Aeromodelling and Aeronautic

- A review trough history and physics of Aeronautic -

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The eternal longing of mankind:

to be able to fly!

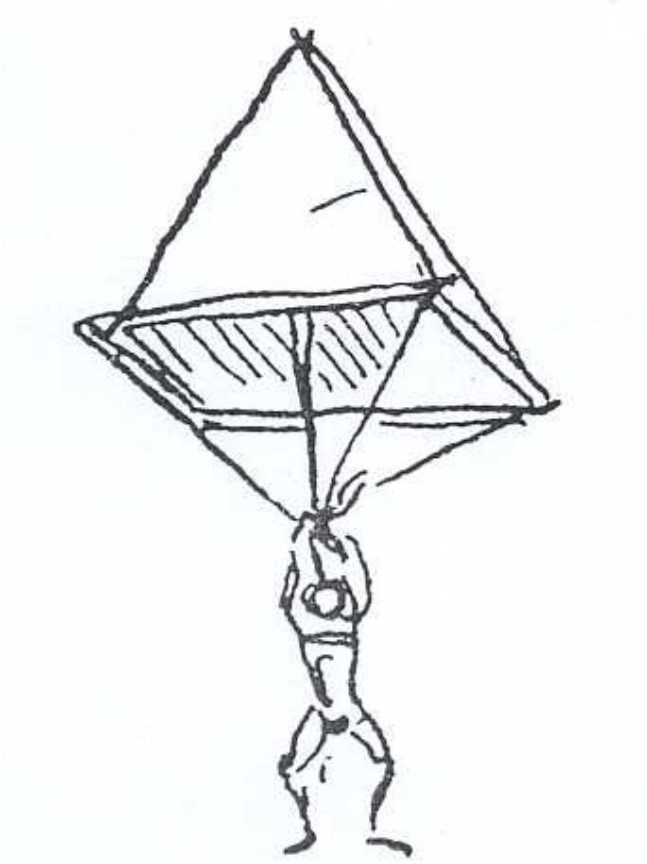
Vier Drachen spannt ich vor den Wagen, bestieg den Feuervogel dann. Und so im Staub und Sturm flog ich zur Höhe.

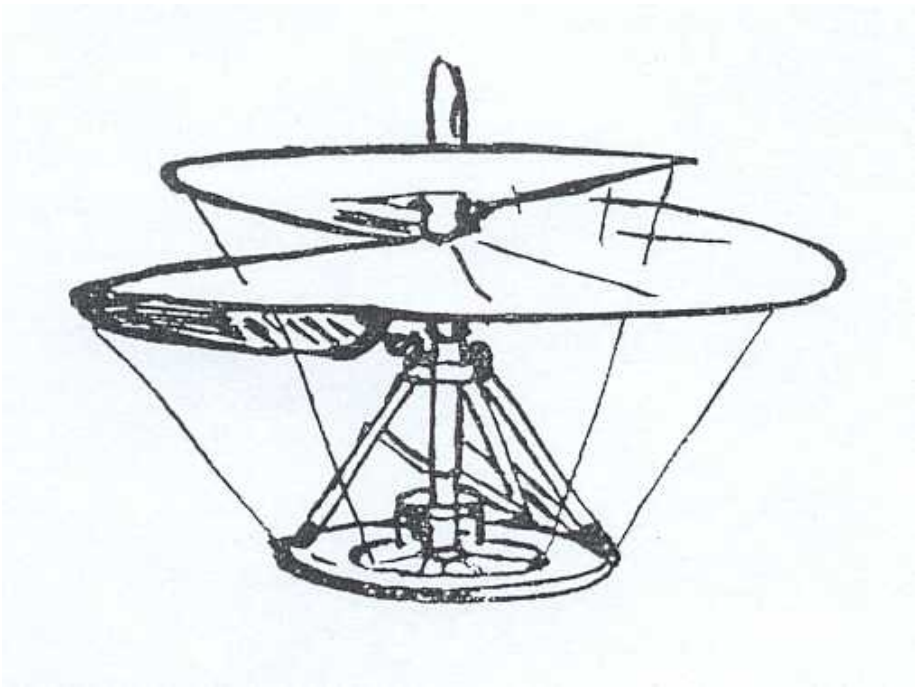
K'üh Jüan, etwa 300 v. Chr.

Dädalus und Ikarus

It‘s a myth –
the first aviation
accident in history
of aeronautic

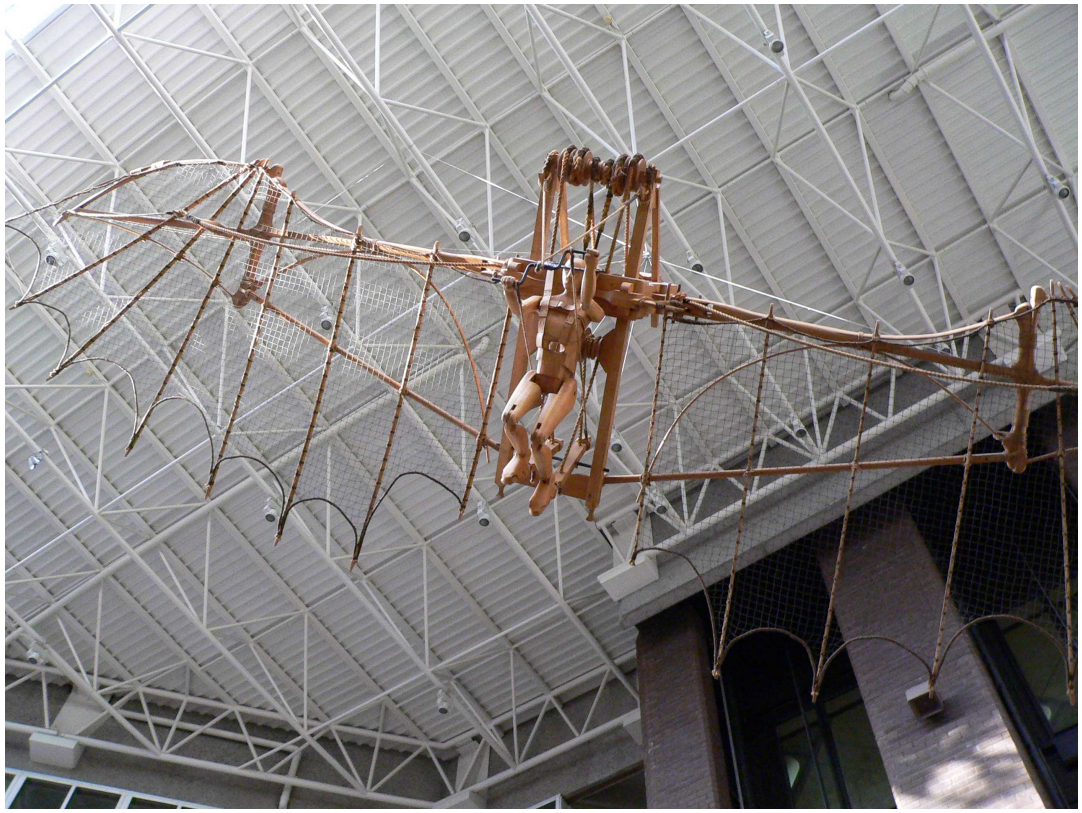
Scientific developments by Leonardo da Vinci (1452-1519)





1485: parachute and .. screw propeller - anticipation of airscrew

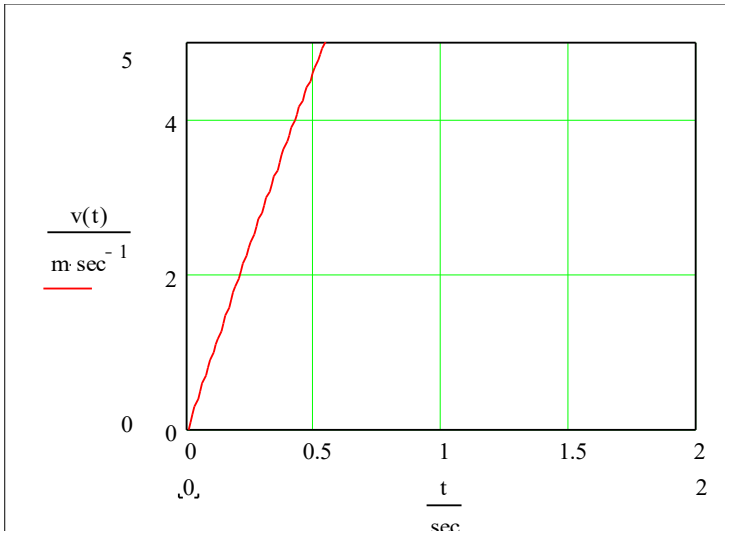
Scientific developments by Leonardo da Vinci (1452-1519)



later: proposal of an aeroplane [University of Limerick]

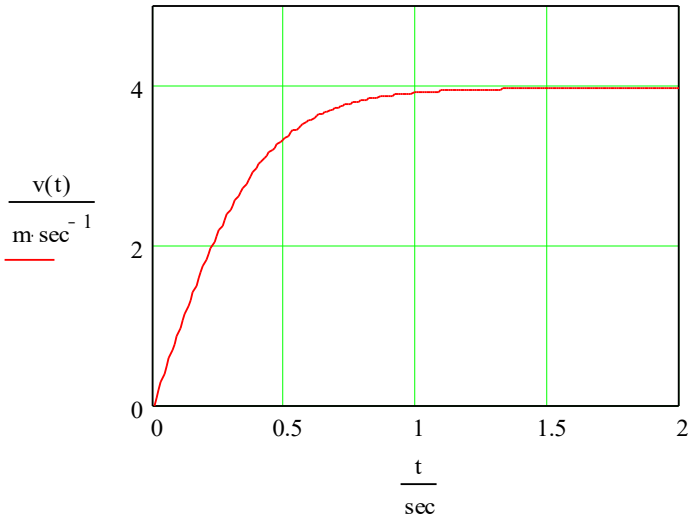
how does a parachute work?

- mass falls free without „drag“



-> velocity increases linear

- mass falls with drag
  numerical example: mass = 1kg, A = 1m²
  results in limited speed of v_{max} = 4m/s

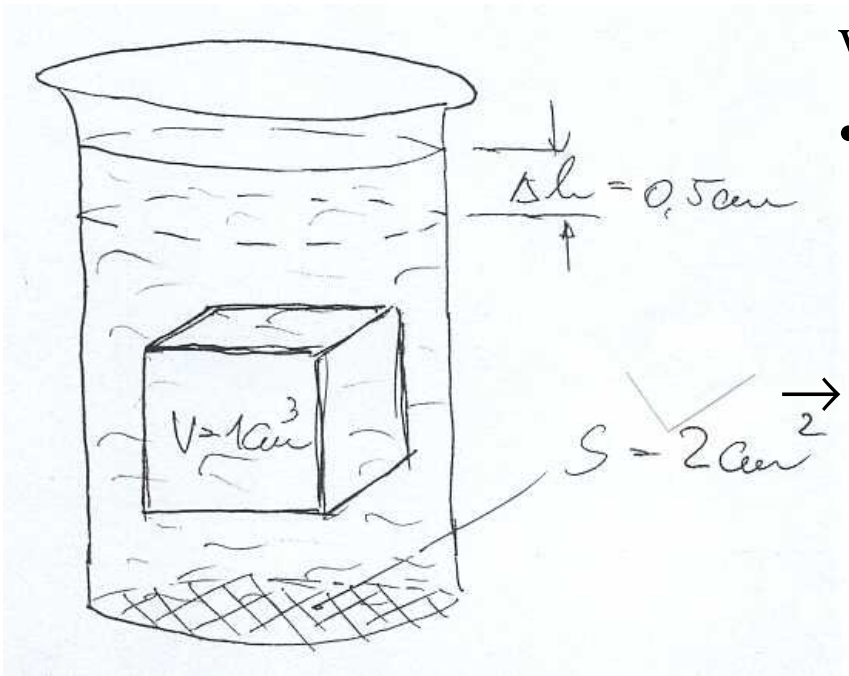


-> velocity goes into saturation

First airborne 1783 – Montgolfier-Brothers

- an unmanned hot air balloon with V =20m^3 cutted the retaining cables and gets airborne for 10Min
- a short time later a balloon ascends with animals and more later with people, crosses over Paris for 25 Minute and landed safely at the edge of town. The audience on earth accompanies the experiment with jubilation
- Why ascends the balloon?

Explanation: corpus in water



- it displaces the same volume of water as its own volume is
- but:
  in which case does the corpus swim?
  in which case does it sink?

→ it depends on the masses of both!

$m_{water} > m_{corpus}$: it swims

$m_{water} < m_{corpus}$: it sinks

and because $m/V = \rho$ (density) →

$\rho_{water} > \rho_{corpus}$: it swims

$\rho_{water} < \rho_{corpus}$: it sinks

.. more bodies in water!

In Dead Sea the salt content is very large, so the people do never sink but swim!

The Earth and its parameters

radius: 6400km

mass: $6*10^{24}$ kg

density: 5.47kg/dm^3

Fe und Si dominate

Magnetic field: 50µTesla

atmosphere: 100km

air density: 1,25kg/m^3

Because of the air‘s mass the earth‘s gravity „holds“ the atmosphere (gravitational attraction)

correlation: water ←→ air

If a corpus lighter than air is brought into Air – i.e. has a lower density than the air – then it is pressed upwards

→ aerostatic lift

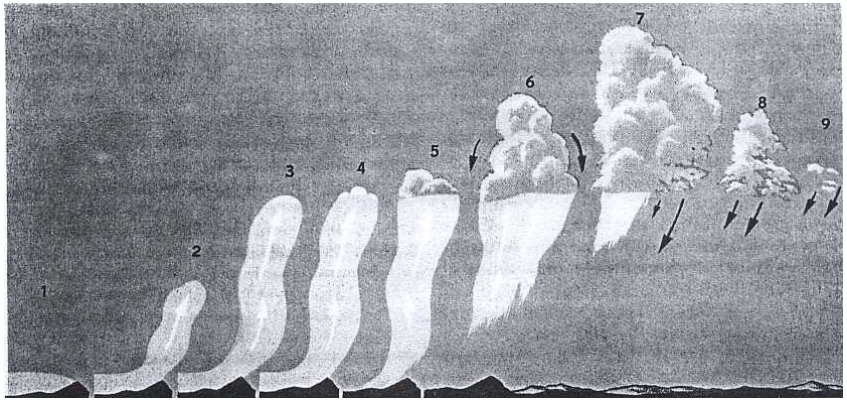
Beispiel für Gase, die leichter als Luft sind:

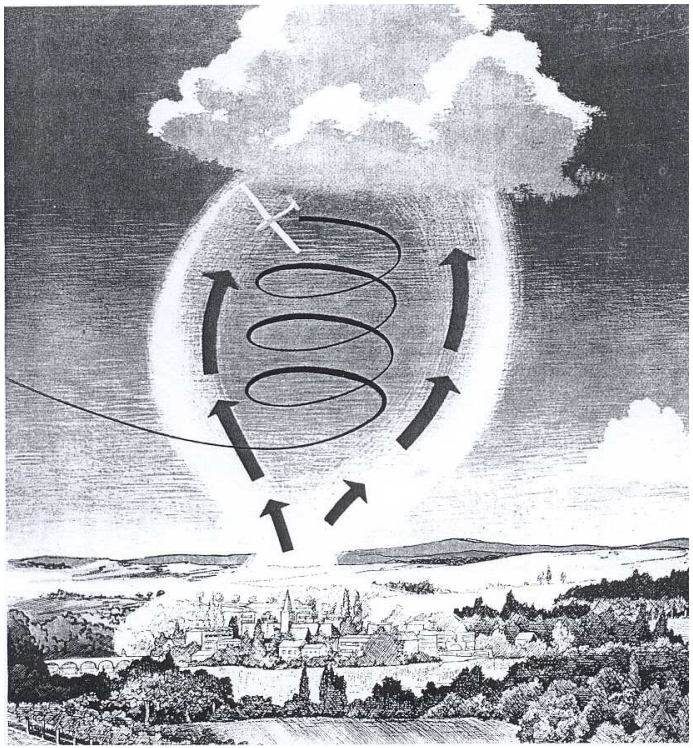
	Wasserstoff	Helium	Luft/100°C	Luft/0°C
ρ in kg/m^3	0.15	0.178	1.05	1.31

Wasserstoff ist sehr gefährlich (brennbar), Helium ist teuer in der Herstellung.

Ein Heißluftballon ($\theta \approx 100^oC$) mit einem Volumen von etwa
$V \approx 1m^3$ trägt eine Nutzmasse von $m_{nutz} \approx 300g$;
$V \approx 3000m^3$ trägt eine Nutzmasse von $m_{nutz} \approx 900kg$.

aerostatic lift – also in nature





Usually the sun shines on different areas of earth: meadows, grain fields, streets…the heat reflection into the air is different too.

Some air regions will be warmer than in surrounding areas

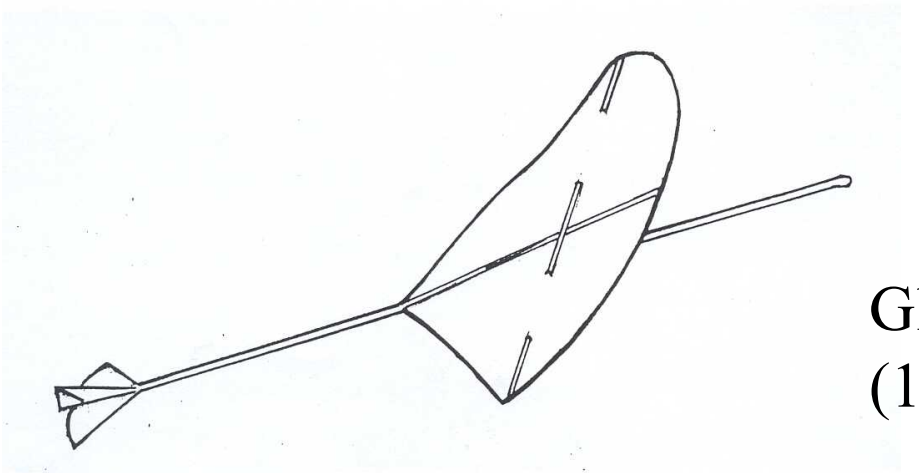
→bubbles of warm air soar… birds of prey, gliders and sailplane models exploit it !

But now: flying !

does a board fly? → it rotates

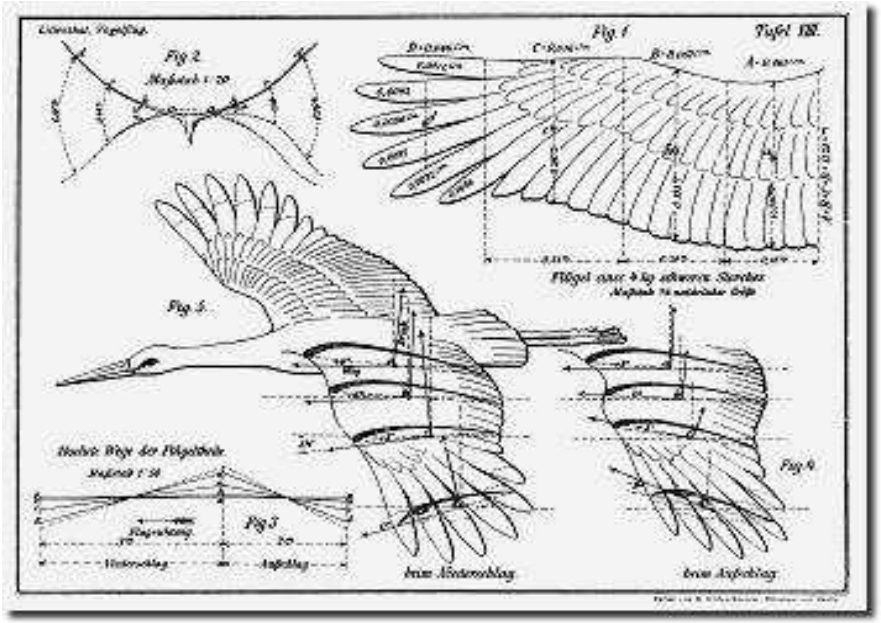
with a good position of c.g.: → it could fly

stabilisation by a horizontal stabilizer → it flies !



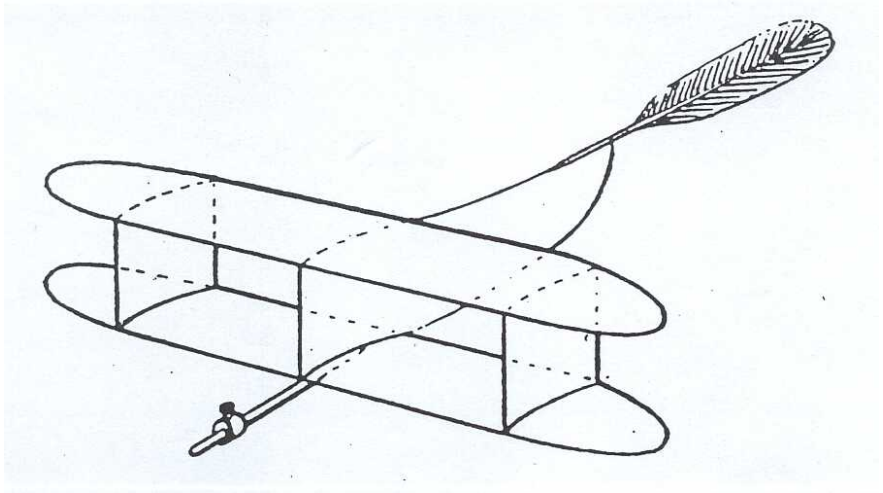
Glider by Sir George Cayley (1773-1857), 1807 designed

additional experiments with models …



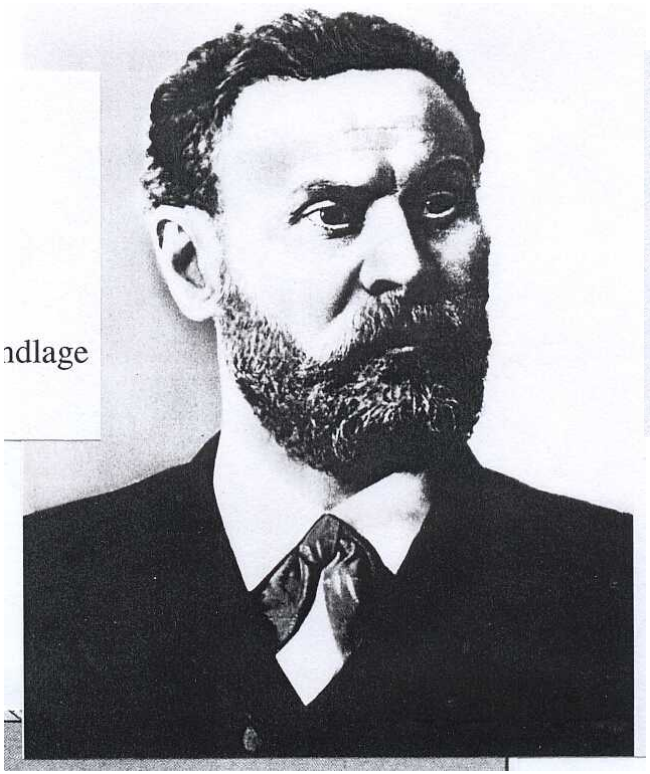
He built a biplane, and with the help of a trimming weight he found the best center of gravity.

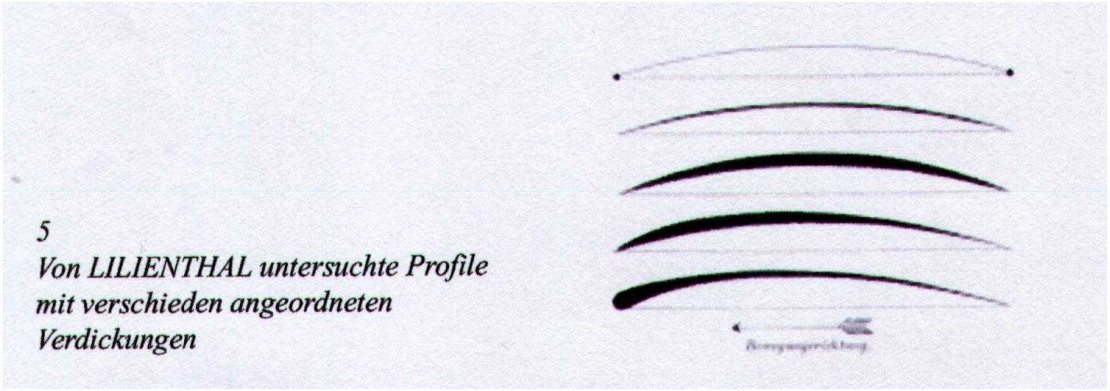
Otto Lilienthal observed storks and so he investigated the flight of birds. He wrote a book:
Bird flight – basic of flying



…and then things really took off !

Lilienthal (1848 – 1896): inventor of aeroplane and aviation pioneer

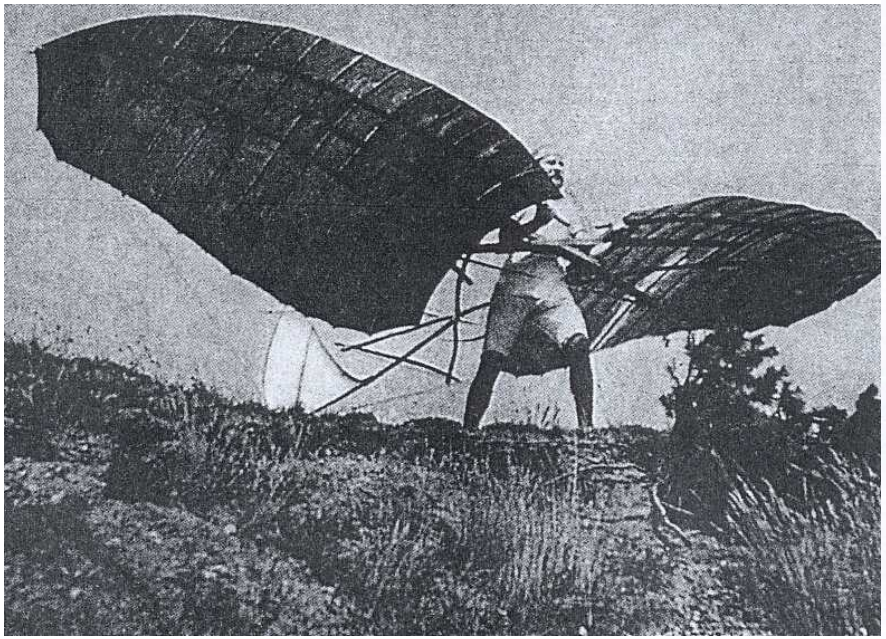


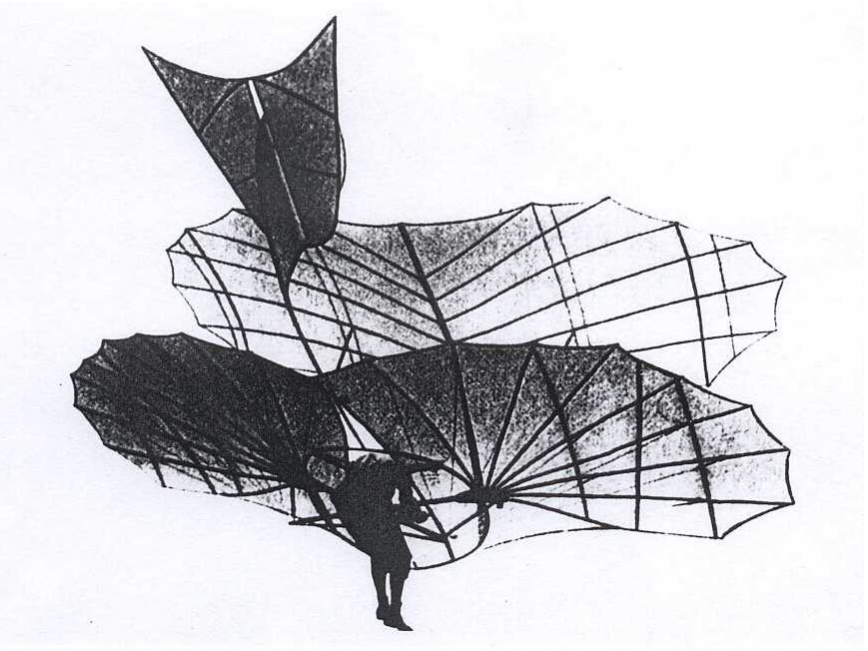


He investigated airfoils in a radial runout – the wind tunnel had not yet been invented

Gliding by Lilienthal

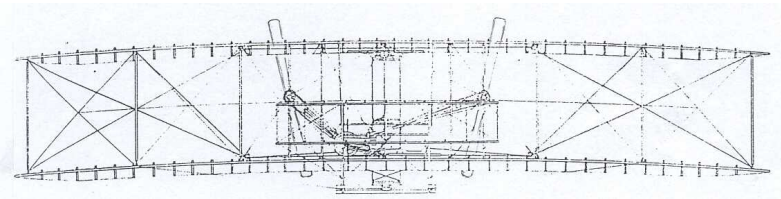
He built his own gliders and tested them

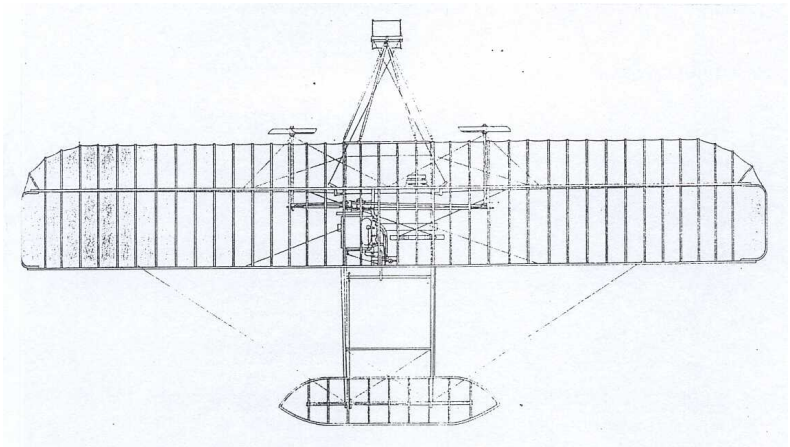




1891 he achieved near Derwitz/ Potsdam flight distances of 25m

Engine powered flight by Wright Brothers



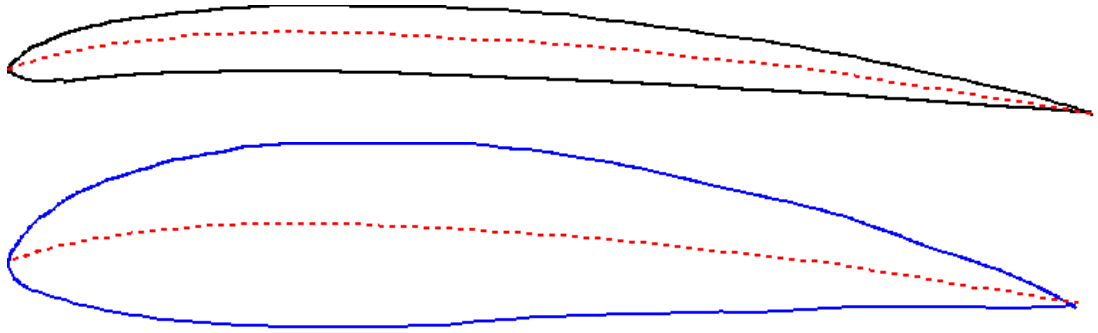


Wright Brothers, USA, achieved next milestone in 1903:
The first engine powered flight.

Improvement by Junkers (1859 – 1935)

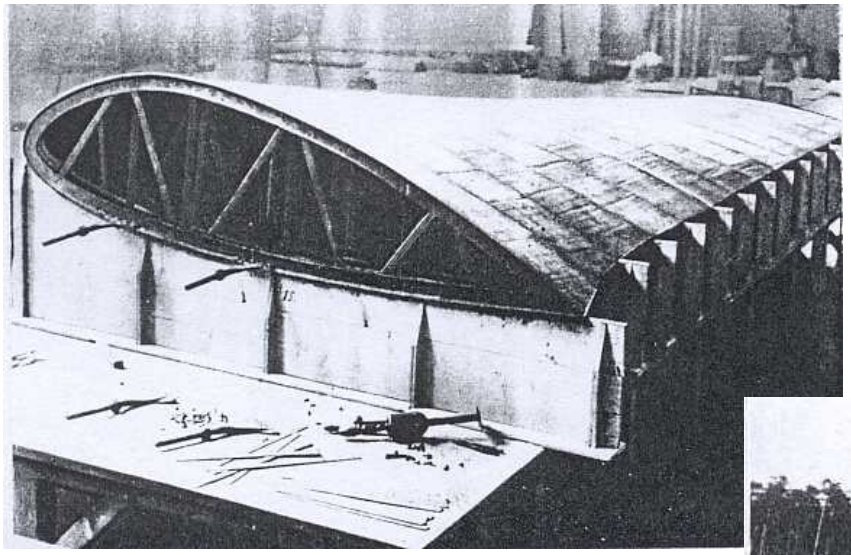

Professor Hugo Junkers.

Idia: keep camber (red line),
but enlarge thickness



His investigations on airfoils with larger thickness resulted in an unsupported wing

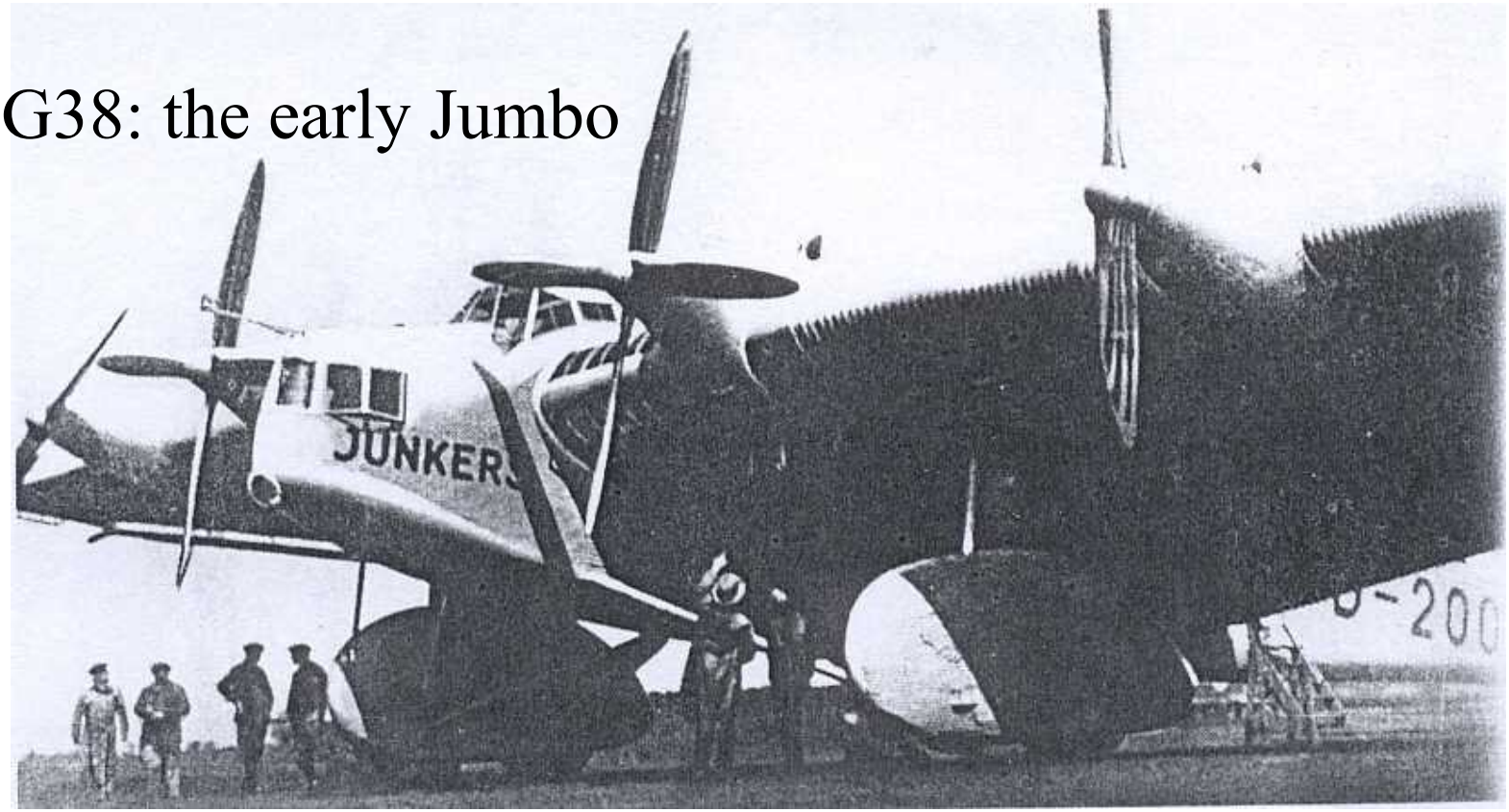
Wing without tensioning ropes



A thicker wing allows internal cross-bracing

→stable, unsupported wing,
→Application „plate donkey “

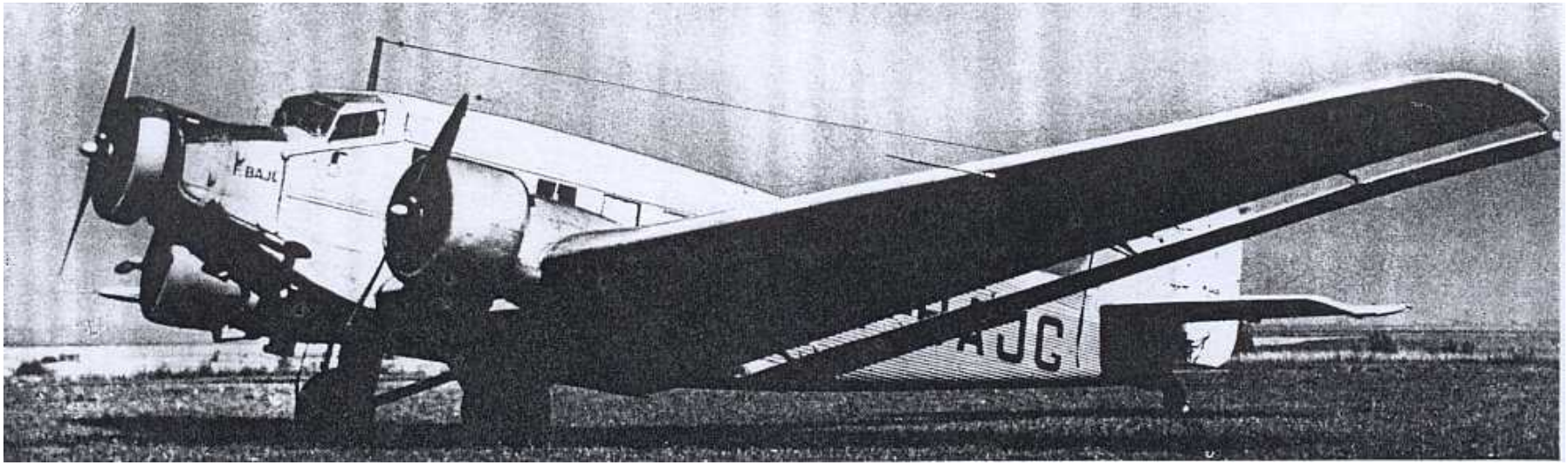
Junkers – commercial aircrafts



- maiden flight Nov. 1929
- only 3 copies built
- engines were accessible in flight
- „flying hotel“ with kitchen and a lounge

Junkers - commercial aircrafts

JU52: prototype of commercial aircraft



- maiden flight march 1932
- 17 passengers
- 5000 copies built
- standard aircraft in 30 airlines

Junkers - commercial aircrafts

JU52: it still flies today

Junkers - commercial aircrafts

JU52: it still flies today

April 2005: maiden flight A380

Luftfahrt

■ **Der Super-Airbus** mit dem Projektnamen A3XX soll dreistöckig mit zwei Passagier- und einer Frachtetage sein.

■ **656 Passagiere** kann er befördern. Die Reichweite wird etwa 14 200 Kilometer betragen.

■ **73 Meter lang** wird der A3XX; damit ist er äußerlich kaum größer als das Konkurrenzmodell 747-400 von Boeing.

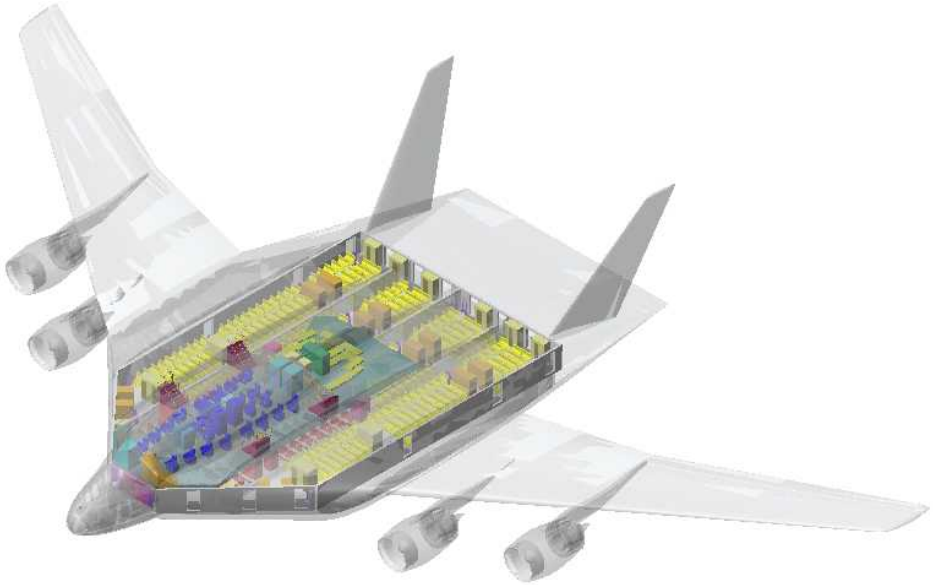
■ **Die Spannweite** wird bei 79,80 Metern liegen. Foto: dpa

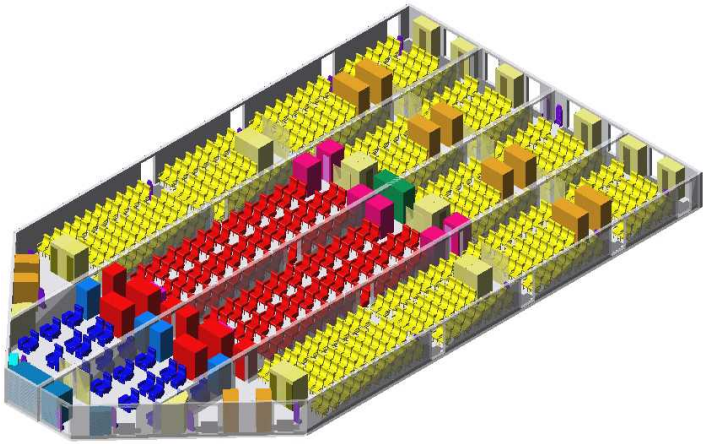
Europas Supervogel schlüpft

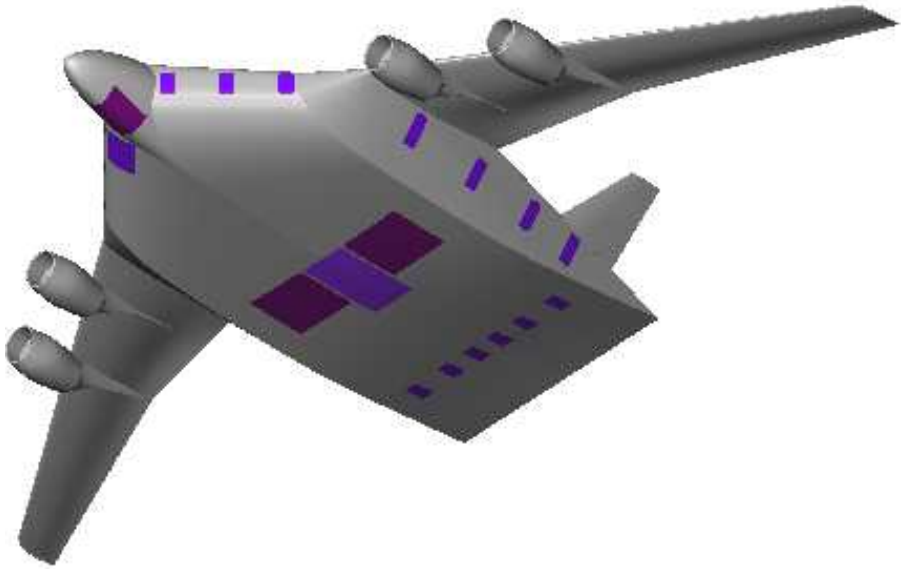
Airbus A3XX: Hamburg und Toulouse teilen sich die Montage / Etwa 50 Bestellungen / Bis zu 50 000 neue Jobs

By the aviation authority registered for 500 bis 550 passengers

... and perhaps in 25 years:

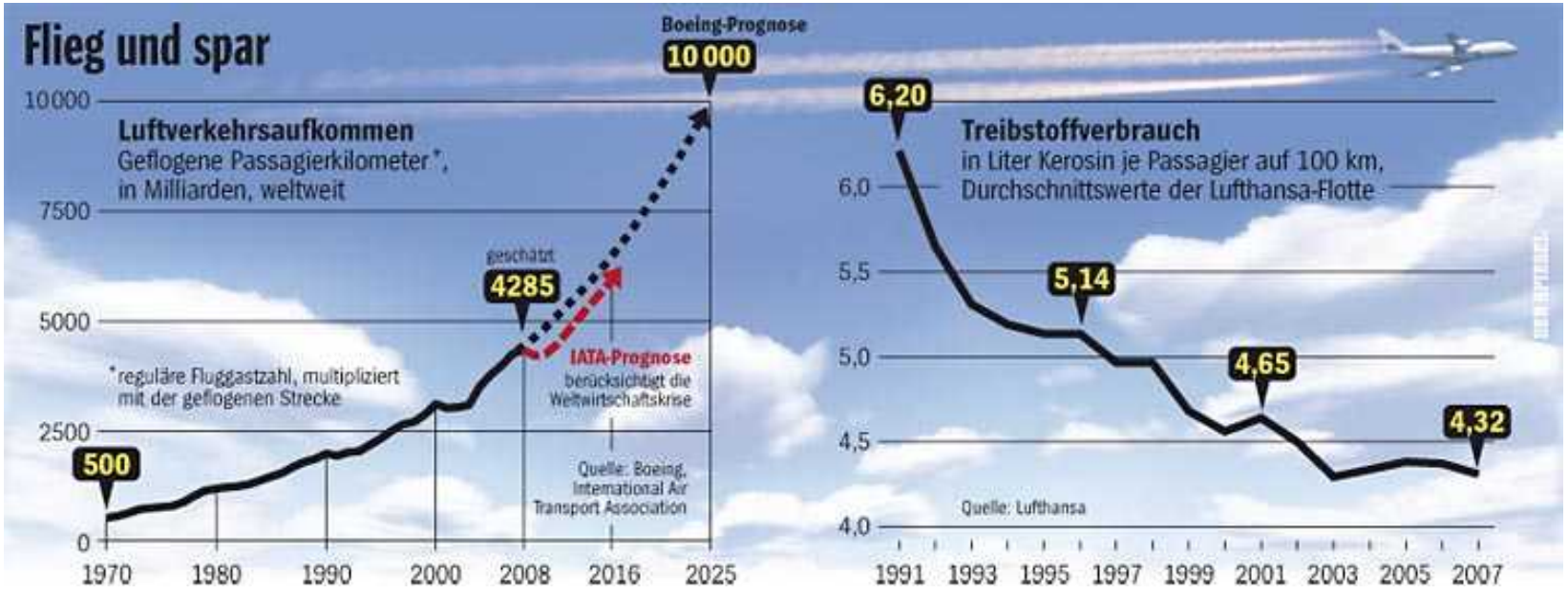






- blended wing body configuration
- number of passengers ≥ 1000
- AC2030 - predevelopment has started at FH Hamburg/demonstrator

Are such large plans necessary?



The statistics showed:
passenger volume doubles every 12 to 15 years!

But unfortunately …

- have the passengers changed their flight behaviour: They wouldn't fly via the large hubs such as Frankfurt, London, New York, Dubai and Tokyo anymore, which the A380 was made for
- does the A380 fly profitable only if all seats are occupied
- was the aircraft less and less demanded, therefore the company announced in 2019 to restrain the production and to terminate it in 2021. Then AIRBUS will have built only 280 pieces instead of the once planned 1500 pieces of A380…?!

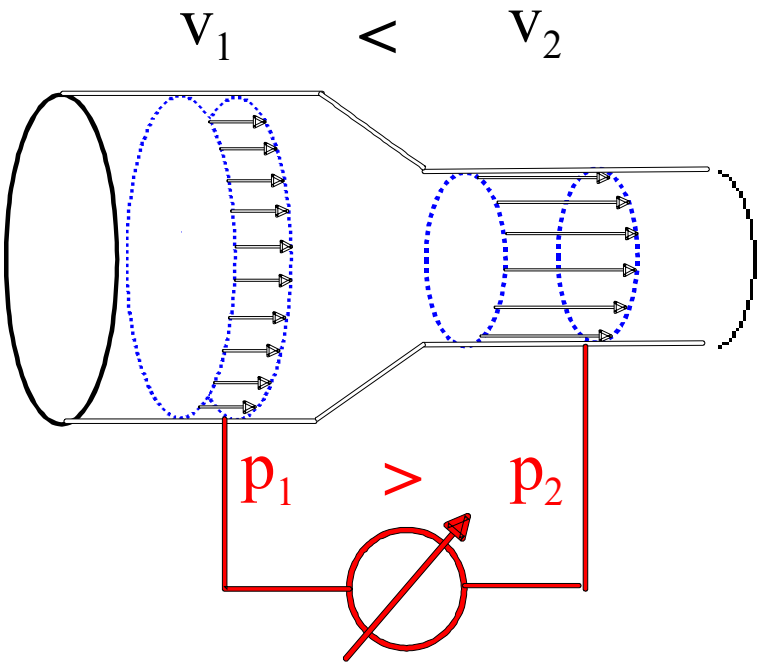
But why can such a large plan fly ?

remember the athmosphere:
its range 100km,
→results in an air pressure of
1000mbar = 1,3kPa = 10N/cm^2

→corresponding to 10m water column; i.e., the postcard does not fall down as long as the length of the tumbler is smaller than 10m

But the air pressure can be changed:
blowing up a balloon - inner pressure increases
drinking with a plastic straw - pressure in mouth decreases

low pressure in streams

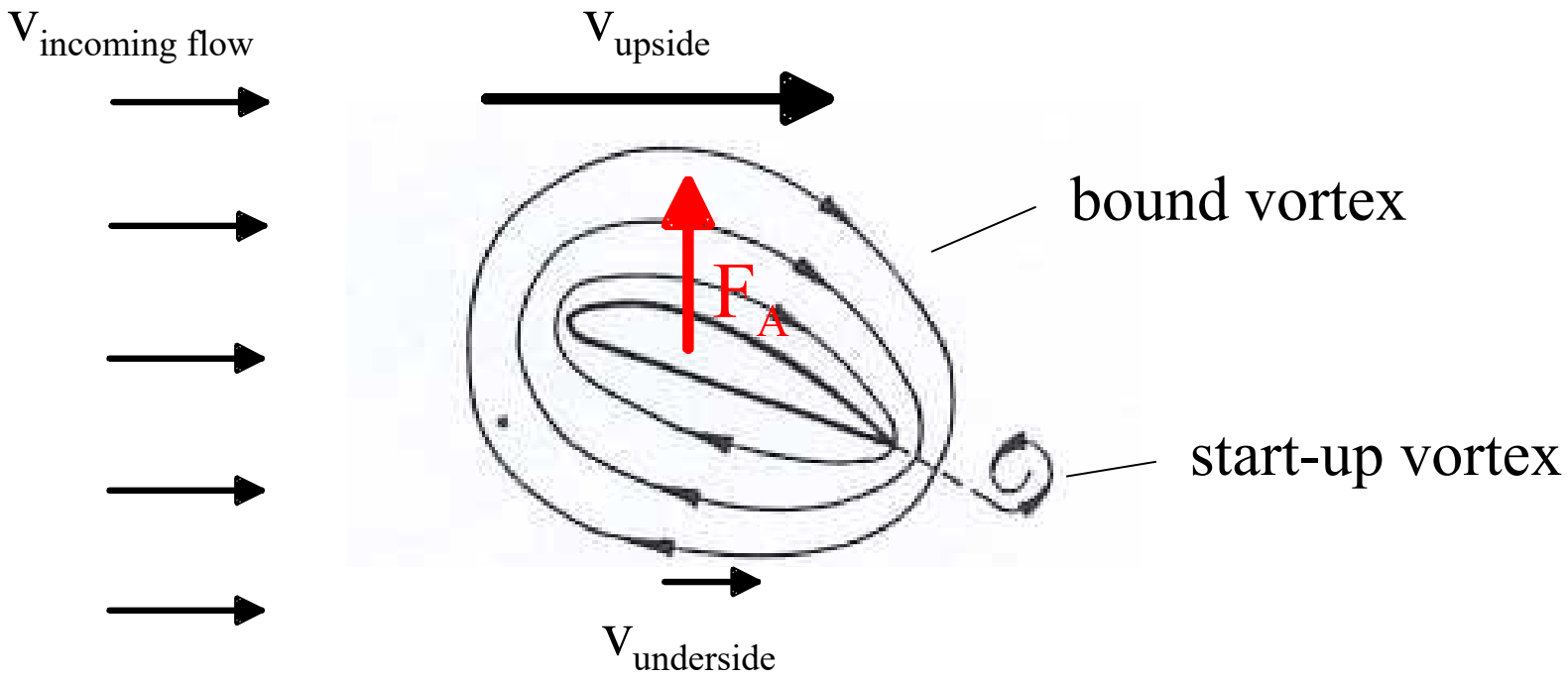


Bernoulli discovered it:

large velocity in streams
= lower pressure in medium

examples:
*blow with air
-between 2 postcards,
-a bag out of a sinkhole
*spoon on water jet

this happens on a flying wing:



→ a plan is hold in sky by low pressure/overpressure

summary

- yearning for the ability to fly is as old as mankind itself
- the aeronautic started with exploitation of *aerostatic lift* (Baloon)
- A plane wing produces lift by differences of air pressure; this results from an air flow with different speed on upper and lower side of the wing (*dynamic lift*)