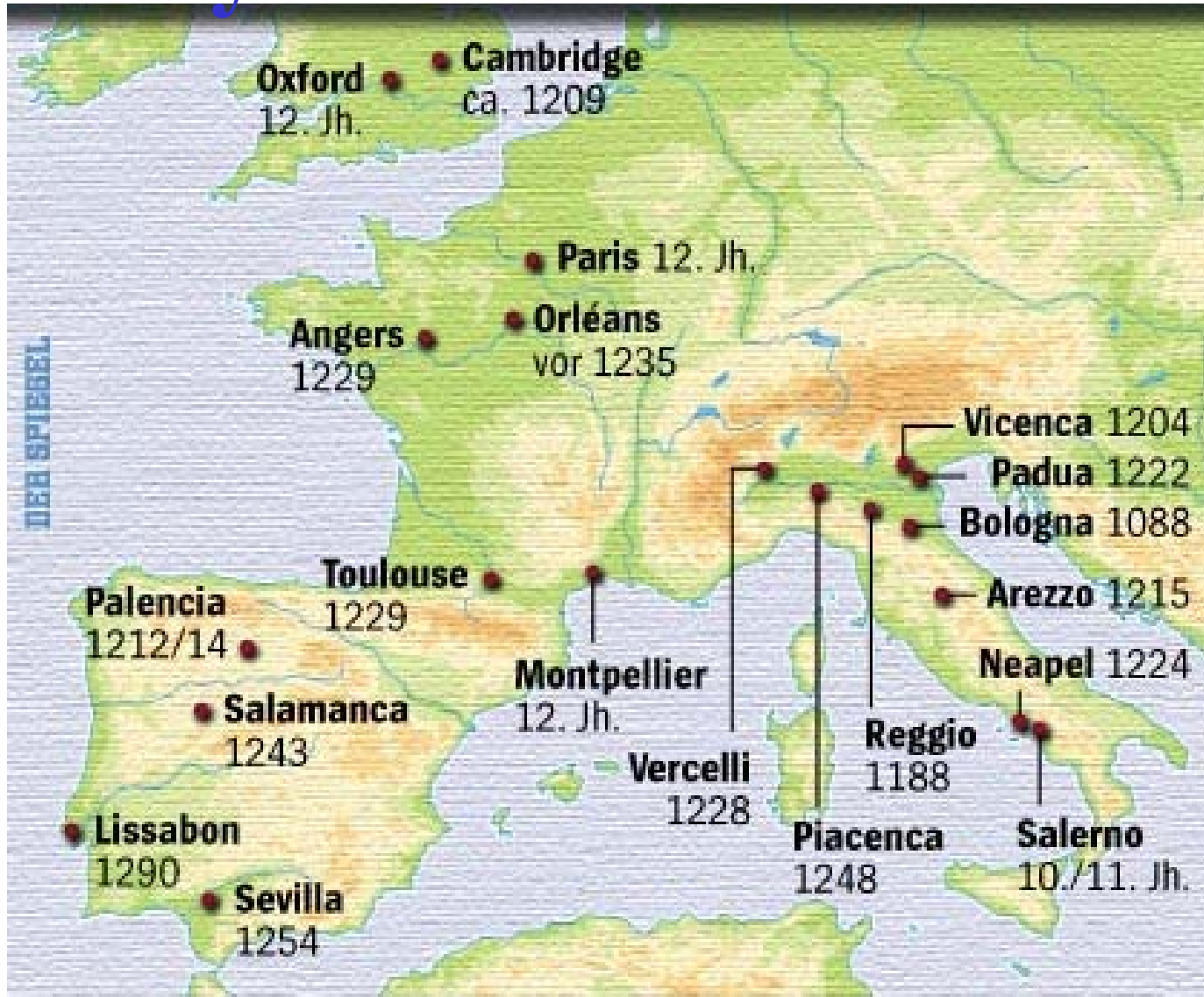


Science and Engineering History – The first Universities



Science and Engineering History – The first Universities

From the beginning, University charters assured **Academic Freedom**, a promise not always kept.

We will discuss implications of repression in the context of the engineering profession in the Ethics chapter.

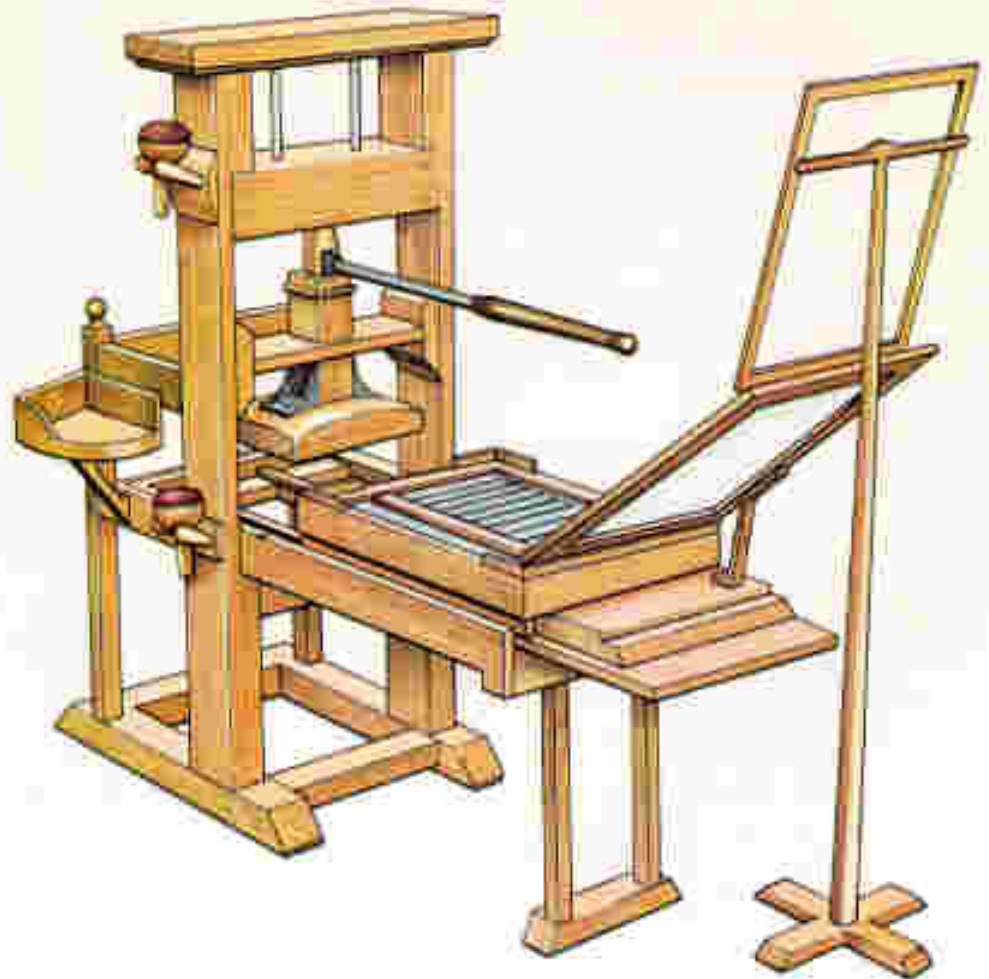
Science and Engineering History – The first Universities

Universities and other places of research create new knowledge.

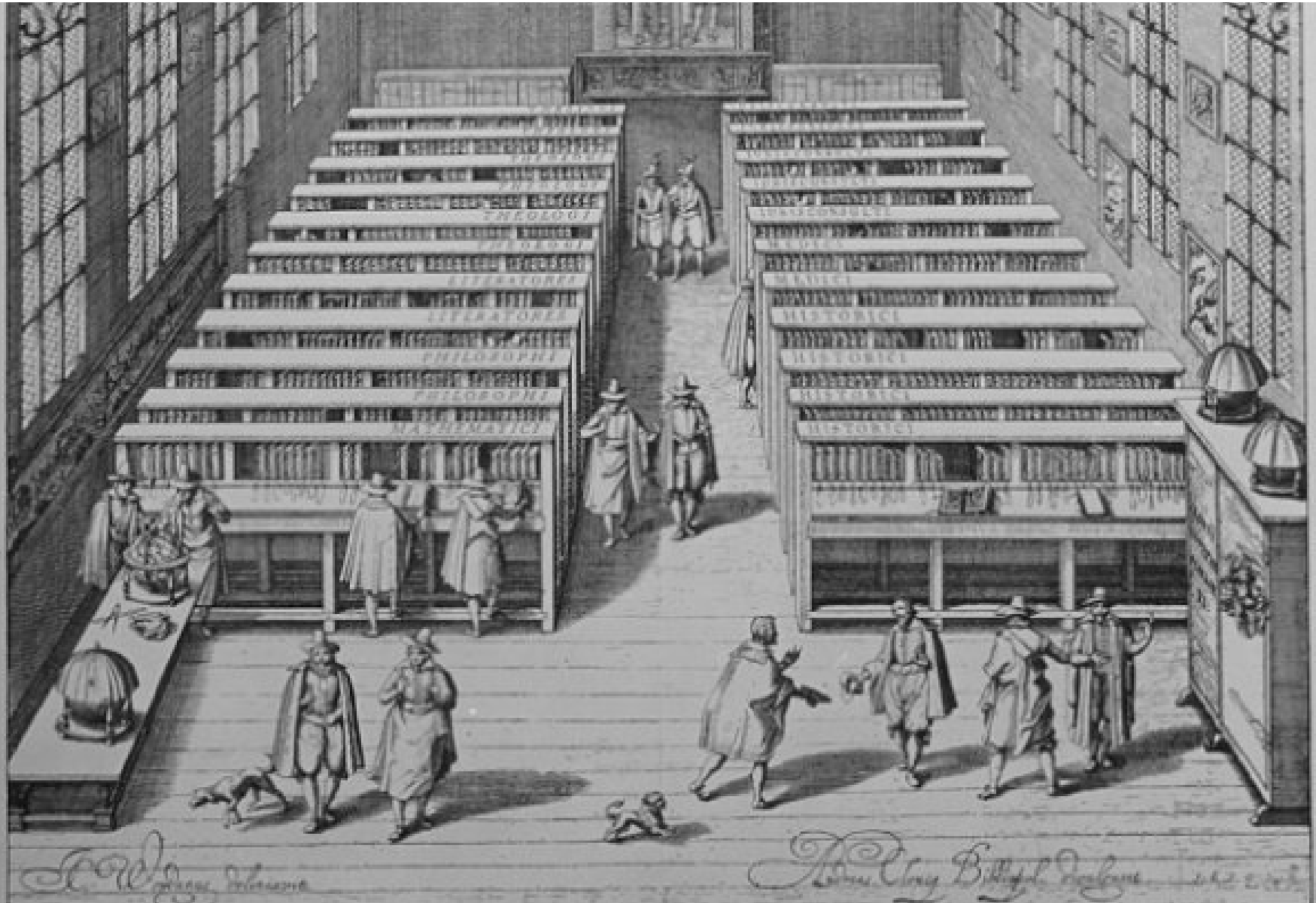
The invention of the printing press around 1450 created an economically favorable means for the distribution of knowledge.

The knowledge of the 17th century was easily stored in a small chapel. (second next slide)

Gutenberg Printing Press ~1450

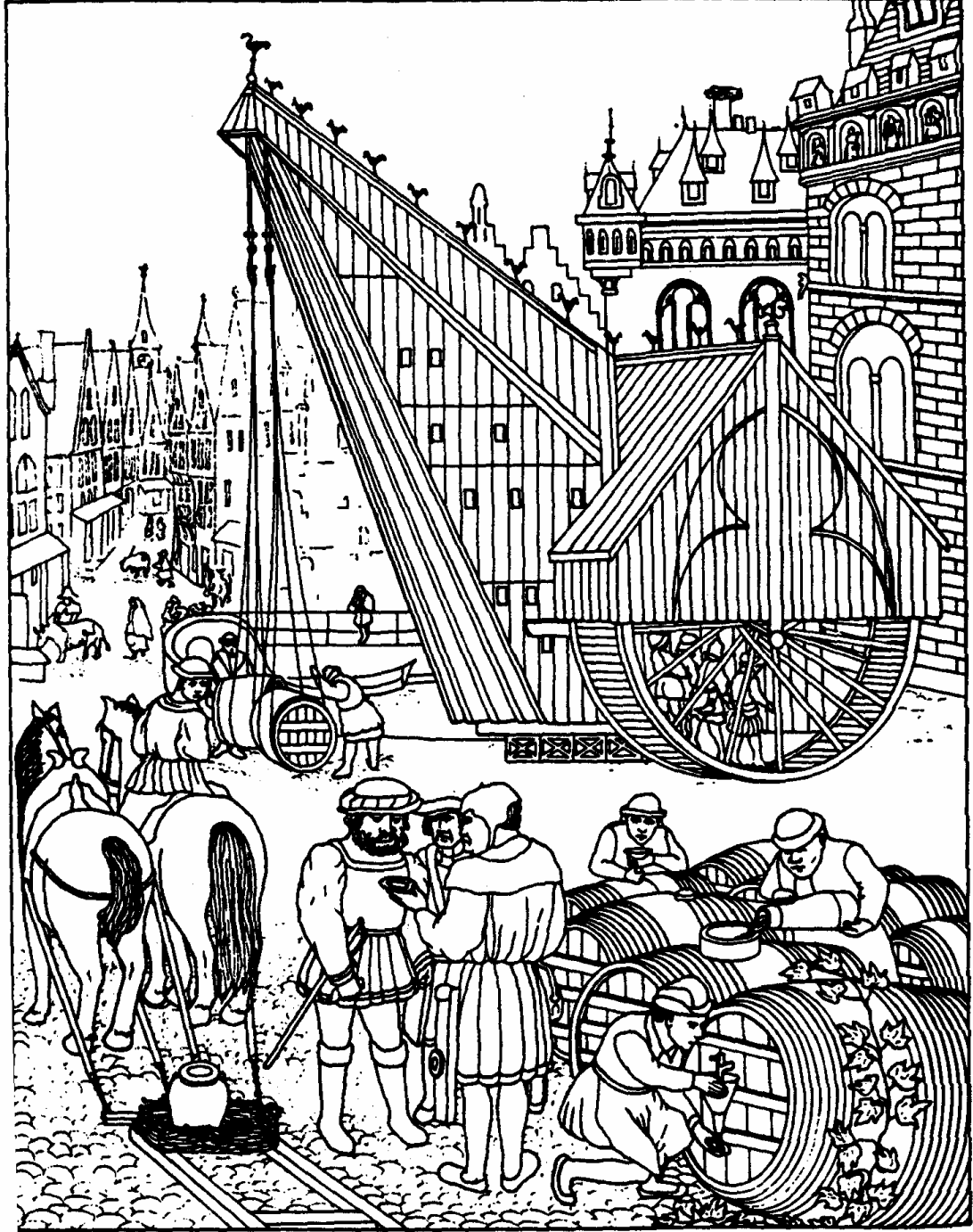


University Library in Leiden, ~1610



*Look how far we
have come:*

Treadmill in Leiden, Netherlands 17th Century



Louis XIV
Roi de France
1638-1715

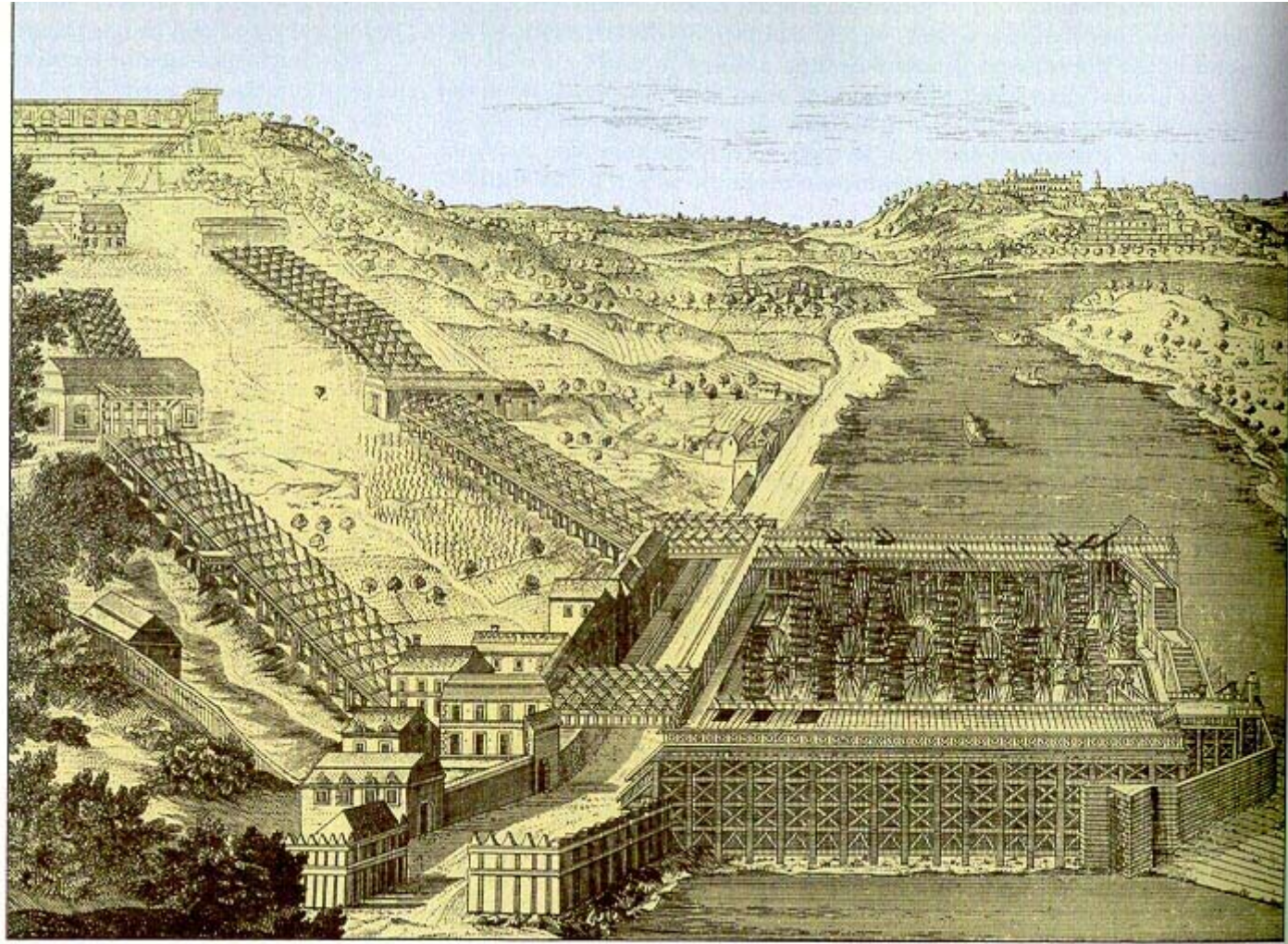
Louis XIV in Majesty,
1701 , by H. Rigaud





Chateau de Versailles

Thirteen water-wheels powered 235 force pumps, which pumped up to 1 million gallons (5,000 m³) of river water into the reservoirs daily. The reservoirs were situated 525 ft (160 m) above the river.



Versailles: The King's Waterworks (supplying his fountains)

Total Output: approx. 50 hp

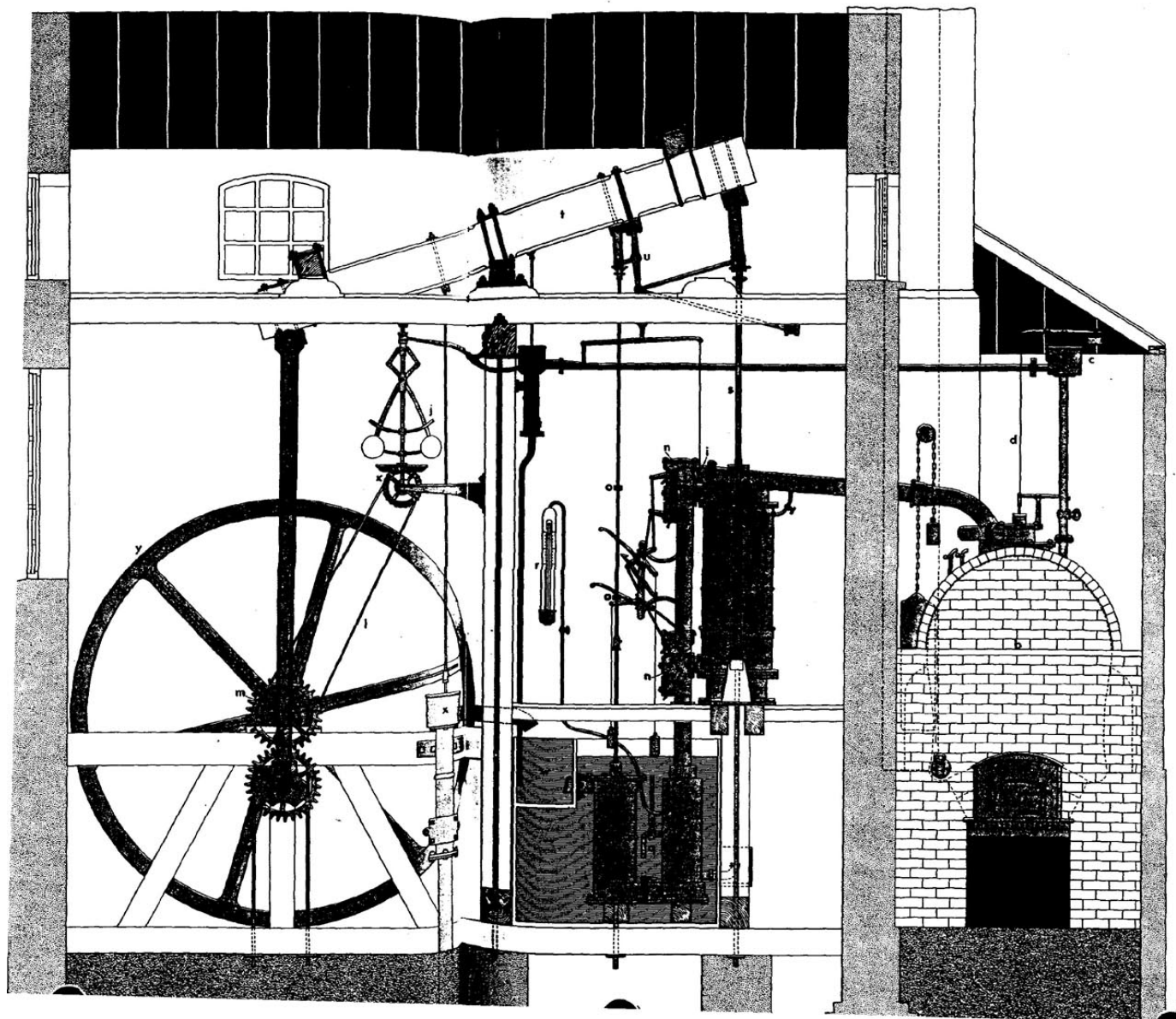


Isaac Newton

**Scientific Inquiry takes time
and effort. Newton's law:**

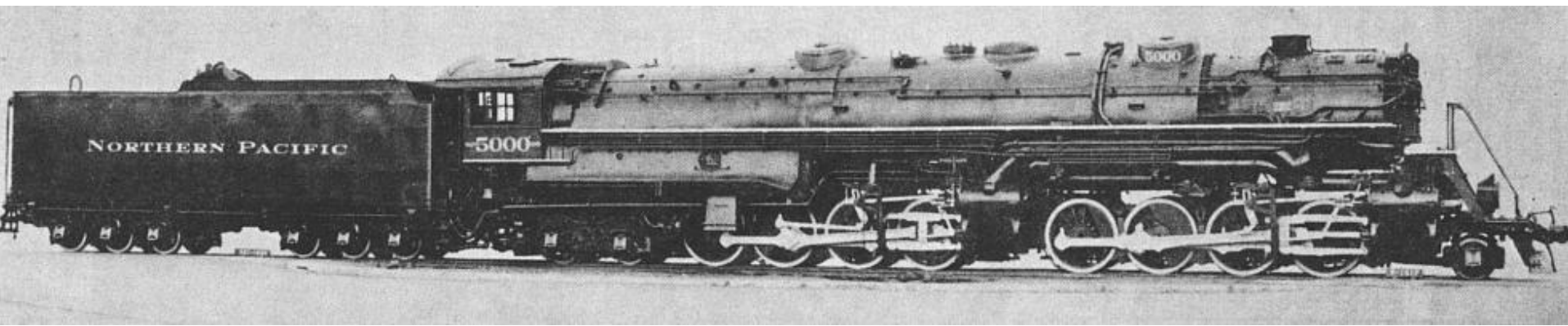
$$\mathbf{F = m * a}$$

- **From Galileo's fall experiments in Pisa, it took 100 years until Newton finally formulated it.**
- **Science is analytical and systematic, but generally NOT intuitive**



Between the years 1781 and 1800, quite a large number of acting steam-engines were manufactured at Boulton & Watt workshops. 1 foot was 10 horsepower worked with twenty-strokes a minute. (a) (b) Boiler. (c) A device which the water level was controlled. At the top of a string (d), a float was attached. When the float sank in the boiler, a valve (e) and water, hoisted by pump (f), poured in. When the float had returned to its original position, the valve was closed again. The boiler was admitted pipe (g) to the cylinder. A throttle valve (h), the aperture was determined by a trifugal governor (j). A gear train (k) and a governor was powered (m) of the sun-and-planet cylinder (h) was closed and steam alternate above and below the two valve chests (n). The valves were opened by projections (o) on a Condenser. (q) Pipe cold water into the Manometer. The piston was transmitted (t) by a parallel link was also linked to a means of which condenser and air were pumped (w). (x) Pump, driven and used to pump water to the cistern condenser and pumped. The balance movement was transferred by a rotary movement by a cog-wheel, the pinion meshed with the sun-wheel's (y) shaft.

Boulton & Watt Steam Engine, ~1800



Northern Pacific class Z-5

The first **Yellowstone** was built in 1928 by ALCO for the Northern Pacific for running throughout the high speed plains of North Dakota. The Yellowstone was designed with the largest firebox ever.

The Yellowstone was the largest steam locomotive in the world (at that time) and ALCO celebrated by serving dinner to 12 people seated in the firebox! The NP Yellowstones produced 5,000 HP.

The First IC Engine

Used coal gas,

About 10 m tall,

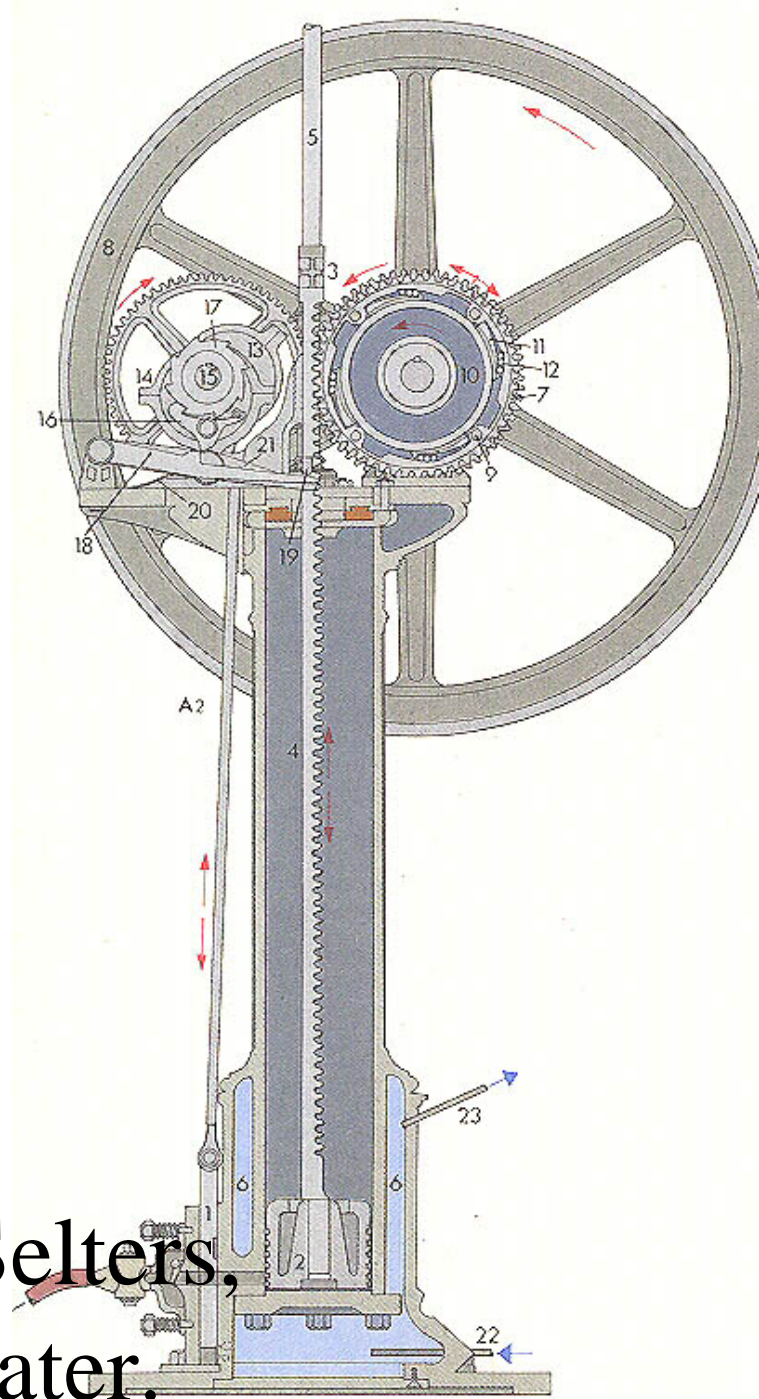
Free-flying Piston

Operation

Step1: The gas/air mixture is compressed as the piston falls under its own weight.

Step 2 : The compressed gas/air mixture is ignited, driving the piston up. (the work stroke)

This engine was installed in Selters, Germany, to pump mineral water.

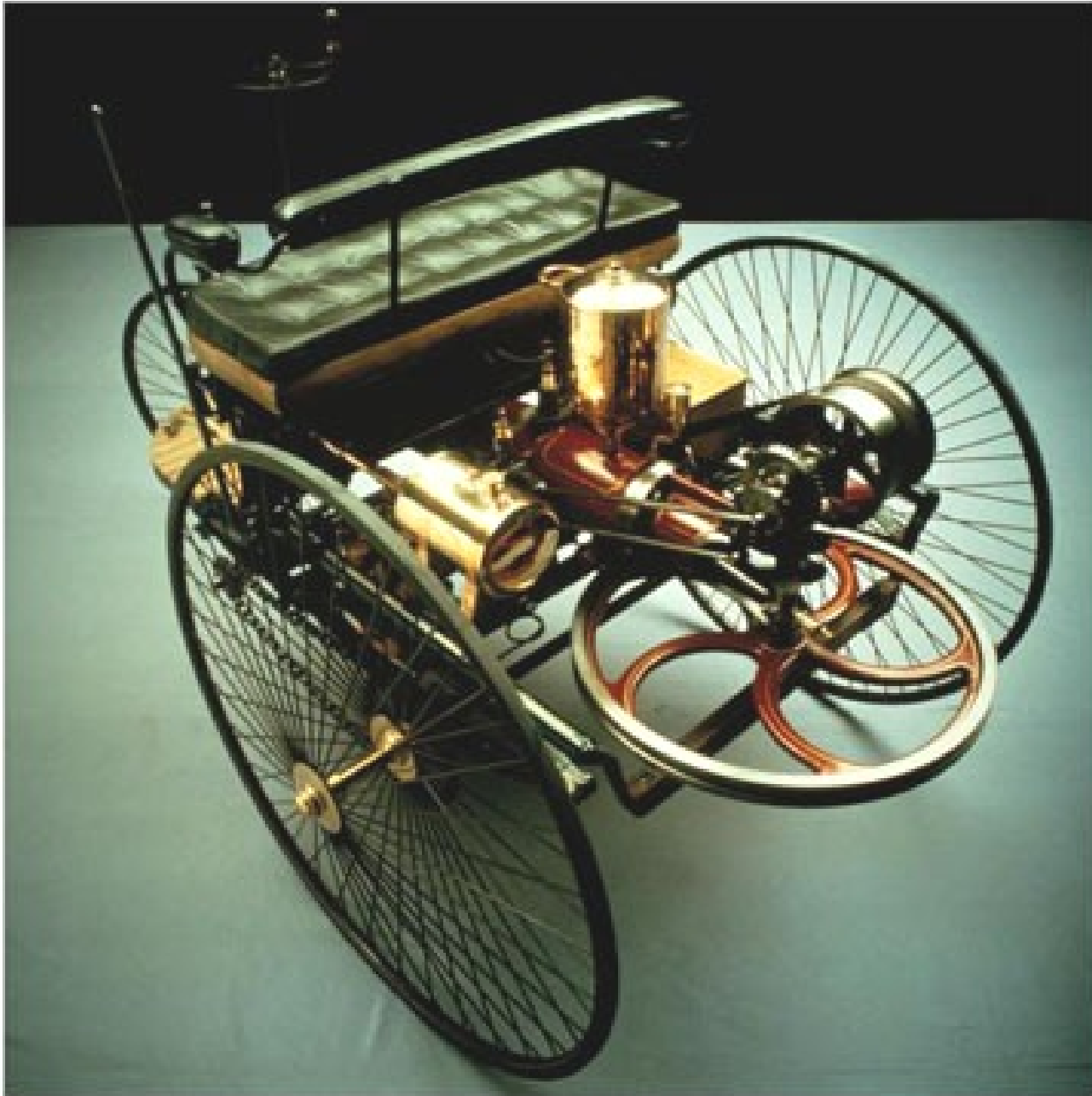




Rudolf Diesel in his Laboratory, 1896

Rudolf Diesel



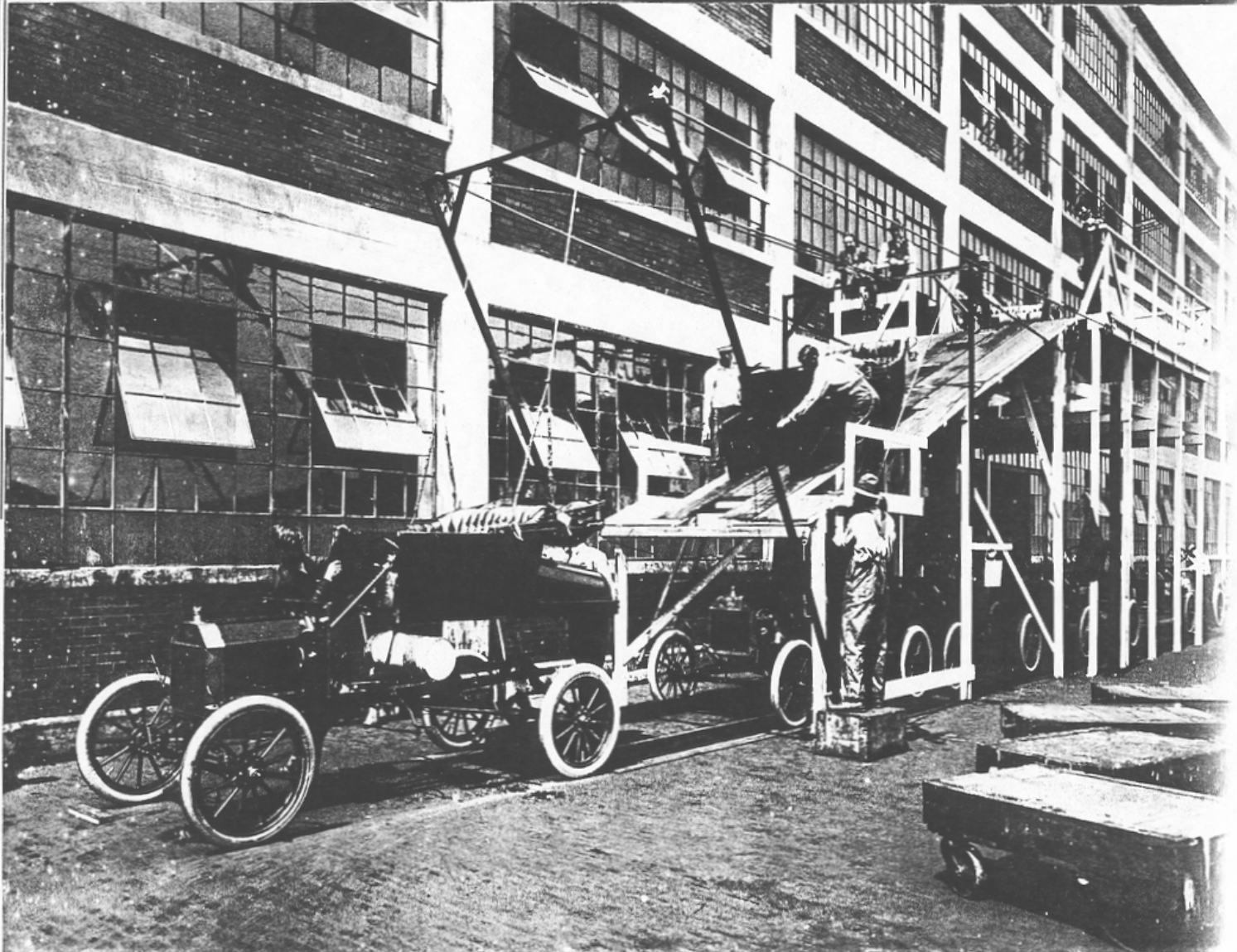


Carl Benz's First Motor car, 1886



Mercedes Motor car, 1910

Olds Assembly Line



America's greatest contribution to the automobile was mass production. The first steps by Ransom Olds were

developed by Henry Ford in 1914 at Highland Park. Bodies were slid down a chute to fall on the chassis.



Model T Ford

Ford's Assembly Line

Mass-production techniques changed the way people work and live throughout the world.

The Model T put America on wheels. But the real revolution was the production technique developed in 1913. Ford Motor Co.'s moving assembly line, and the rapid spread of its mass-production methods, profoundly changed the way people work and live world-wide.

Ford's Assembly Line II

As William C. Klann, a foreman in Ford's engine-assembly shop, told it, he and his colleagues had visited slaughterhouses and had been impressed with how conveyors carried hogs and cattle through a disassembly process.

Why not use the same idea to speed up an assembly system? Mr. Klann and his colleagues began experimenting with a **conveyor** to speed up the assembly of one component of the Model T engine.

Assembly Line Movies

Several interesting movies showing automotive assembly lines during the first half of the 20th century have been posted on the web. Please visit:

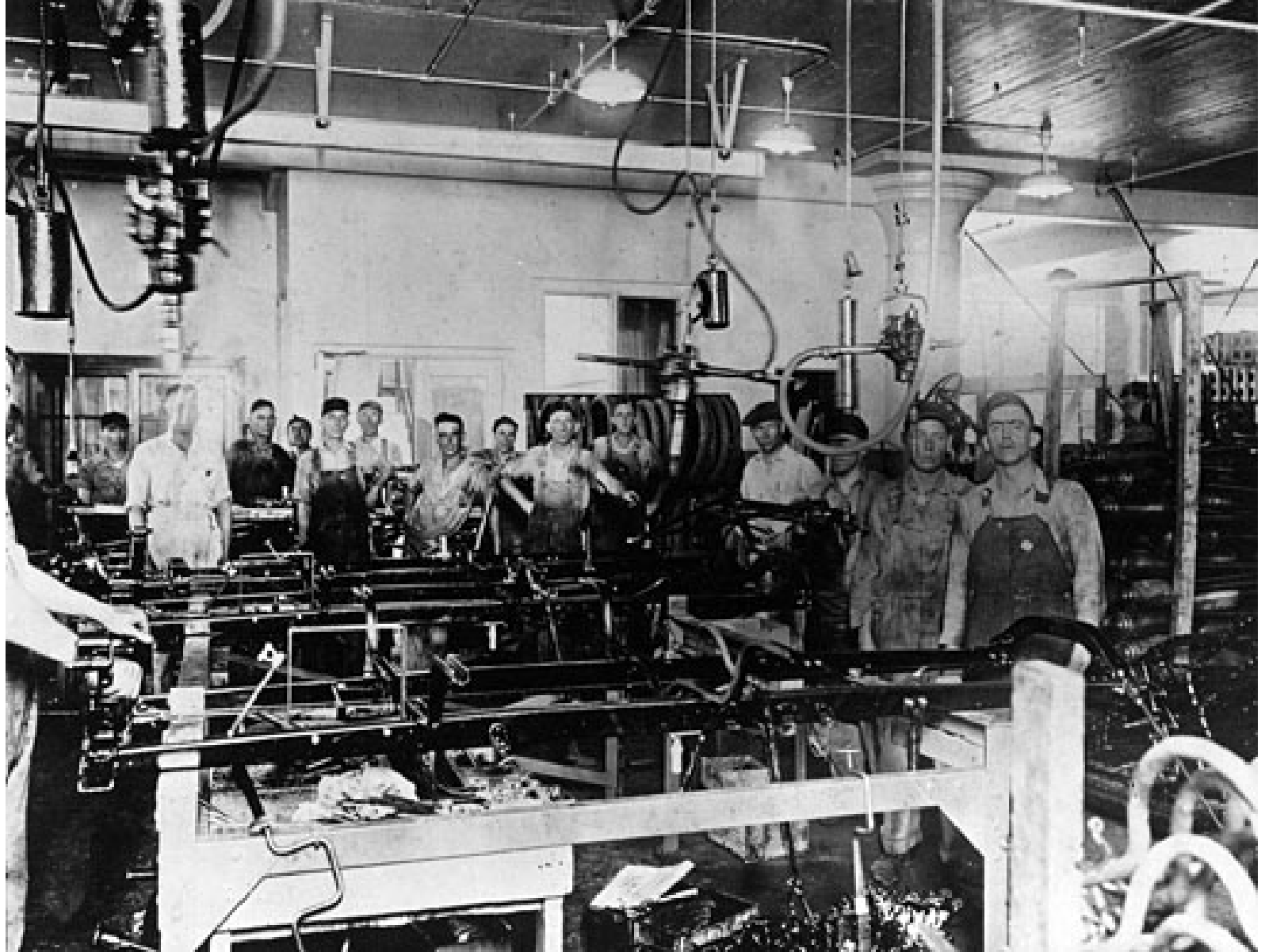
<http://www.archive.org/search.php?query=assembly%20line%20AND%20mediatype%3Amovies>

I suggest you start with the ‘Master Hands’ series, documenting Chevrolet assembly and manufacture. You can also find movies on the manufacture of Ford cars, Boeing warplanes, and other related topics.

For next week’s discussion of the **Wright Brothers**, please visit:

http://www.centennialofflight.gov/sights/movie_media3.htm

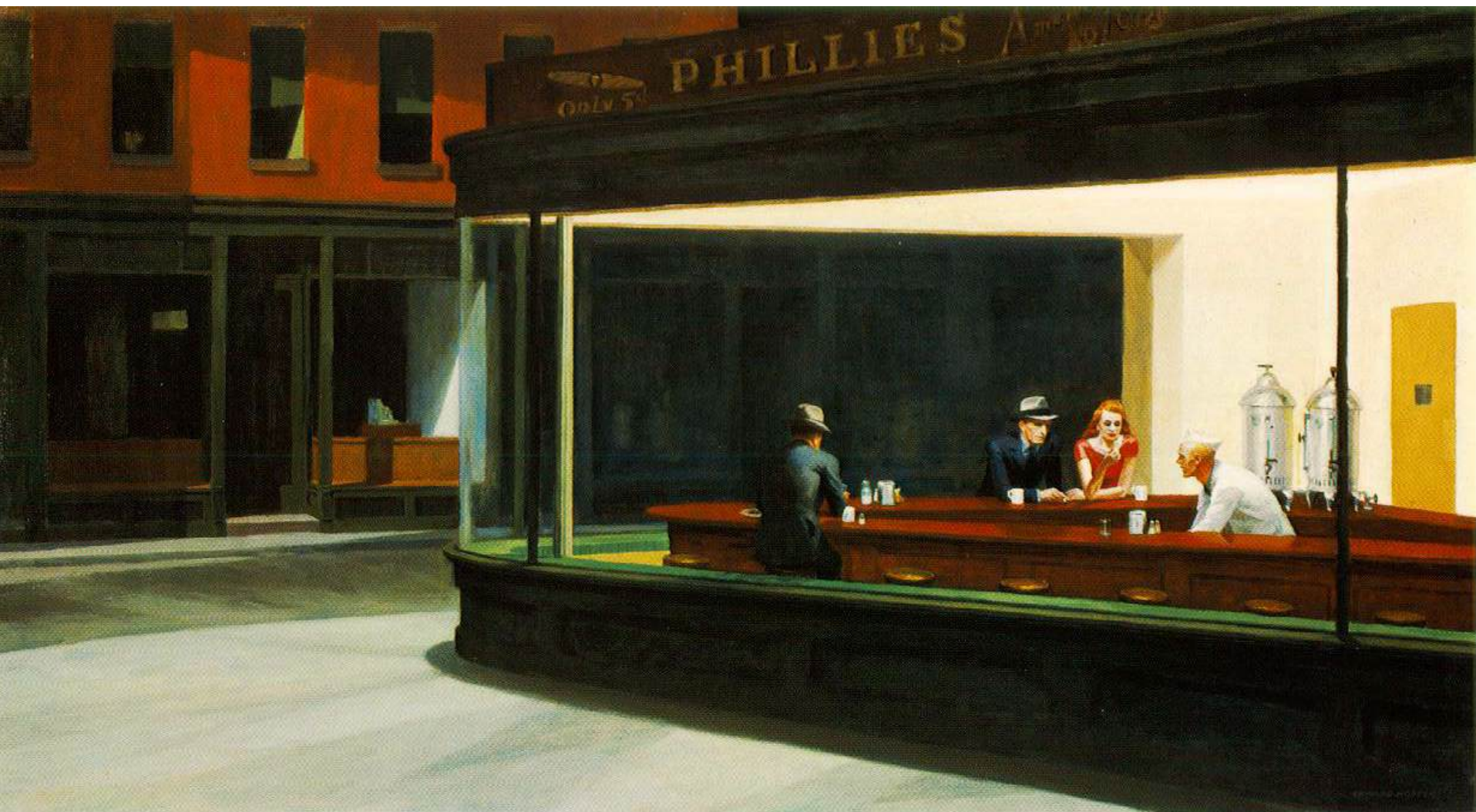
You can download and view several movies about the Wright brothers.



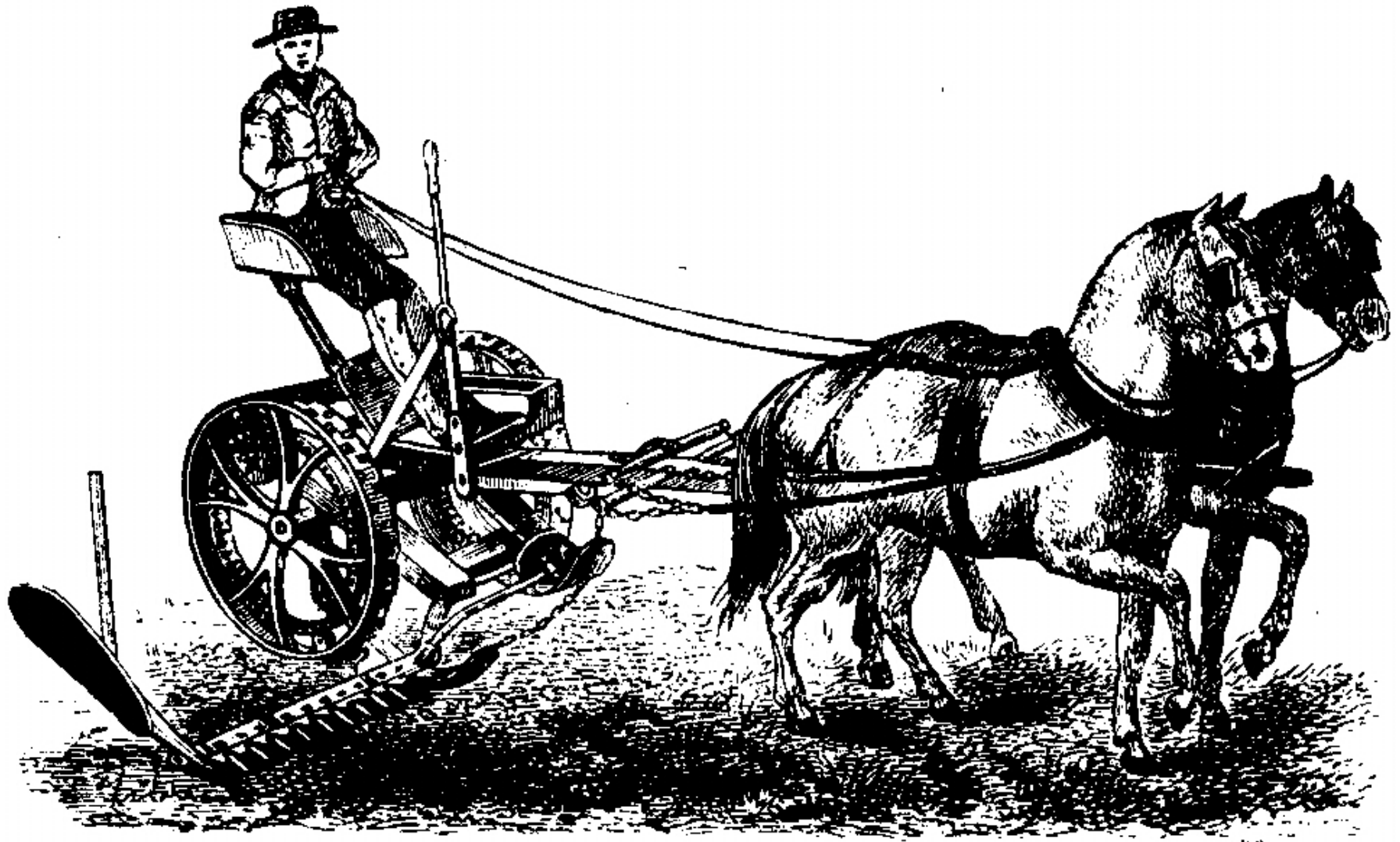
Auto workers at the piston and rod assembly line at the Highland Park Plant, ca. 1918.



The body drop on the assembly line of the Highland Park Plant.



Nighthawks
by **Edward Hopper**



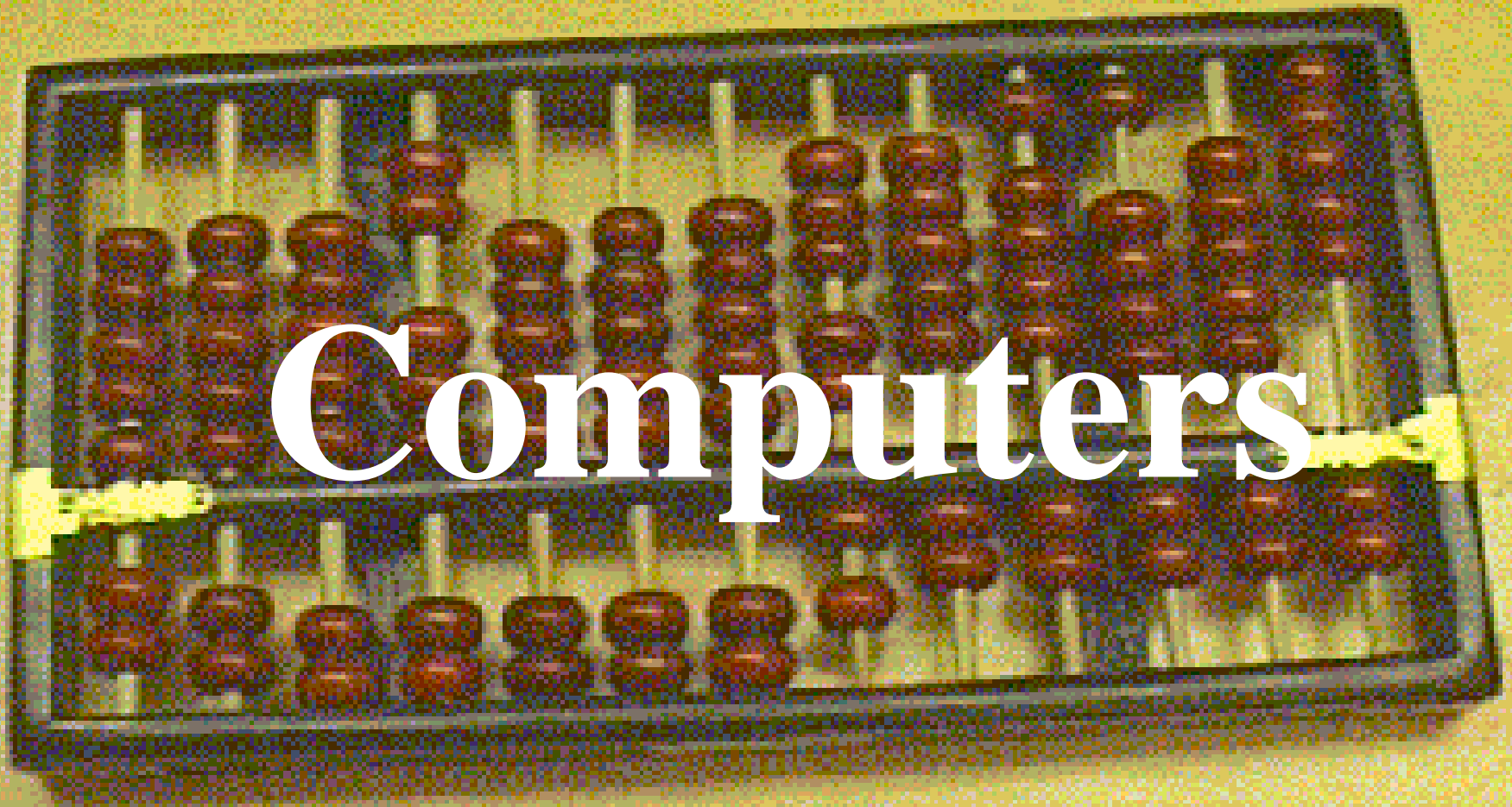
McCormick's Reaper

Many inventions from the Industrial Revolution period are still used today:

the sewing machine (invented by Elias Howe),
the steel plow (invented by John Deere),
the reaper (invented by Cyrus McCormick),
vulcanized rubber (inv. by Charles Goodyear),

The Industrial Revolution greatly transformed the economies and societies of the U.S. and the other industrial countries.

Computers



A computer automatically performs logical (mathematical) operations on input information and puts out answers, according to a predetermined 'program' of instructions.

Herman Hollerith's Punchcard Machines

Hollerith won the competition for the delivery of data processing equipment to assist in the processing of the data from the 1890 US Census



Abb. 7 Titelseite.
Scientific American 63(1890) No. 9.
(August 30, 1890)

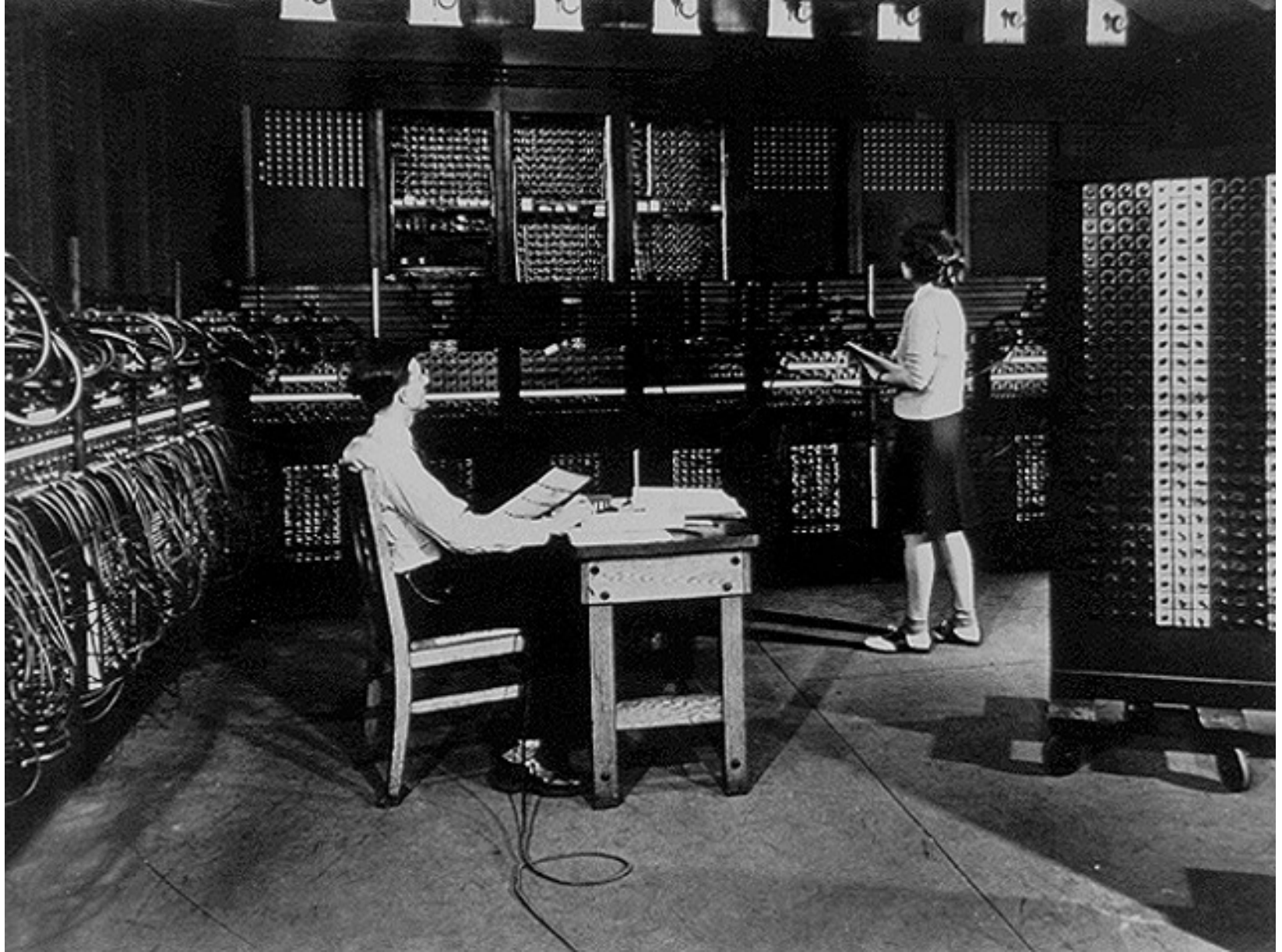
Zuse and the Z1



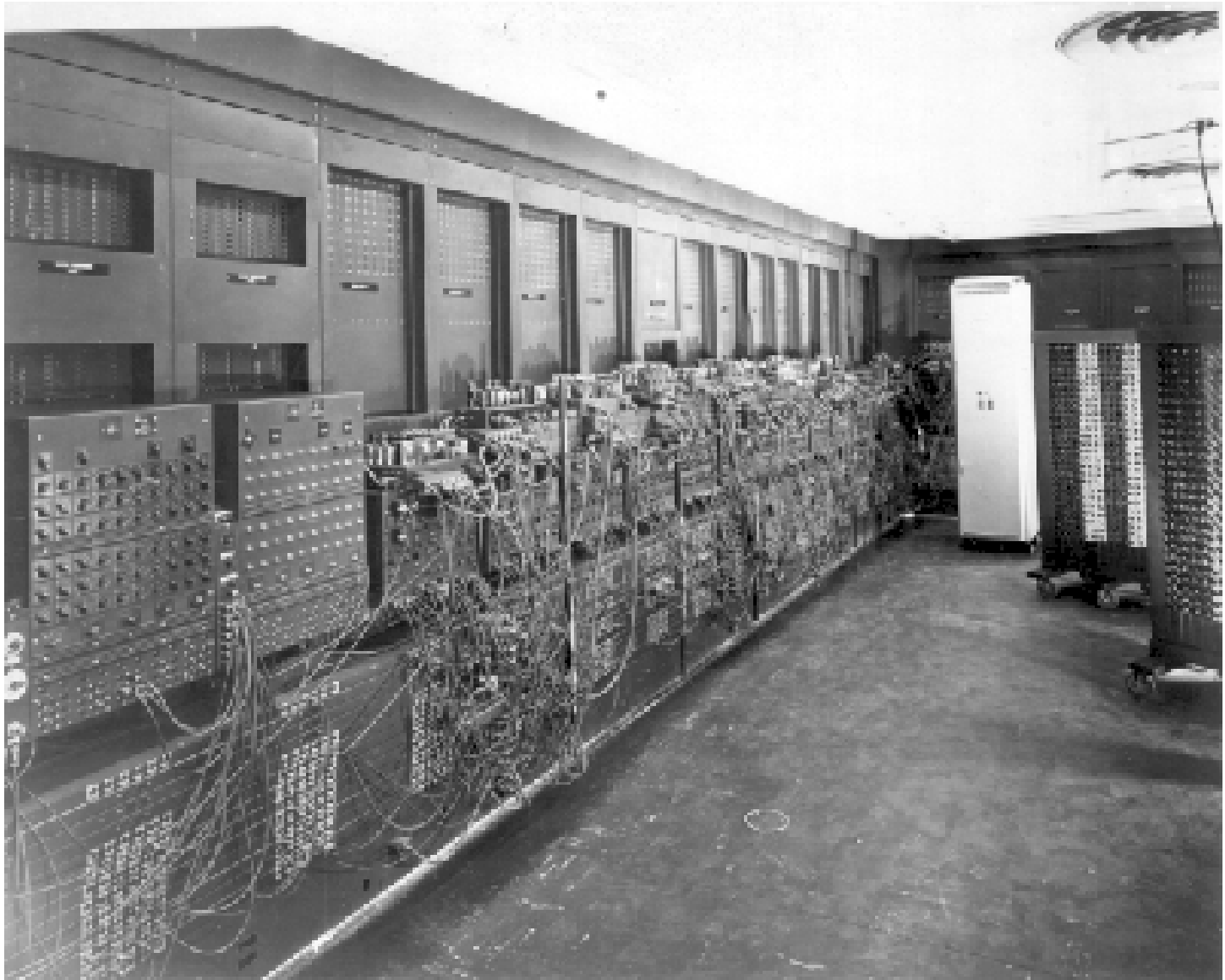
From 1936 to 1938, Konrad Zuse developed and built the first binary digital computer (Z1). A copy of this computer is on display in the Museum for Transport and Technology in Berlin.

Zuse completed the first fully functional program-controlled electromechanical digital computer in the world (the Z3) in 1941, but it was destroyed in 1944 during the war.

The machine used electromechanical relays rather than vacuum tubes.



Eniac, 1946



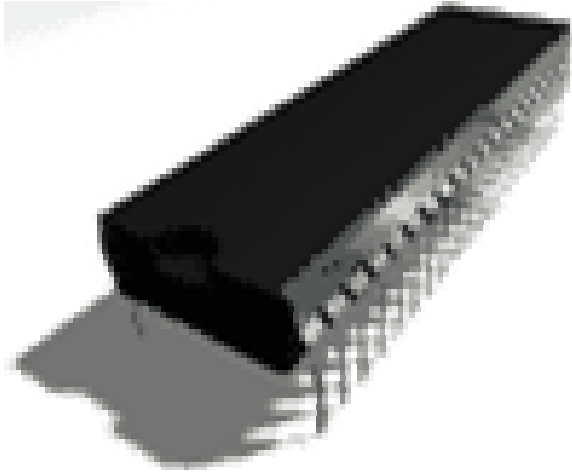
Eniac, 1946

The Eniac

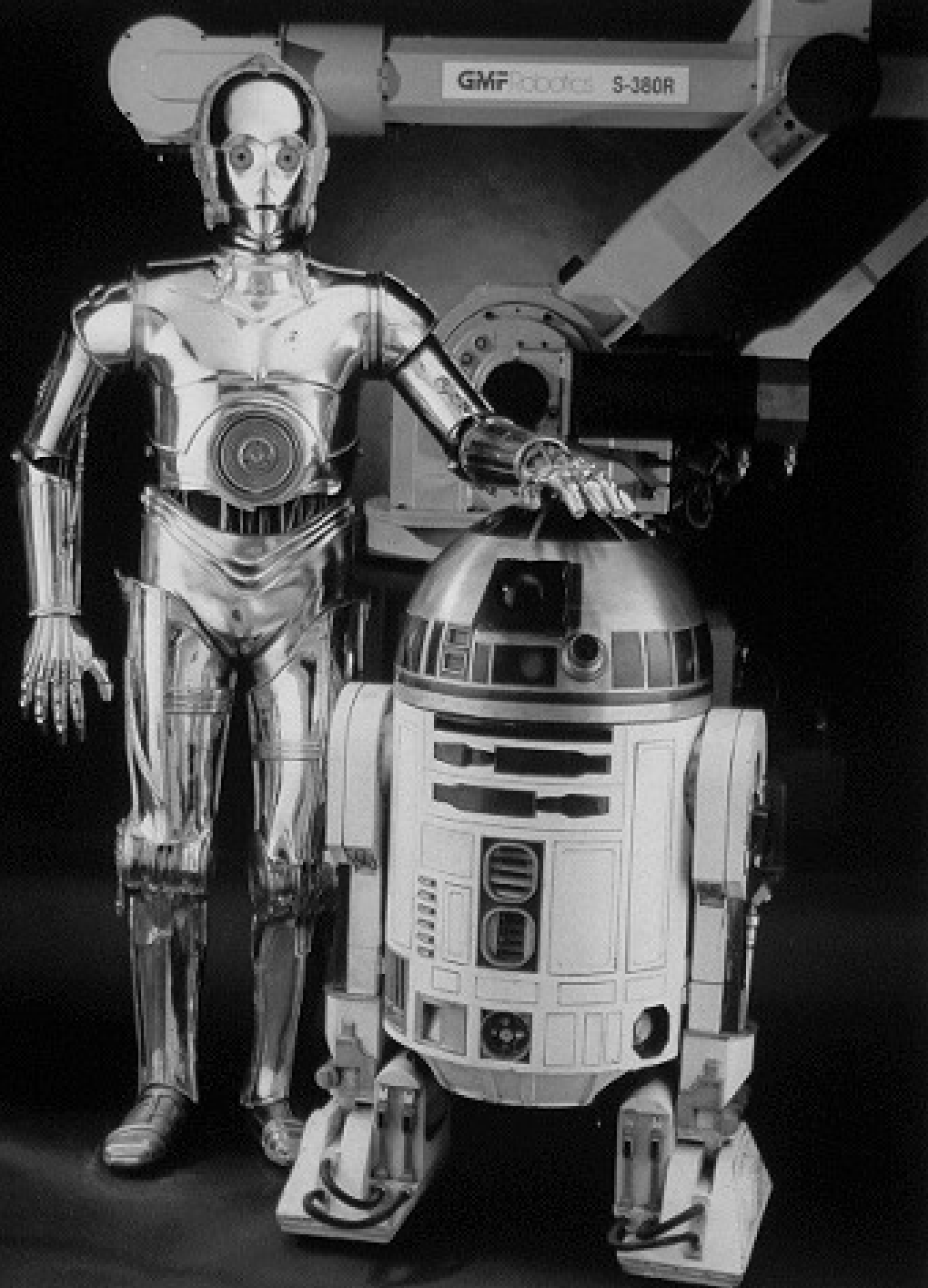
The ENIAC was a large-scale, general purpose digital electronic computer. Built out of some 17,468 electronic vacuum tubes, ENIAC was in its time the largest single electronic apparatus in the world. The ENIAC combined very diverse technical components and design ideas into a single system that could perform 5,000 additions and 300 multiplications per second.

Although slow by today's standards - current microprocessors perform 100 million additions per second - this was two to three orders of magnitude (100 to 1,000 times) faster than existing mechanical computers or calculators.

1971: INTEL 4004



The first single chip CPU was the Intel 4004, a 4-bit processor meant for a calculator. It processed data in 4 bits, but its instructions were 8 bits long. Program and data memory were separate, 1K of data memory and a 4K of program memory (in the form of a 4 level stack, used for CALL and RET instructions). There were also sixteen 4-bit general purpose registers.





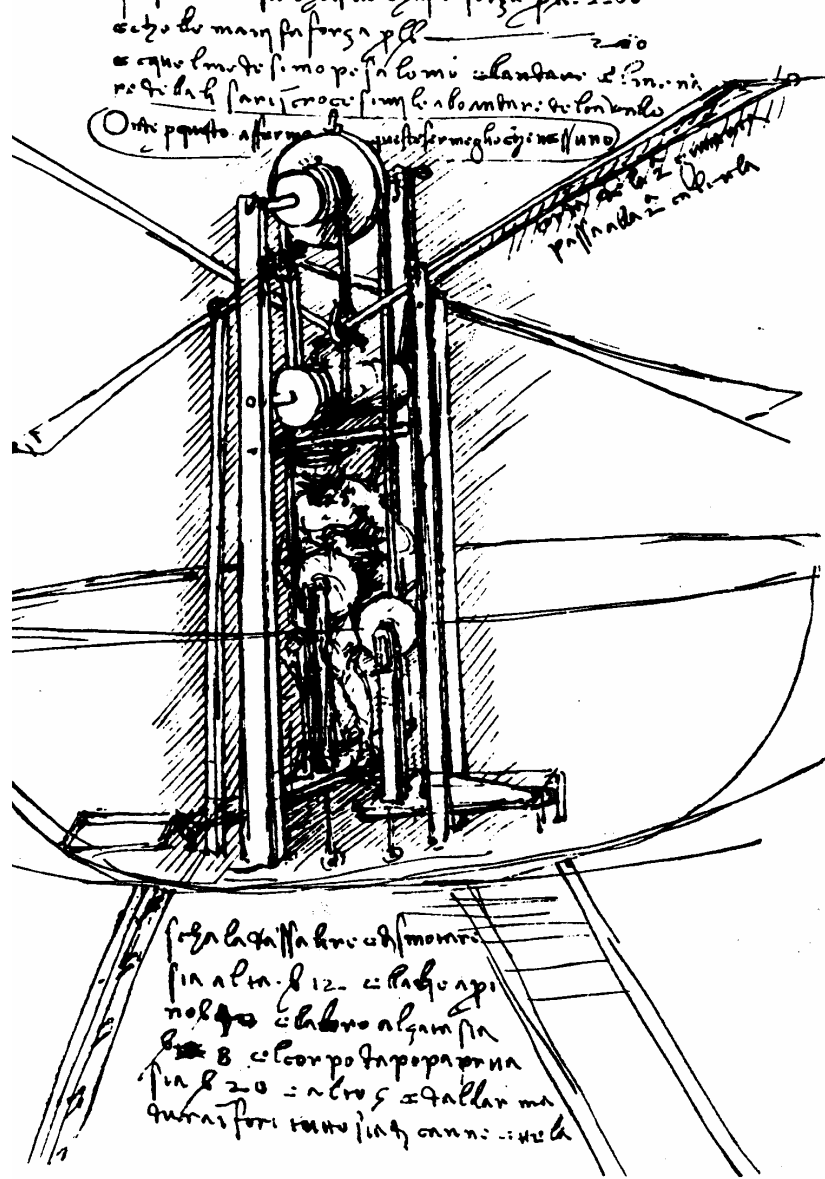
IBM PC 1981

Aviation

**What does he
have to do with
Aviation?**

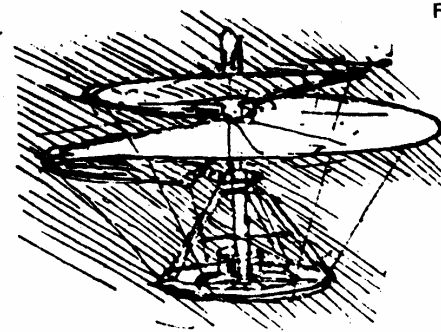
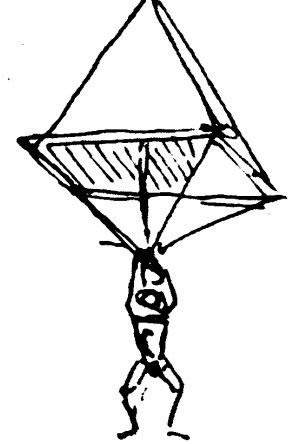


Leonardo's Helicopter 1485 A.D.



C Self-portrait of Leonardo da Vinci. Sketch for a wing mechanism, based upon that of a bird, by Leonardo da Vinci.

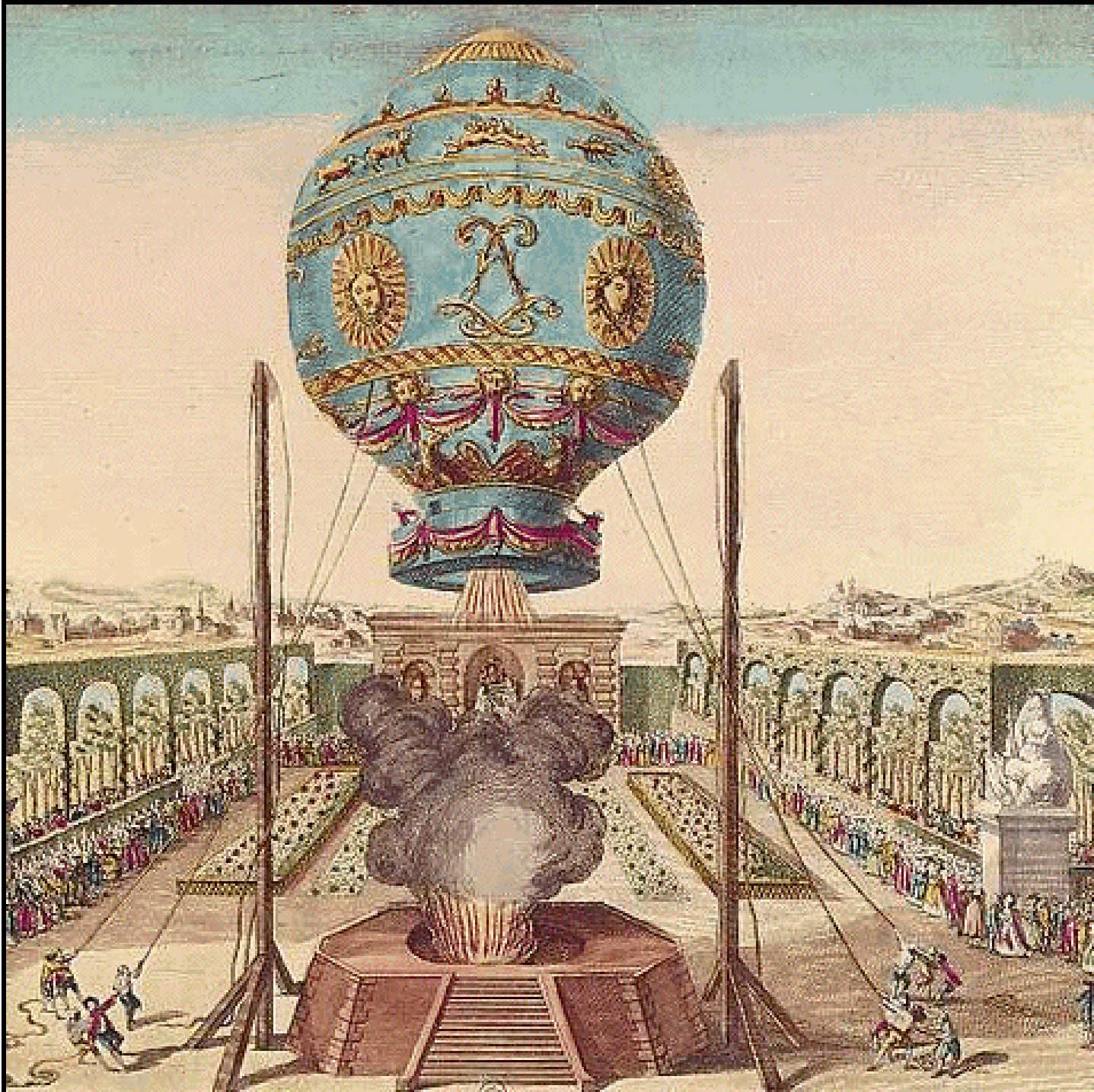
- C Da Vinci design for a flapping-wing aircraft, to be worked by both arm and leg movement, c. 1485.
- D Ornithopter design by da Vinci, in which the pilot stood in a central structure.

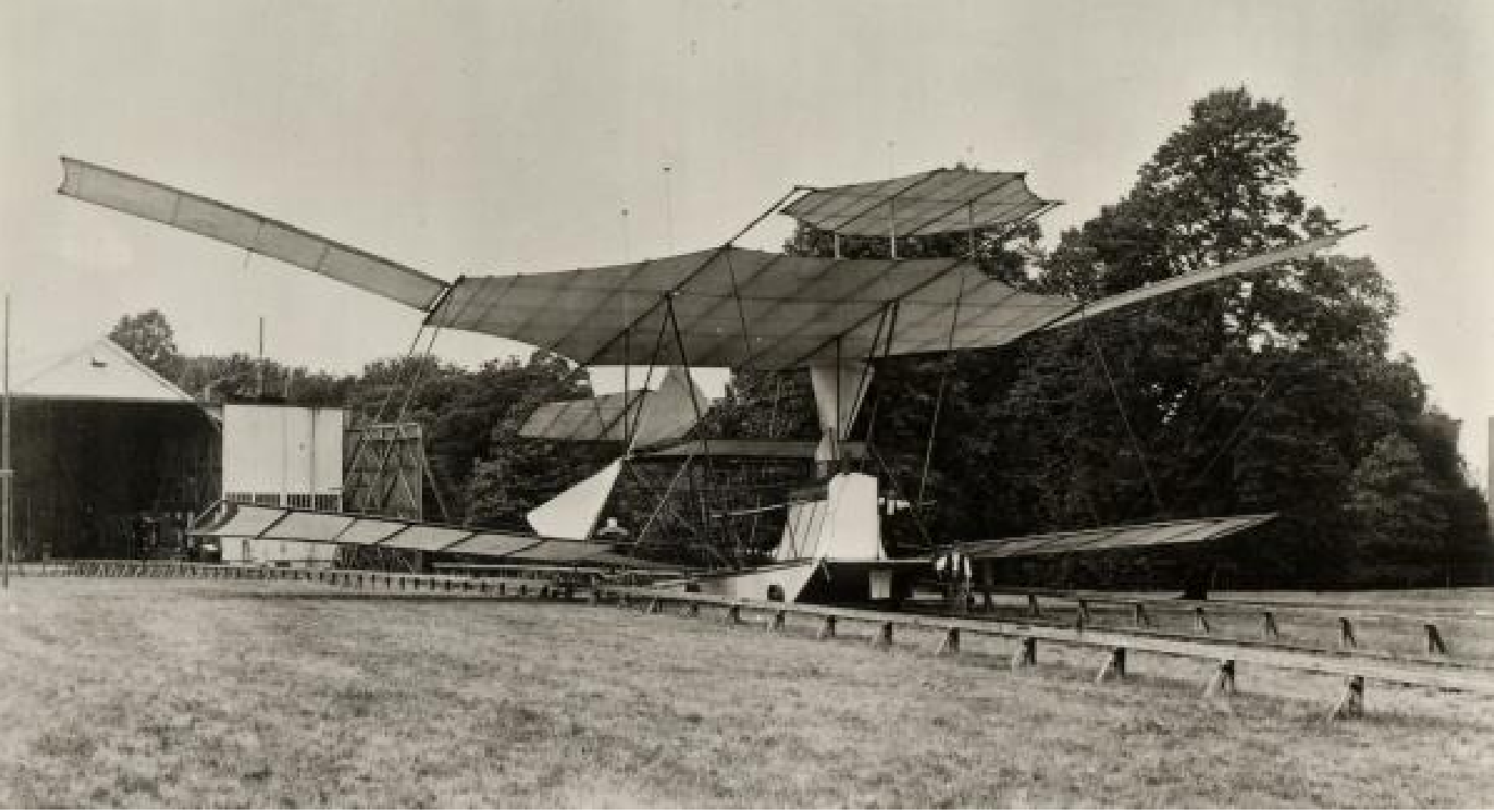


- E The earliest design for a parachute, by Leonardo da Vinci, c. 1485.
- F Helix vertical take-off device, designed by Leonardo da Vinci, 1490.

F

La Montgol fière 1783

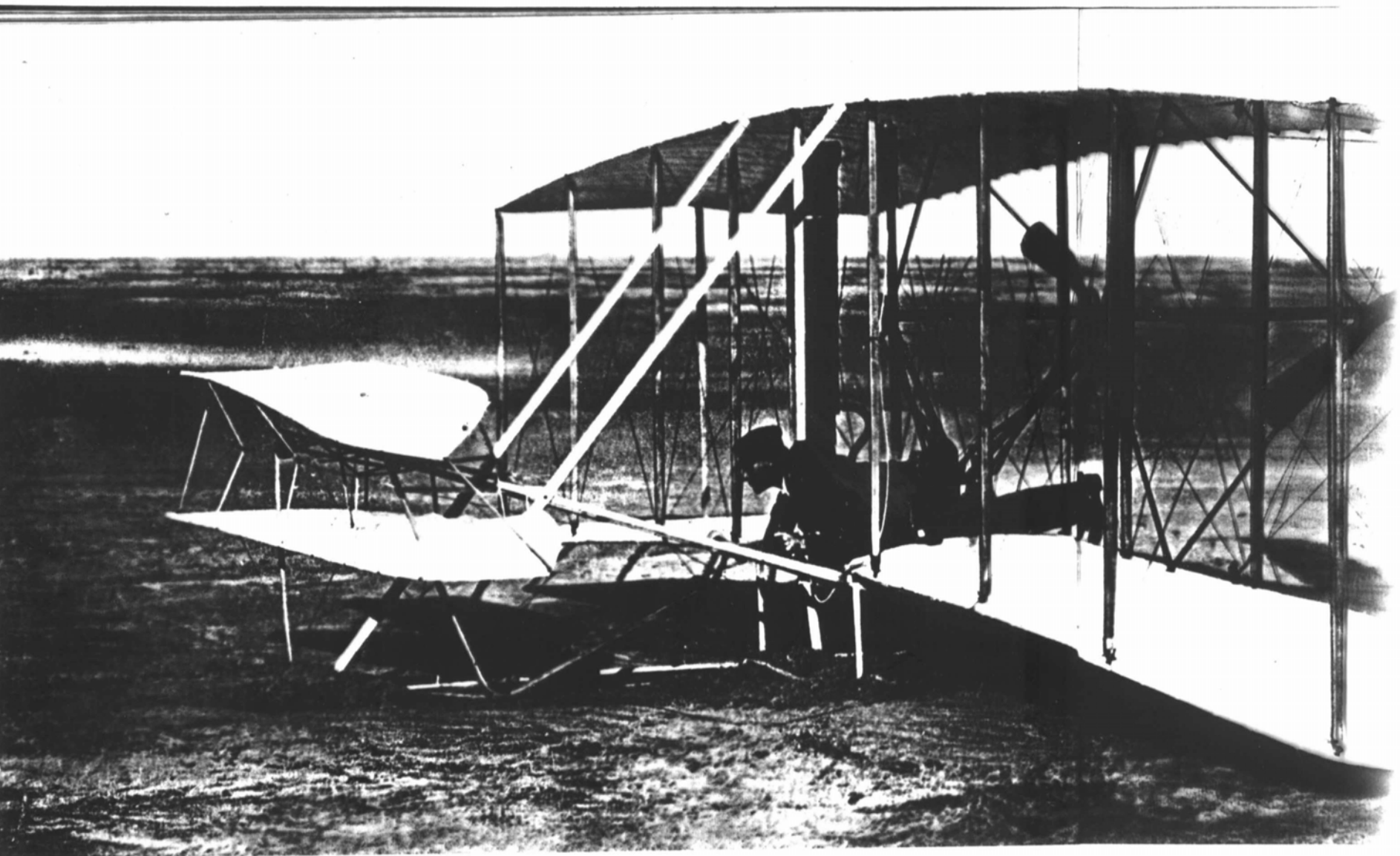




Hiram Maxim 1893

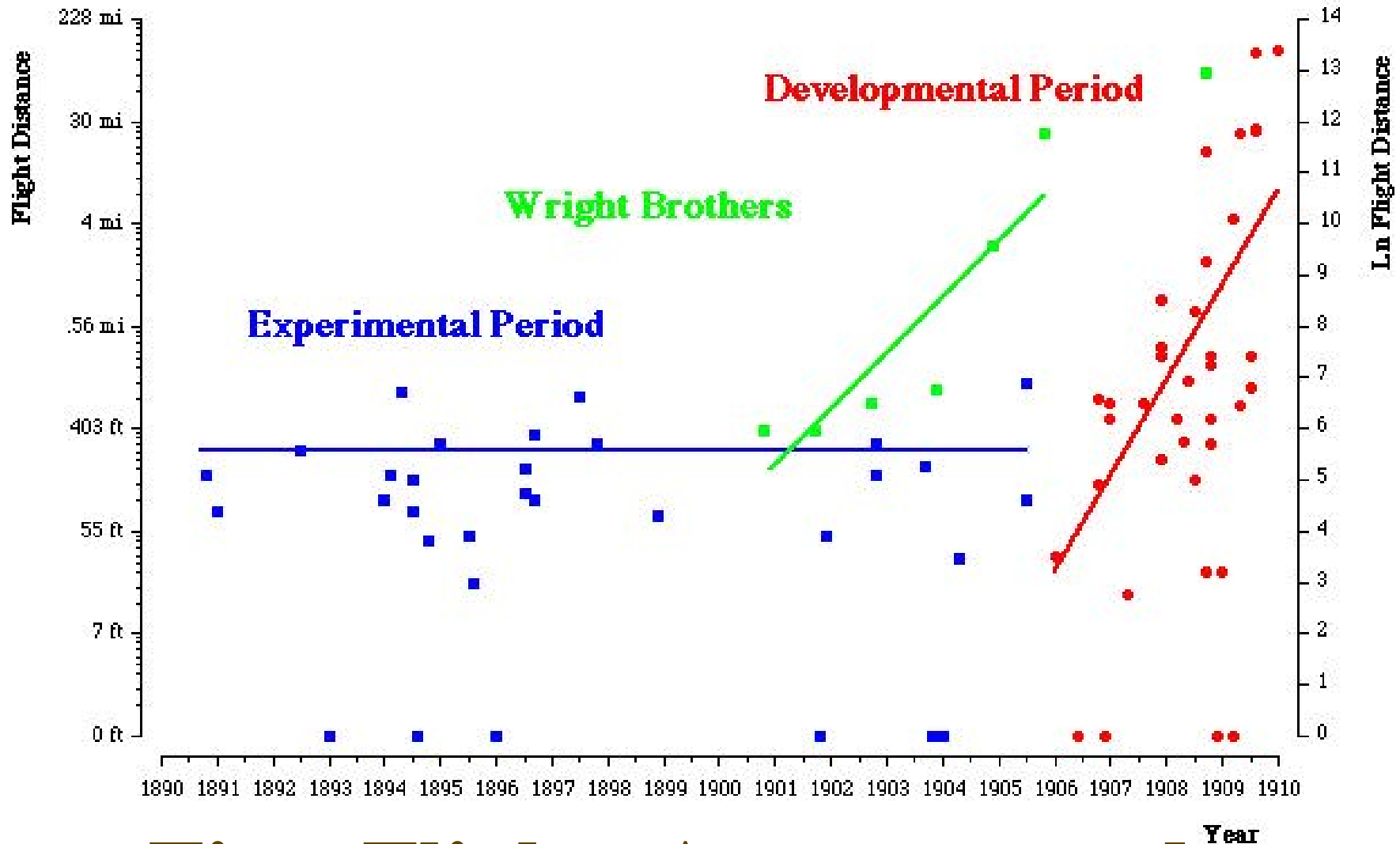


Otto Lilienthal 1895



First Flight: Wright Brothers 1903

Attempts at Flight 1890 - 1909



First Flight: Attempts and Accomplishments



The Airplane as Computer

The Future of Aviation



AFP

The Future of Technology

- **More Automation. Why?**
- **How will automation shape future technologies?**
- **What do future technologies mean for YOU as future engineers?**

The End

Third Class

Textbook Topics Covered:

Chapter 1.4, 1.5-1.9

Design Project

This week's Assignment (submit to Lab Instructor next week):

(a) Identify need:

Submit one-page report next week before your lab session to the lab instructor.

+ (b) Introduction to Autocad.

This does NOT apply to Rancho students.

Design Project (cont'd)

Your Assignment:

see Design project web page:

<http://www.me.unlv.edu/Undergraduate/courses/notes/egg102/proj-sch.htm>

Design Project (cont'd)

from Design project web page:

Describe problem and possible approach to the design of mobile robot steering, blade, and chassis. Report 1 due the week of Jan. 31

Design Project (cont'd)

Describe problem and possible approach to the design of mobile robot steering, blade, and chassis.

Look at other inventor's ideas, patents,
Design literature in the library etc.

Design Project (cont'd)

(b) Each student submits: one-page outline and concept sketches:

Introduction to Autocad.

During the first lab session, The lab TA will introduce those who are interested to Autocad.

Complete Lab 7 Assignment posted at:

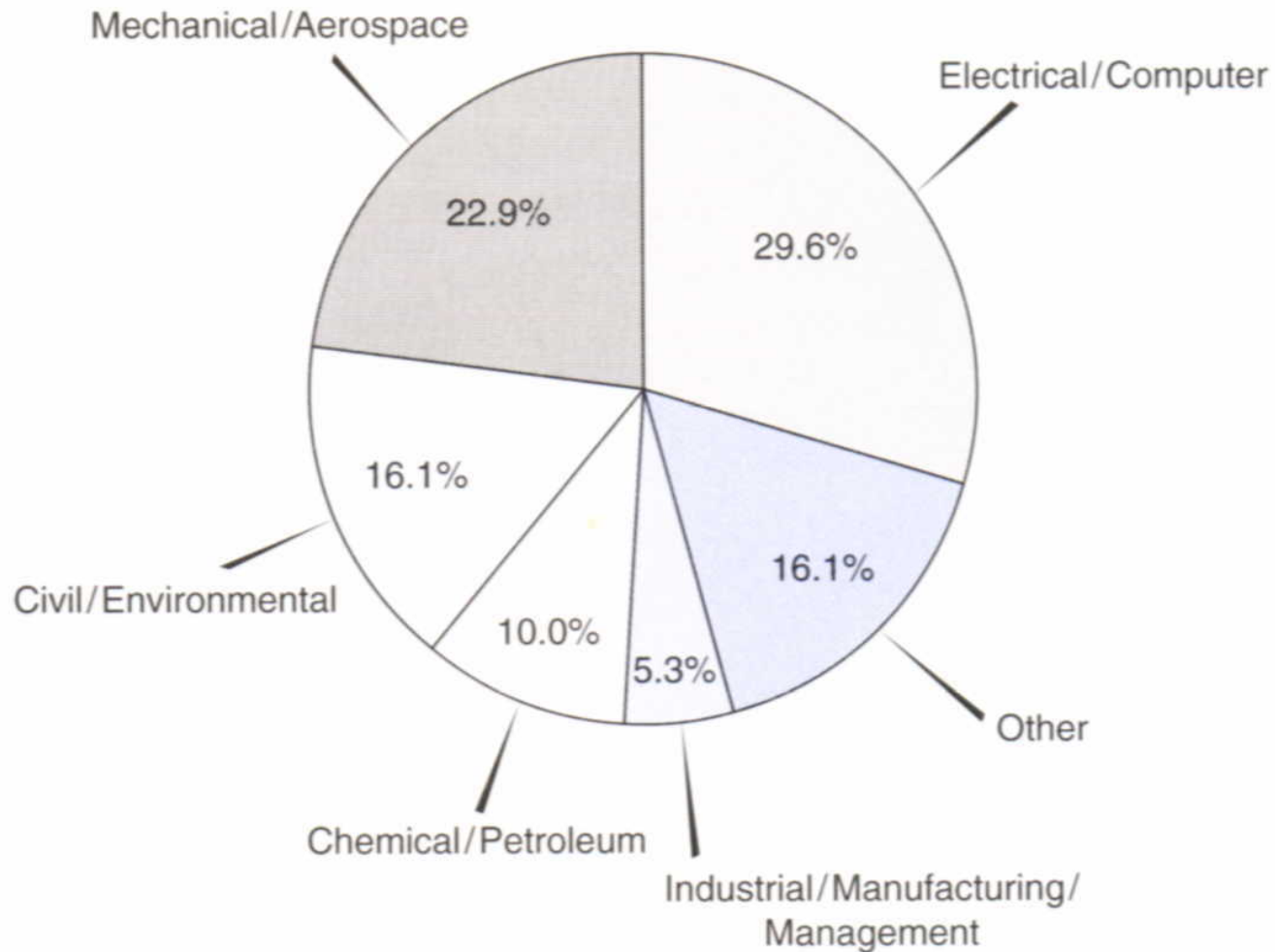
<http://www.me.unlv.edu/Undergraduate/courses/notes/102lab/102lab.htm>

Chapter 1.4

The Engineering Disciplines

Figure 1.18

Degrees by Discipline



Engineering degrees by discipline. Total degrees awarded was 59 134. (*ASEE Profiles of Engineering & Technology Colleges, 1999 Edition*)

Quoted from: Eide, Engr' Fundamentals

Chapter 1.4.1 Aerospace Engineering

**Aerospace
Engineers
develop:**

Space Vehicles



Chapter 1.4.1 Aerospace Engineering

Aircraft



Chapter 1.4.1 Aerospace Engineering

Turbines

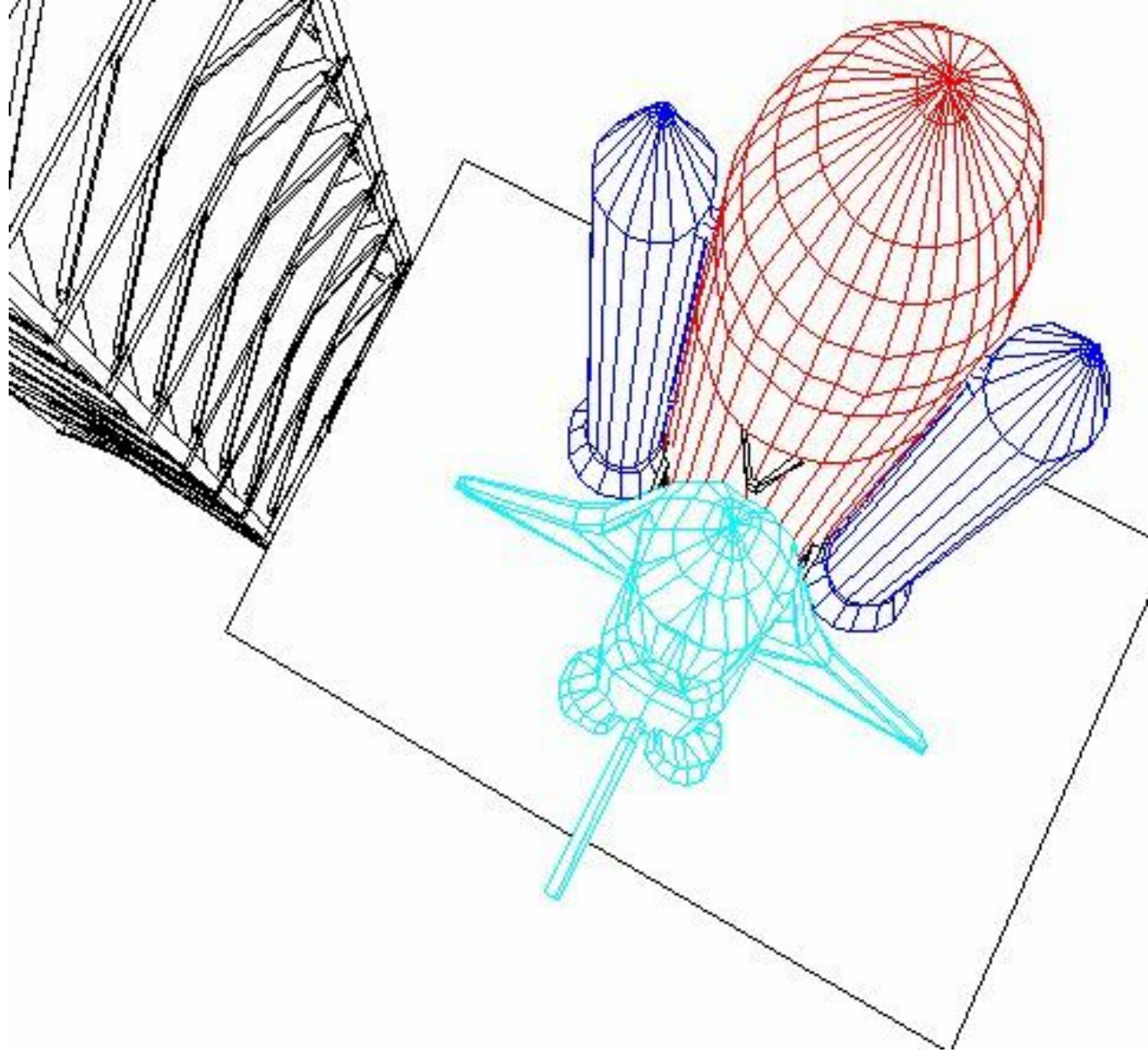


Chapter 1.4.1 Aerospace Engineering



Structures for Air and Space Vehicles

Chapter 1.4.1 Aerospace Engineering

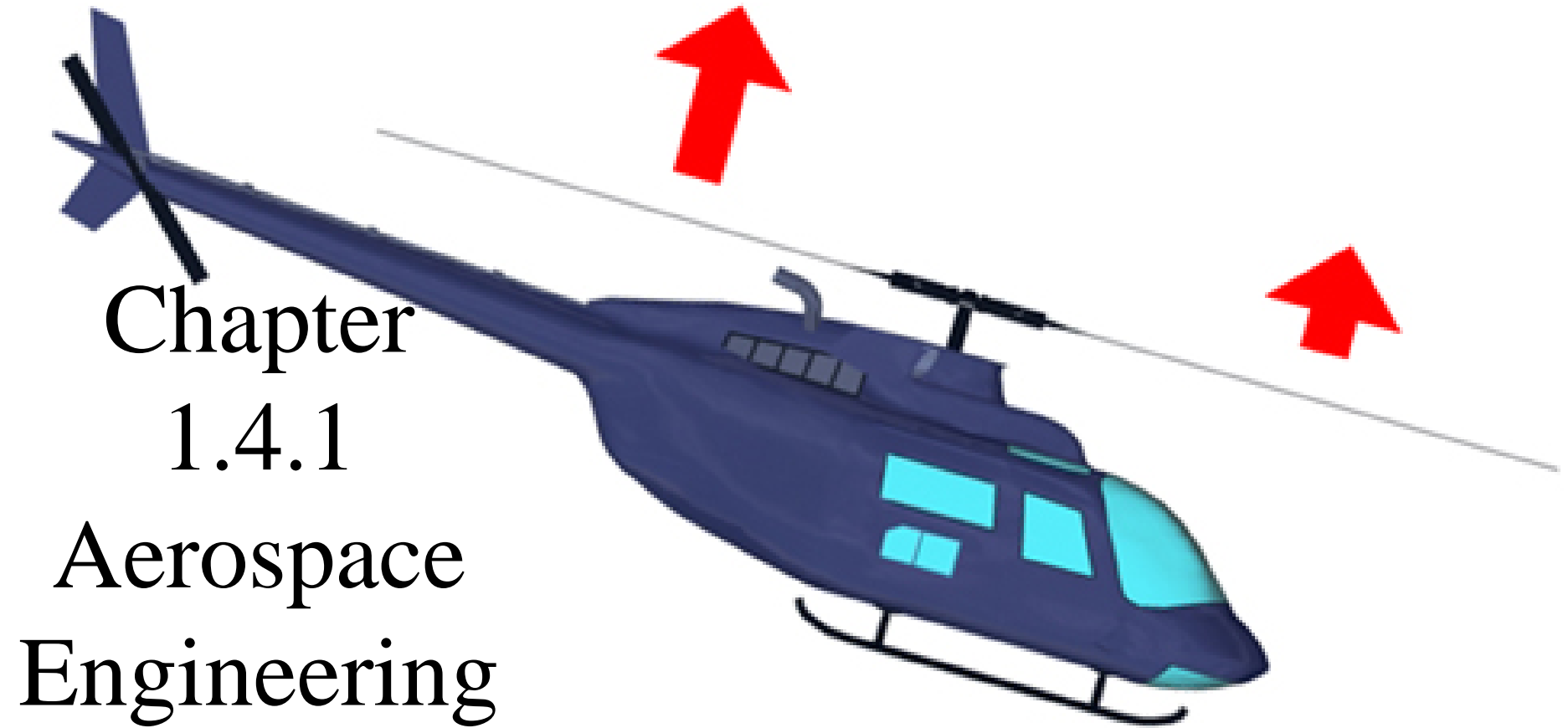


Structures: CAD Wireframe Image

Chapter
1.4.1
Aerospace
Engineering



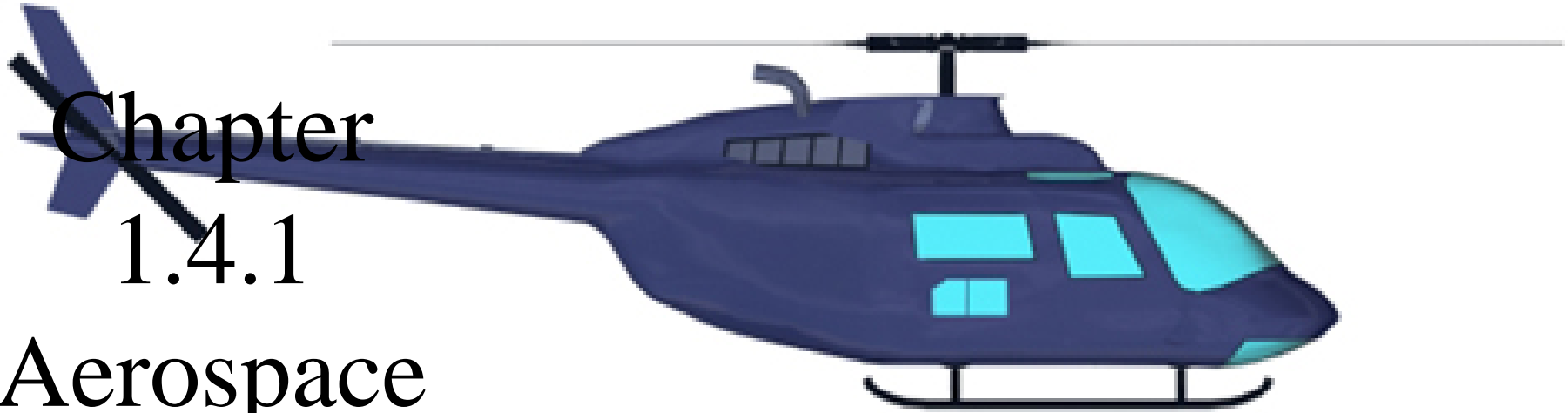
Air Vehicles



Chapter
1.4.1

Aerospace
Engineering

Air Vehicles: Control: Forward Motion



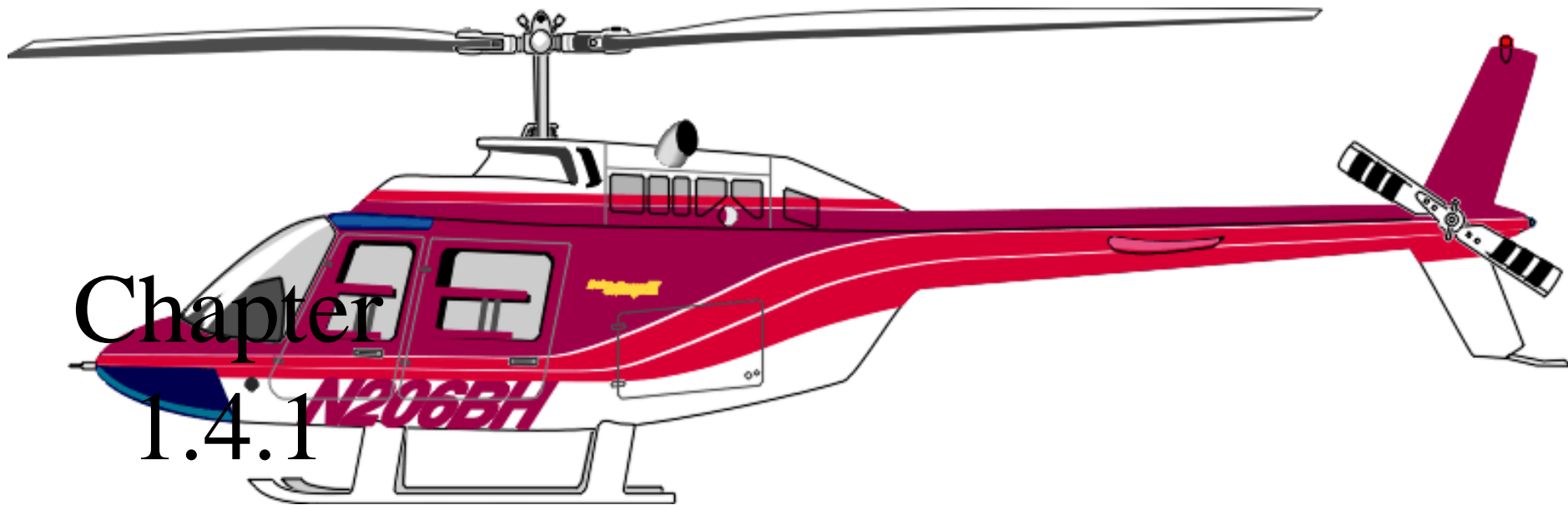
Chapter

1.4.1

Aerospace

Engineering

Air Vehicles: Control: Upward Motion



Chapter
1.4.1

Aerospace
Engineering

Air Vehicles: Control: Tail Rotor

Helicopter Design must address:

1. Basic aerodynamics of vertical flight:

(in the early 1920's)

2. Powerplant (engine)

3. Minimizing structural weight and engine weight:

4. Counteracting rotor torque reaction: Providing stability and properly controlling the machine.

5. Problem of high vibrations:

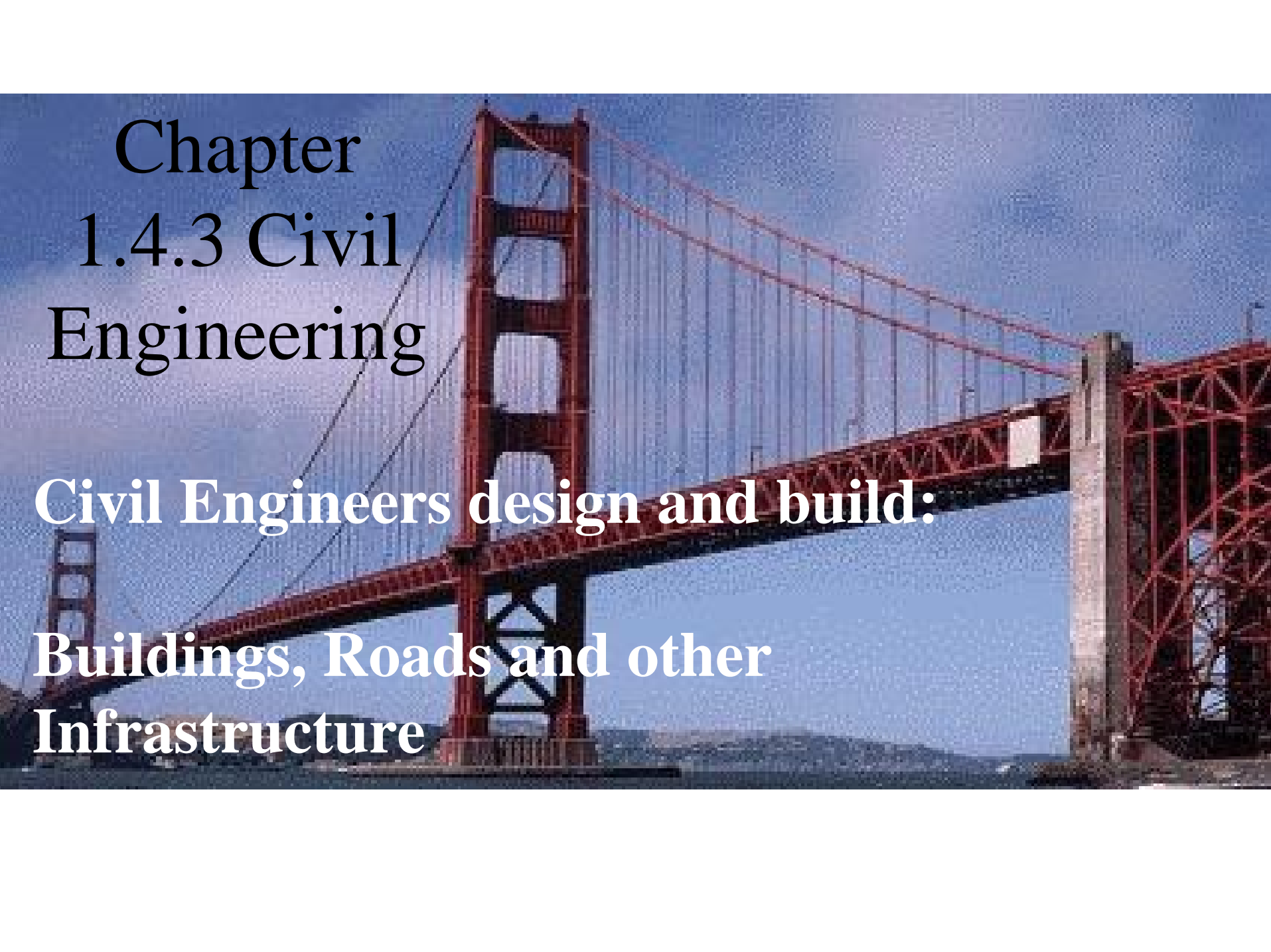
Chapter 1.4.2

Chemical Engineering

Chemical Engineers develop and operate:

Chemical and pharmaceutical processes, plants



A photograph of the Golden Gate Bridge in San Francisco, California. The bridge's iconic red-orange steel towers and suspension cables are visible against a clear blue sky. The bridge spans a body of water, with hills visible in the background. The text is overlaid on the left side of the image.

Chapter 1.4.3 Civil Engineering

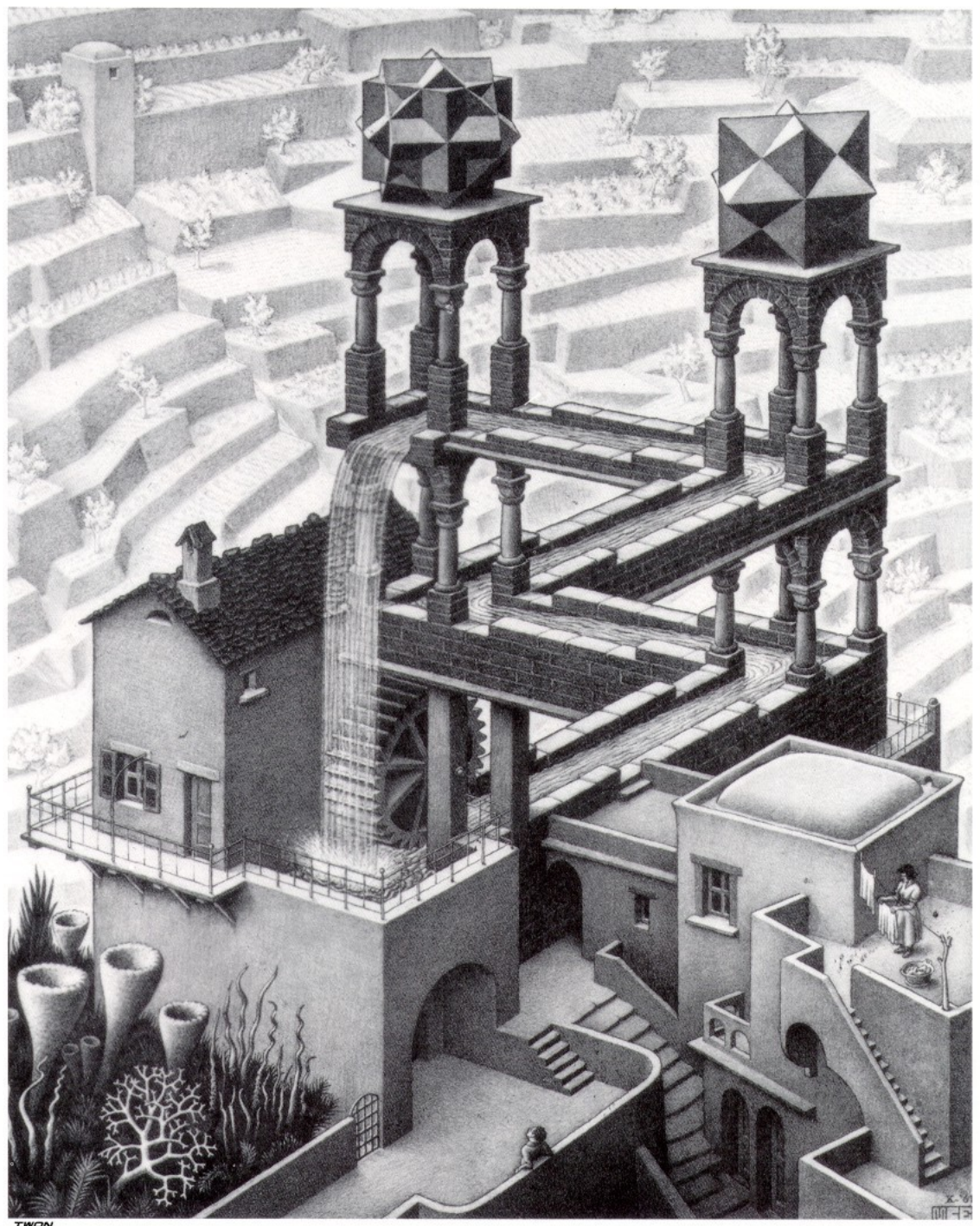
Civil Engineers design and build:

**Buildings, Roads and other
Infrastructure**

Chapter 1.4.3 Civil Engineering

**Someone
Please build
me this one!**

Maurits Cornelis
(M.C.) Escher
Waterfall



Chapter 1.4.4

Mechanical Engineering

Mechanical Engineers design and develop:

**Machines, Moving Structures,
Equipment**

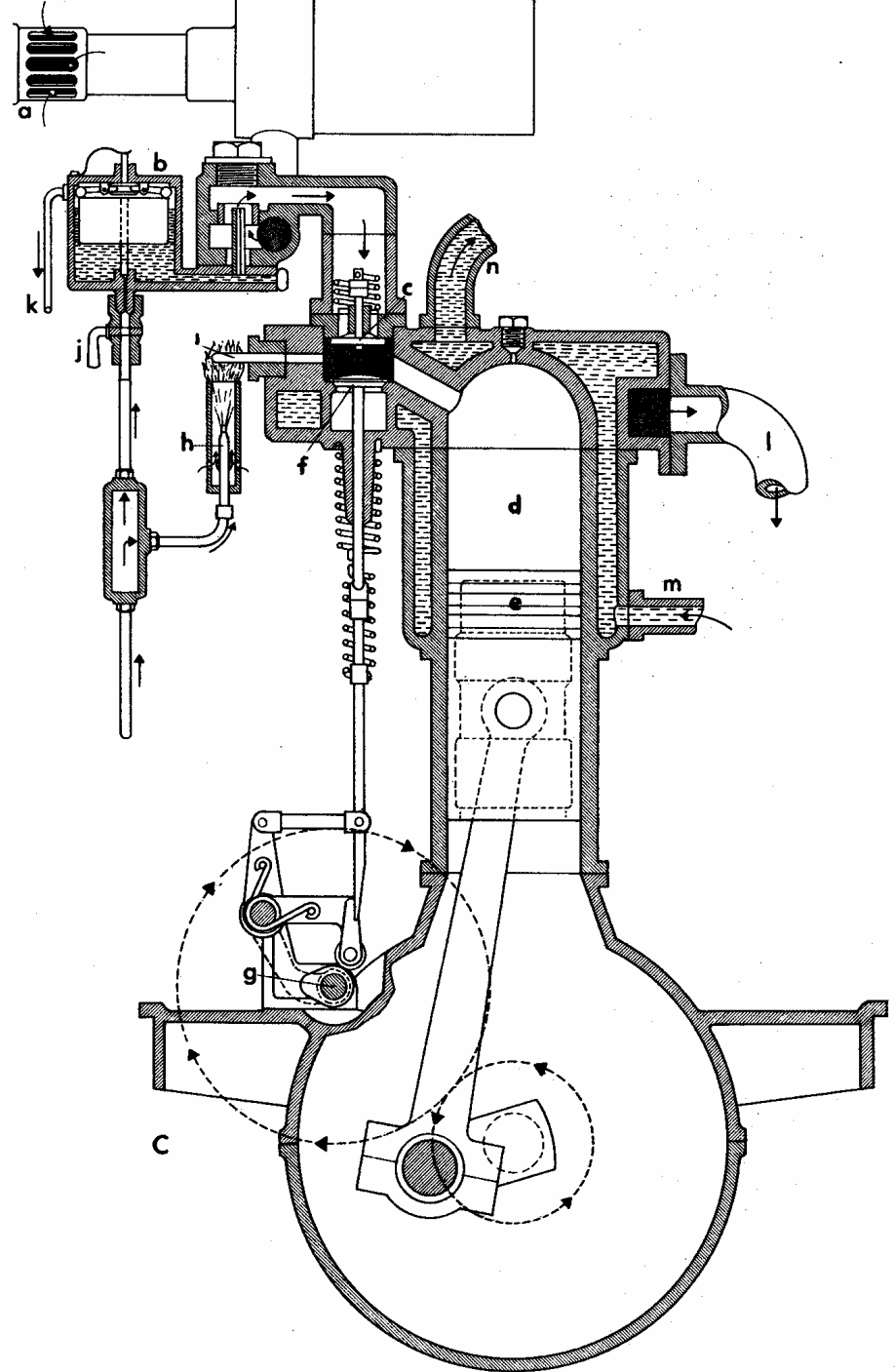
Chapter 1.4.4 Mechanical Engineering

Example: Turbine Design



Gottlieb Daimler

1883

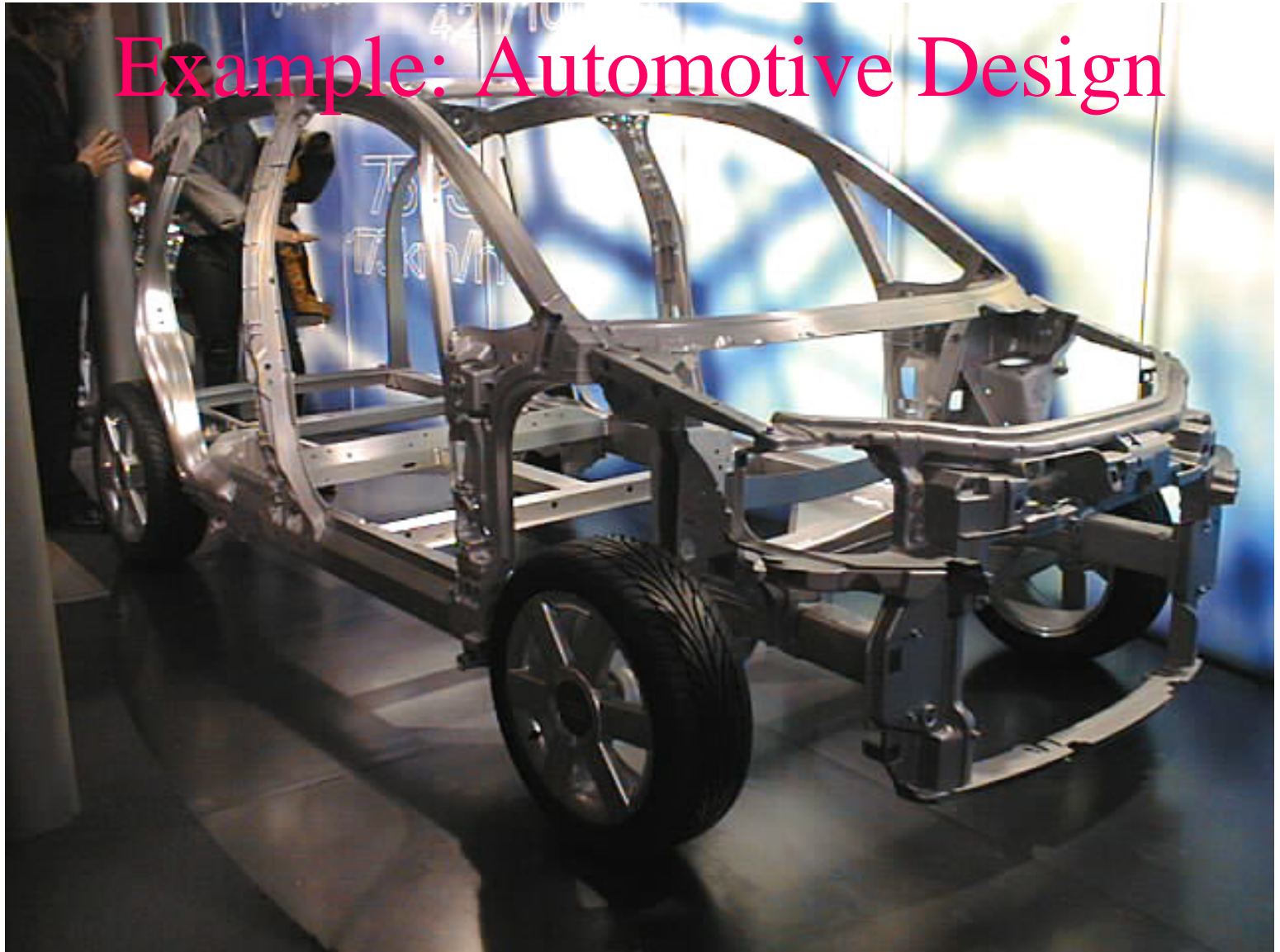


Chapter 1.4.4 Mechanical Engineering



Chapter 1.4.4 Mechanical Engineering

Example: Automotive Design



Chapter 1.4.4 Mechanical Engineering

Example: Automotive Design



Chapter 1.4.4 Mechanical Engineering

Example: Automotive Plant



Chapter 1.5 to 1.8

Total Quality

Read the Text!

Question: Explain the reasons for the success of Japanese car manufacturers in the 1970's.

Scientific Management

Frederick Taylor is the person who is most often associated with the system labeled scientific management.

Taylor's work not only represented the beginning of the managerial era in industrial production but also signaled the end of the craft era in the United States.

To control production, Taylor developed methods for the measure and design of machining methods as part of a general plan for increasing the planning functions of management. Taylor's fundamental concept and guiding principle was to design a production system that would involve both men and machines and that would be as efficient as a well-designed, well-oiled machine.

Taylorism

Time studies were used to allow management to take control of the operations, thereby controlling production methods, and, by default, production.

This system required that management should take a more active role in the factory and, through engineers and salaried foremen, take greater control over operations. **Skilled craftsmen and foremen had to give up their power.**

Taylor timed the workers' actions with a stopwatch. However, he did not time the entire job; instead, he broke down complex sequences of motions into what he labeled the elementary ones. He then timed the elementary actions as were performed by the workers he considered to be efficient in their movements.

Taylorism II

These calculations determined the piecework rate with bonuses paid for better rates and penalties taken for slower work.

Although Taylor designed Scientific Management to resolve problems in the workplace, the effects of Scientific Management spread from the factory to everyday life.

The immediate result of scientific management was a drastic cut in the cost of manufactured goods (**1/10 to 1/20 of the previous cost of manufacture**).

Also, scientific management allowed the raising of wages (even while the cost of the product was dropping). This movement also caused a shift in the factories from unskilled laborer, usually paid at a subsistence wage, to machine operator, who was more highly paid.

"Taylorism" and Organized Labor

In manufacturing, the efficiency movement caused an increase in output per unit of labor, between 1907 and 1915, of 33 percent a year, compared to an annual average increase of 9.9 percent between 1900 and 1907.

Anti-working class character: Through the scientific management methods, workers were treated as machines, devalued, and paid less money for their efforts.

A consequence of this treatment of workers was the rise of the unions and increased strikes and unrest among workers. One of the most famous strikes was against U.S. Steel in 1909, when more than 3,500 unorganized, mass production workers revolted against inhuman working conditions

Interestingly, later, the principles of scientific management were accepted by organized labor which considered Taylor's principles a means for protecting jobs and controlling members.

Today

- Mass Production is Largely Automated. In developed countries, the misery of the 19th century has largely disappeared.
- Mass Production resulted in mass Advertising and Mass Entertainment, e.g. Professional Sports, Television.
- The major economic factors are no longer capital and machinery, but knowledge.
- The smartest producer (with the most knowledge) sets the standard.
- Global economy and unprecedented wealth.
- Education is the largest single determinant of Income and Satisfaction.
- The converse is also true: The uneducated often feel powerless and disenfranchised. Karl Marx would say ‘alienated.’

Chapter 1.5 to 1.8

Total Quality

In 1947 **W. Edwards Deming Ph.D.**, an American statistician, was invited to help the Japanese work on their census tracts. The Japanese industrialists were receptive to idea of improving quality because they wanted to have a larger export market. What Deming was teaching, however, went well beyond traditional statistical control courses. It involved a management philosophy.

Total Quality

Deming is considered the father of modern-day, flexible lean production systems. Deming's idea was to record the number of product defects, locate their sources, institute changes and then record how much quality improved. One would then refine the process until it was done right.

Deming was considered too much of an educator to help the **top-down management style** in Detroit, and U.S. auto companies weren't interested in his theories on worker relations and better efficiency.

Total Quality

Deming saw a different way for auto businesses to operate. He saw the "assembly-line" mentality of low-income workers being forced into repetitive jobs, while management controlled things from above, as a mentality of the past.

"People are entitled to self-esteem," he once said. "Our system crushes it out." Deming taught the Japanese the essence of teamwork and, in turn, developed the principles of quality control.

Total Quality

By 1980, American corporations were in a near panic as the Japanese were selling products in the United States for less than American companies could produce them. At the time, NBC aired a special television report, "If Japan Can, Why Can't We?"

Shortly after the program aired, Deming was besieged by calls from corporations across the country asking him for help.

Total Quality

Total Quality Management (TQM)

Total = Quality involves everyone and all activities in the company.

Quality = Conformance to Requirements (Meeting Customer Requirements).

Management = Quality can and must be managed.

TQM = A process for managing quality; it must be a continuous way of life; a philosophy of perpetual improvement in everything we do.

Chapter 1.5 to 1.8

Total Quality

TQM as a Foundation

TQM is the foundation for activities which include;

Meeting Customer Requirements

Reducing Development Cycle Times

Just In Time/Demand Flow Manufacturing

Improvement Teams

Reducing Product and Service Costs

Improving Administrative Systems Training

Total Quality

Principles of TQM :

Quality can and must be managed.

Everyone has a customer and is a supplier.

Processes, not people are the problem.

Every employee is responsible for quality.

Problems must be prevented, not just fixed.

Quality must be measured.

Quality improvements must be continuous.

The quality standard is defect free.

Goals are based on requirements, not negotiated.

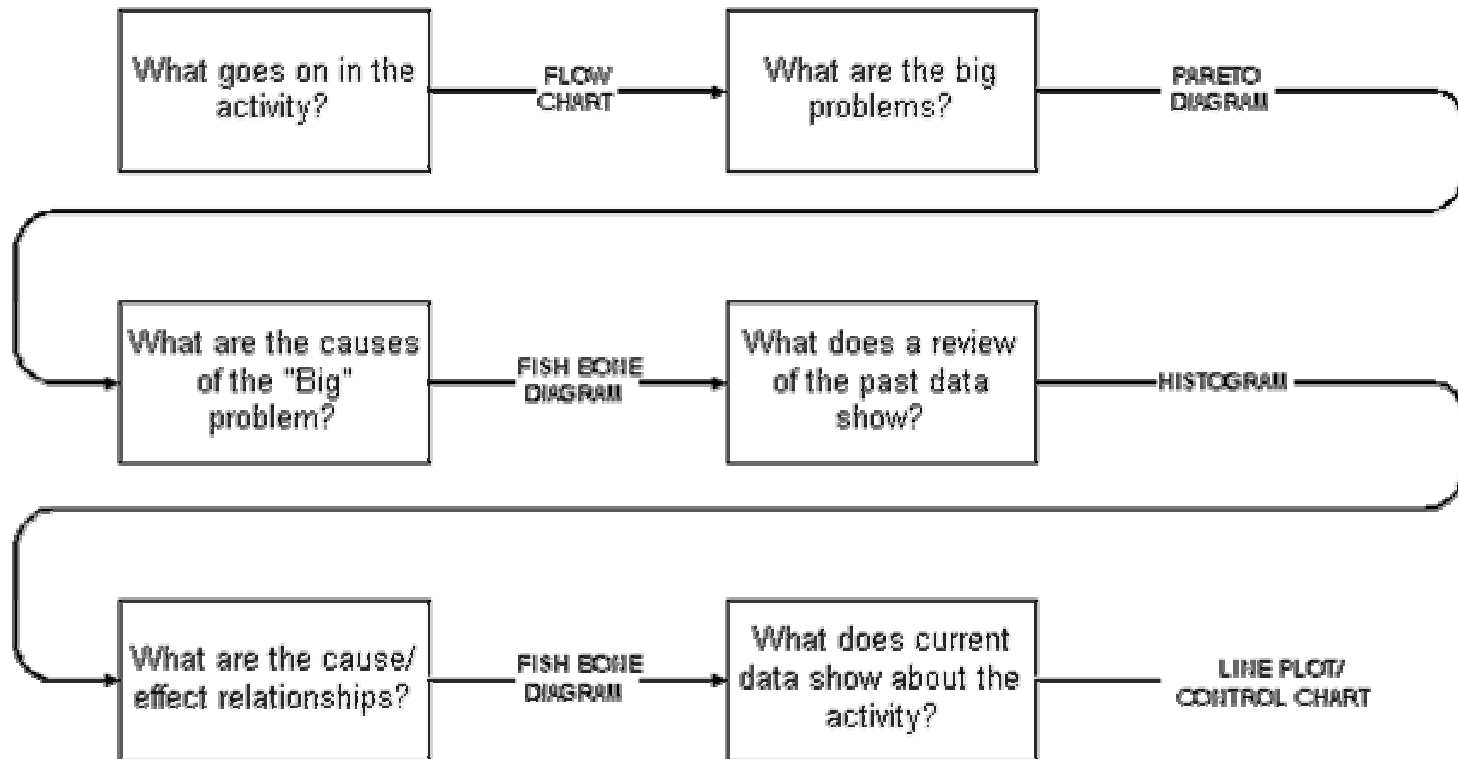
Life cycle costs, not front end costs.

Management must be involved and lead.

Plan and organize for quality improvement.

Total Quality

Six Questions - Six Graphs For Planning A Change



Chapter 1.9

Engineering Education

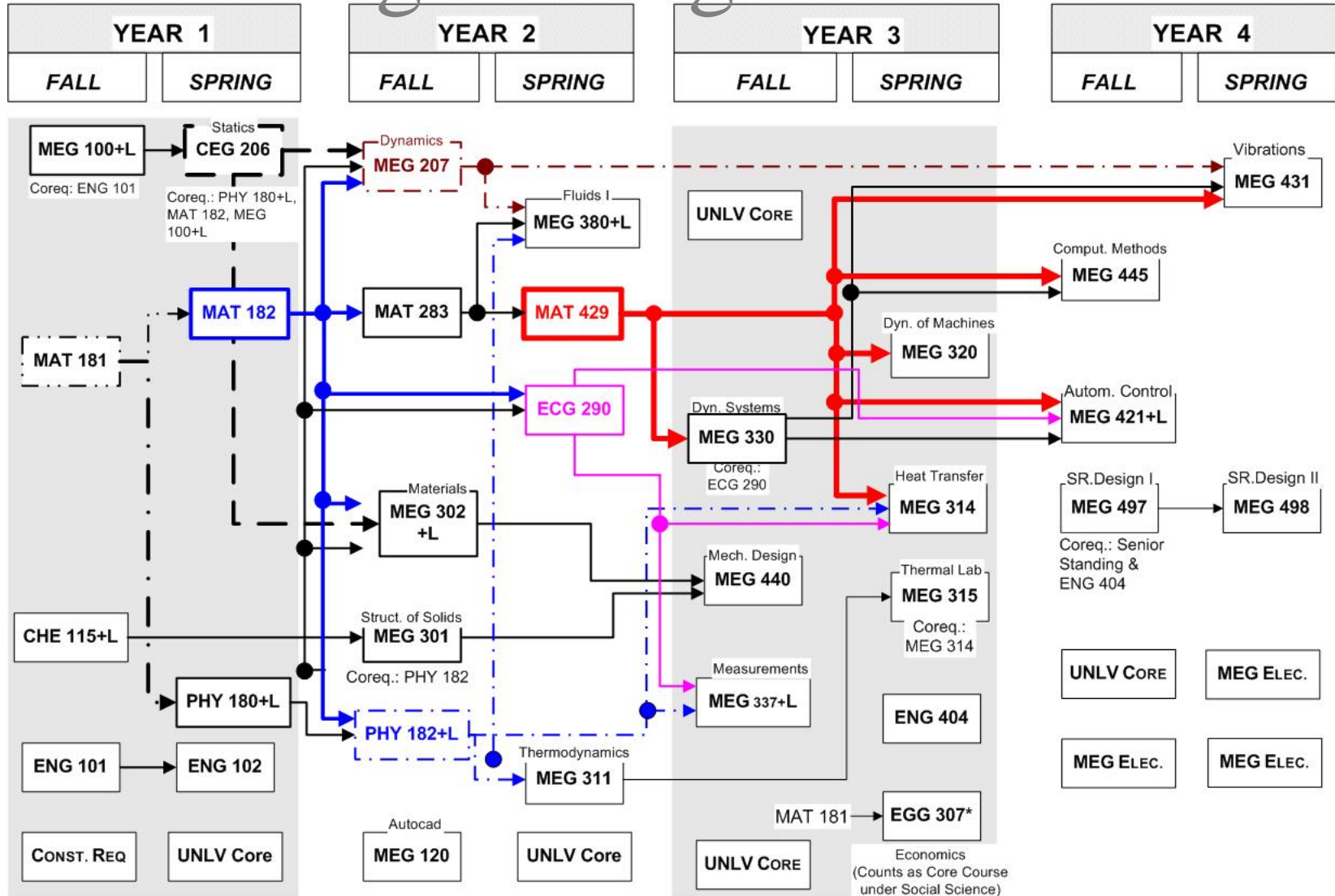
UNLV – MEG Curriculum

See: <http://www.me.unlv.edu/>

The Mechanical Engineering program at UNLV

see:

<http://www.me.unlv.edu/Undergraduate/Flowchart-2004-2006-5-04.htm>



Chapter 1.9

Engineering Education

UNLV – MEG Curriculum

See: <http://www.me.unlv.edu/>

Degree Requirements

Mechanical Engineering Pre-Major:

English Comp. ENG 101 and 102..... 6
credits

Mathematics MAT 181 and 182..... 8
credits

Social Sciences/Humanities 6
credits

Chapter 1.9

Engineering Education

Degree Requirements Mechanical Engineering Pre-Major, cont'd:

Engineering MEG 100, 100L, CEE 241;
MEG 120 and 207.....

10 credits

Social Sciences/Humanities 9
credits

EGG 307 (Engineering Economics), and
six additional elective credits in the
appropriate fields.

MEG Curriculum Years 1 and 2

**Plan for
Pre-
requisites!**

