	Y	Y	Y	Y	Y/N	Y	N	Y	N
mg/S	Y	Y	Y	Y	Y	Y	>	Y	Y
CG	Y	Y	Y	Y	Y	Y	?	Y	?
P/mg	Y	Y	Y	Y	N	N	Y	Y	Y
M q	Y	Y	Y	N	Pilot	Pilot	Y	Pilot	?
L&N	nat	nat	nat	N	Y	Y	Y	Y	nat
Route	Y	Y	Y	Y	Pilot	?	Y	Pilot	Y

Tentative Flow Chart

- Old times

- 1873

- 1890

- 1893

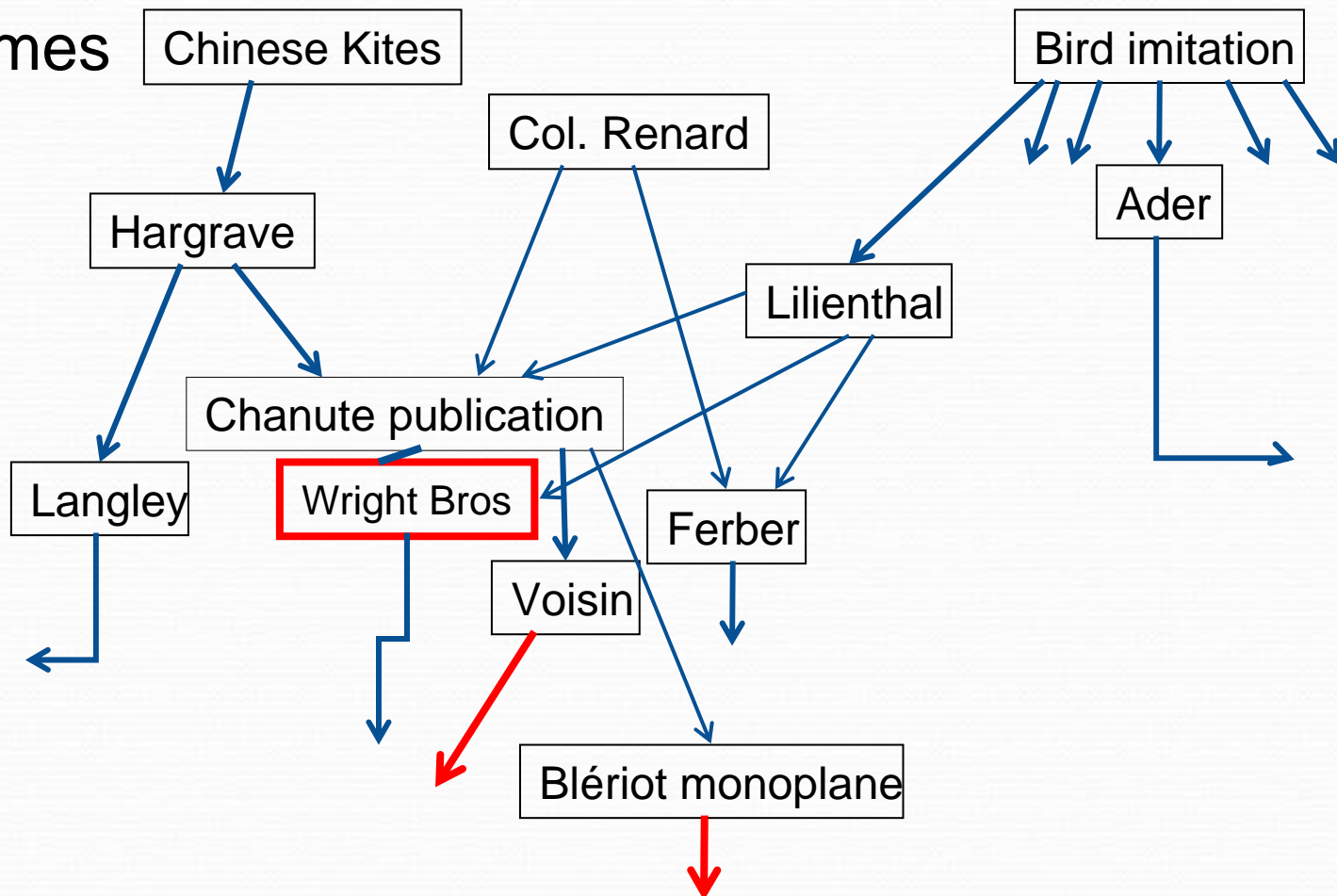
- 1894

- 1903

- 1906

- 1907

- 1908



Engines (and a/c weight)

- Maxim 1893: 2x180 Hp (5tons)
- Ader 1897: 28 cv (350kg)
- Flyer Kitty Hawk 1903: 4 cylinders, ex-Darrack, home-made 12 Hp (300 kg ?)
- Flyer III Dayton 1906 and Le Mans 8/1908: improved home-made 20Hp (325kg)
- Voisin Farman 1908: 50cv (350kg)
- Santos-Dumont 1906: 50cv (290kg)
- Flyer A Paris/Pau end 1908: Barriquand et Marre 50cv

Handling Qualities

The problem of the turn

- Many pioneers wanted to turn « flat »
- Only those who did solid « hang gliding » accepted to bank (and enjoyed it)
- For flat turns, rudder was chosen as sole means of turning
- The Wright brothers, possibly inspired by the bicycle, wanted to bank in turn

The problem of taking off

- Taking off wasn't easy with low powered engines
- The Wright used their catapult
- Most pioneers tried to pull the stick from the beginning
- By so doing, they increased Angle of Attack, increased drag and often failed to reach the takeoff speed
- In 1907, Farman, in despair after a series of aborts, swore, pushed his stick violently. **Took off the ground immediately.**
- He rapidly understood the role of drag and taught to others

Wright vs European approach

Stability and control:

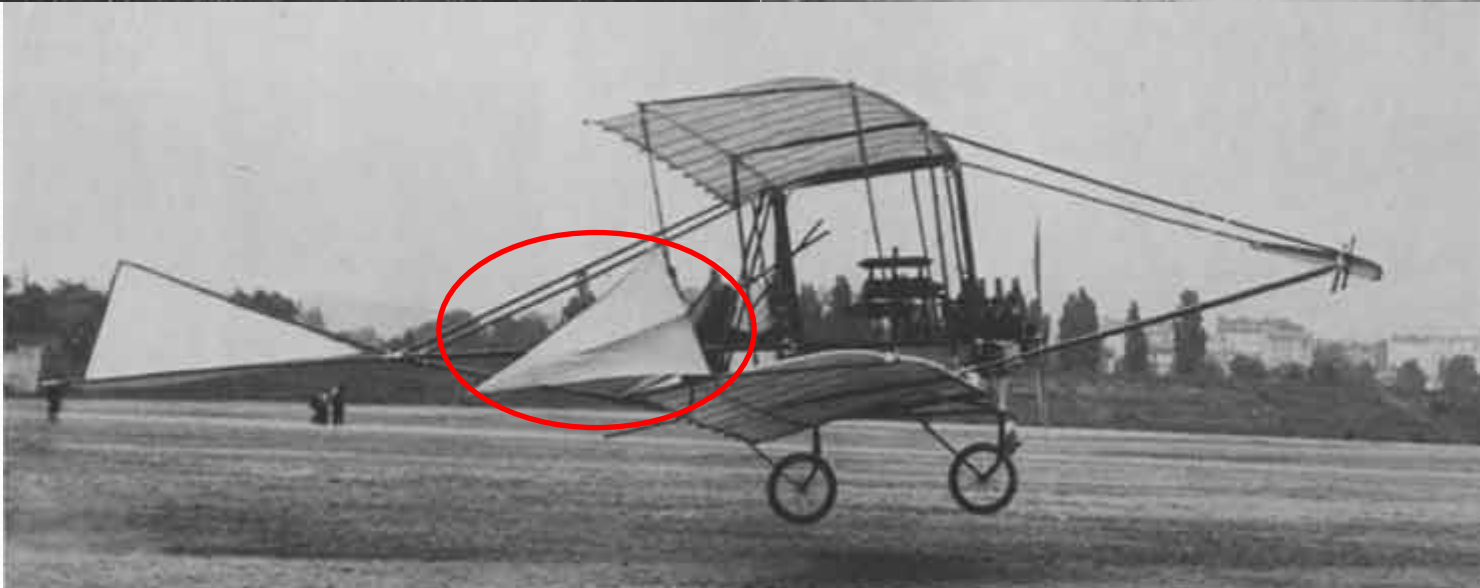
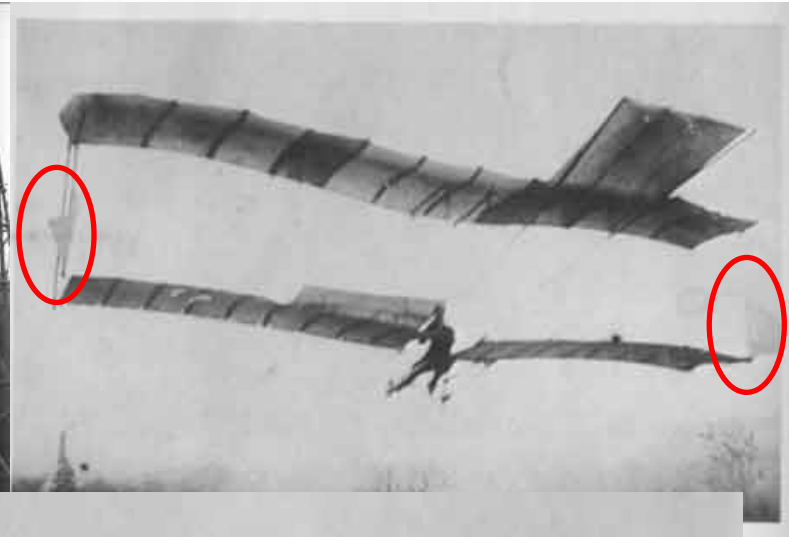
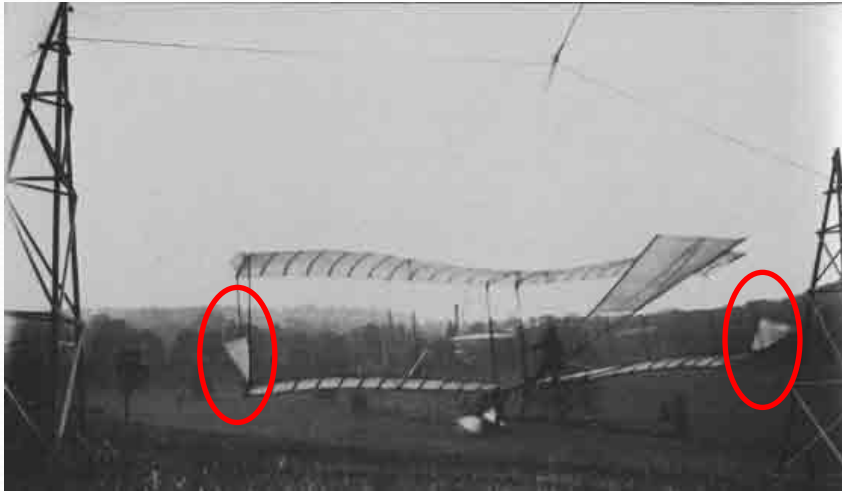
- In 1908, stability and control were not separate in the minds of engineers/pilots: a/c was controllable or not
- However a **cultural** difference arises:
- The Wright tried to control by all means. Their aircraft were statically unstable pitch and roll. They had to rely on their pilot skills
- Europeans searched for natural stability first: with natural stability in roll/yaw, flight with no roll control was possible

Ex: Ferber, Voisin, etc...

The outcome

- Neither approach was exact
- Wing warping induced such an amount of adverse yaw that it had to be soon replaced by ailerons (+ moderate dihedral)
- Europeans had to add roll control by ailerons to equate the **graceful manoeuvring agility** of the Flyer shown in 1908

Cne Ferber: winglets



Wright vs European approach

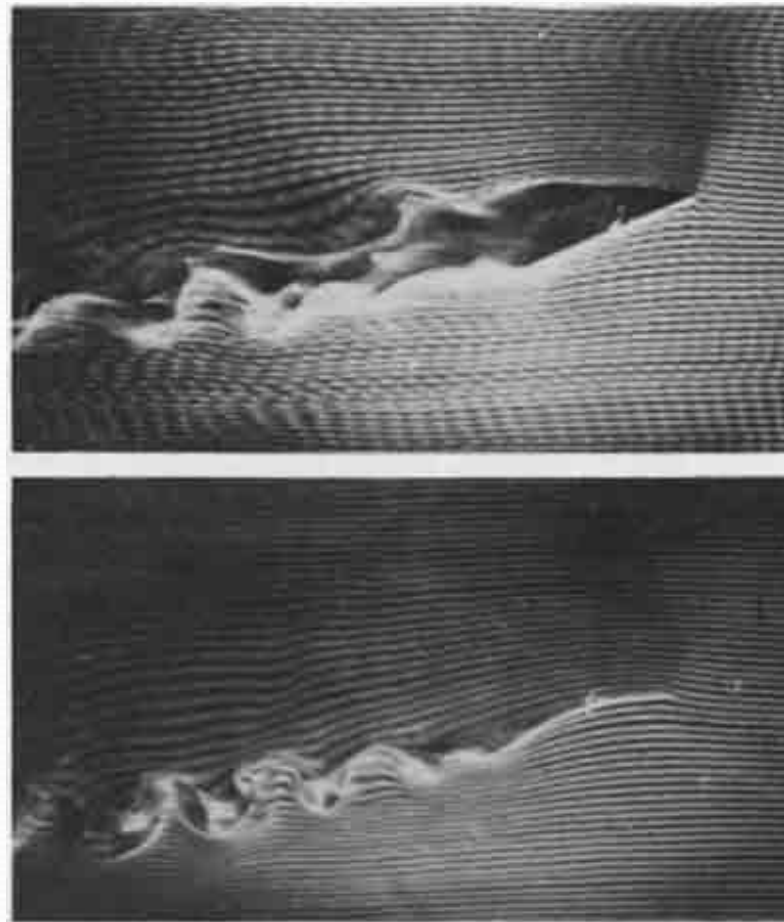
Overall aircraft Performance

- When it came to increase the flight envelope in speed (or angle of attack) the Flyer concept became more difficult to fly, because the gain of the wing warping was adapted for the original flight speed (AOA) only
- The european concept: natural stability first and then maneuverability, was much more adequate to fly at other speeds (AOA)

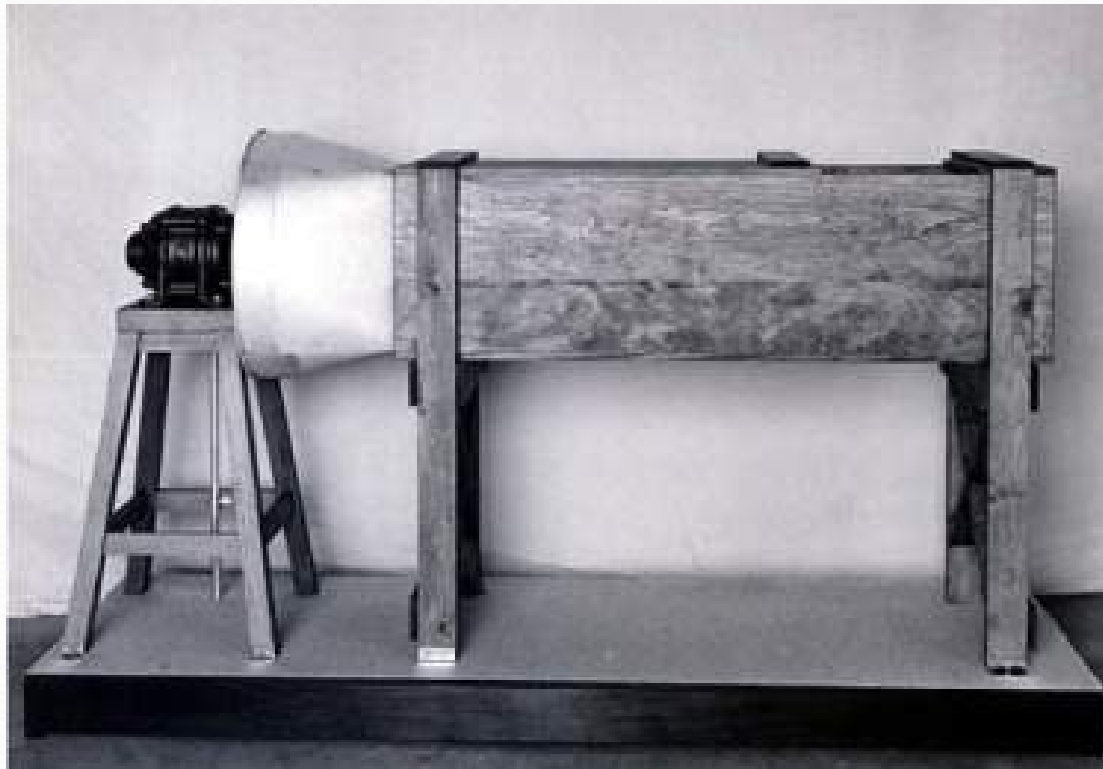
Wind-Tunnels

- Principle was first described by Mariotte, <1684, Fr
- Tunnels preceded by whirling arms: Cayley, Maxim, Lilienthal,...
- First tunnel: 1871: Wenham & Browning, Greenwich, UK
- Later researchers often preferred the use of full scale kites for dynamometric tests: Lilienthal, Hargrave, Ader, etc...
- 1880, 1890: Philips, Maxim, tunnels
- 1894, Marey, sucking tunnel for smoke visualisation
- Colonel Renard: 1896 first accurate measures in Meudon, Fr
- 1901: the Wright tunnel, Dayton
- 1909, Gustave Eiffel sets principles for the use of subsonic tunnels

First flow viz by Marey, 1894 +



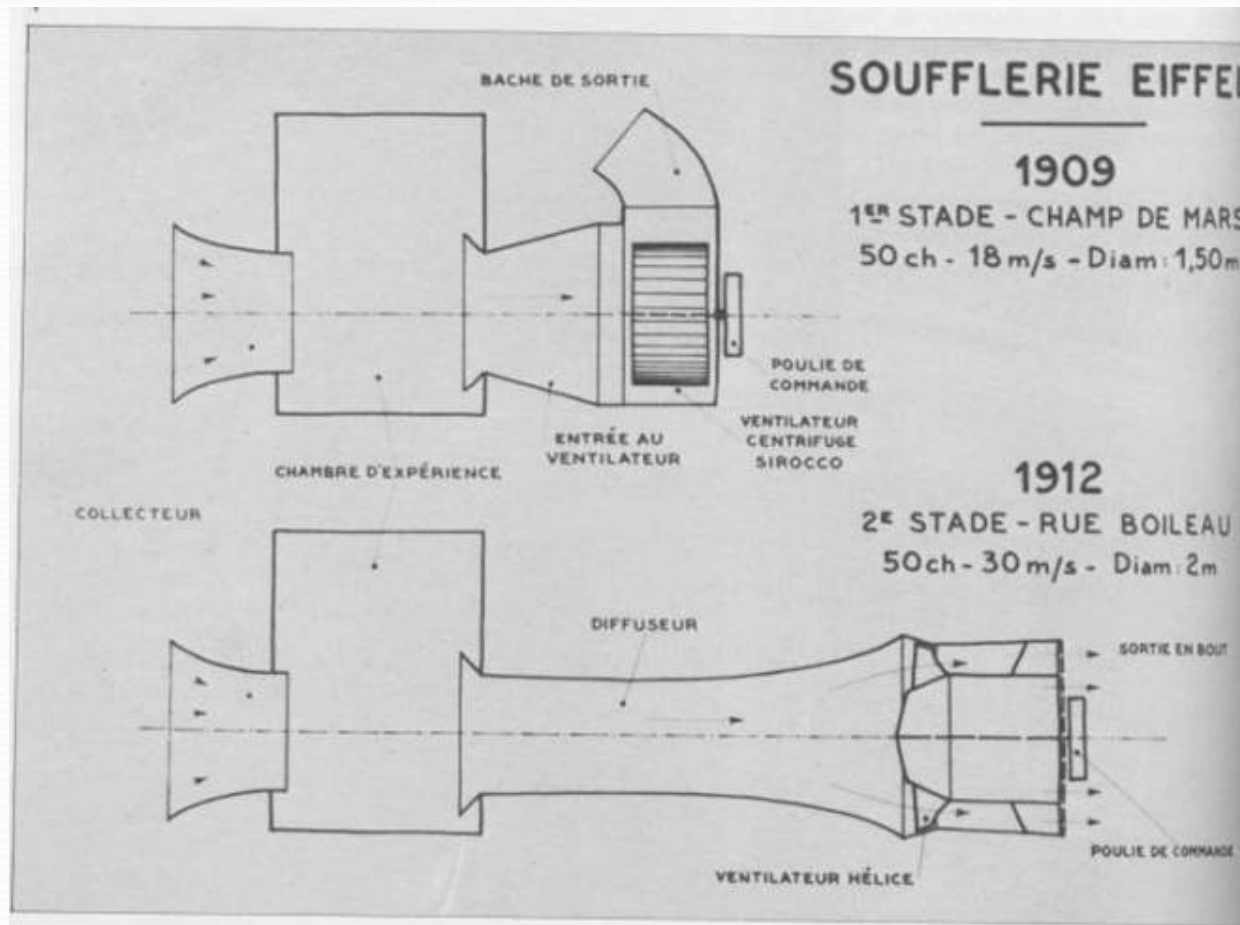
The Wright Wind-Tunnel, 1901



Presentation by Wilbur Wright

-wooden box. It was **16 inches wide by 16 inches tall by 6 feet long**. Inside of it we placed an aerodynamic measuring device made from an old hacksaw blade and bicycle-spoke wire. We directed the air current from an old fanEventually we learned how to operate it so that it gave us **results that varied less than one-tenth of a degree**.Over a two month period we tested more than two hundred models of different types of wings. All of **the models were three to nine inches long**.we measured monoplane wing designsbiplanes, triplanes and even an aircraft design with one wing behind the other like Professor Langley Professor Langley was the director of the Smithsonian Museum at the time and also trying to invent the first airplane. On each little aircraft wing design we tested **we located the center of pressure and made measurements for lift and drift**.Sometimes we got results that were just hard to believe, especially when compared to the earlier aerodynamic lift numbers supplied by the German **Lillienthal**. His **numbers** were being used by most of the early aviation inventors and they **proved to be full of errors**. Lillienthal didn't use a wind tunnel like Orville and I did ...

Eiffel wind-tunnels



Conclusion

- The science of aviation diffused much more than heroes say
- The Wright brothers undoubtedly achieved the very first controllable machine
- In particular, their specifically american temper led them to demonstrate the concept of **positive handling**, which was not so important as **genuine stability**, with their european competitors
- However, **very few of the Flyer's features** remained
- Aviation developed much more rapidly in Europe
- Final scoop: Henry Farman (first closed loop 1 km) was a British citizen, awarded French citizenship in 1932.