

PH Pädagogische Hochschule Wien

ENERGY - OVERVIEW

I.Hantschk/H.Fibi 2009



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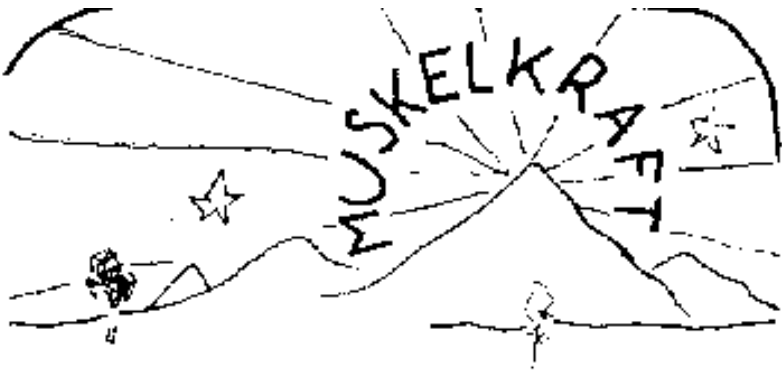
e-mail: Hans210347@a1.net or johann.fibi@phwien.ac.at

2009

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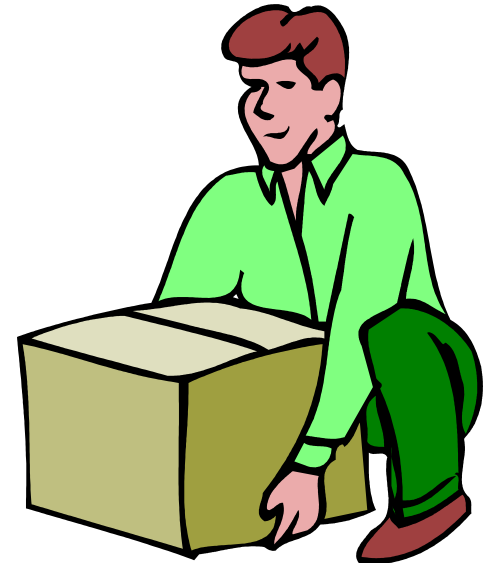
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Horse Power

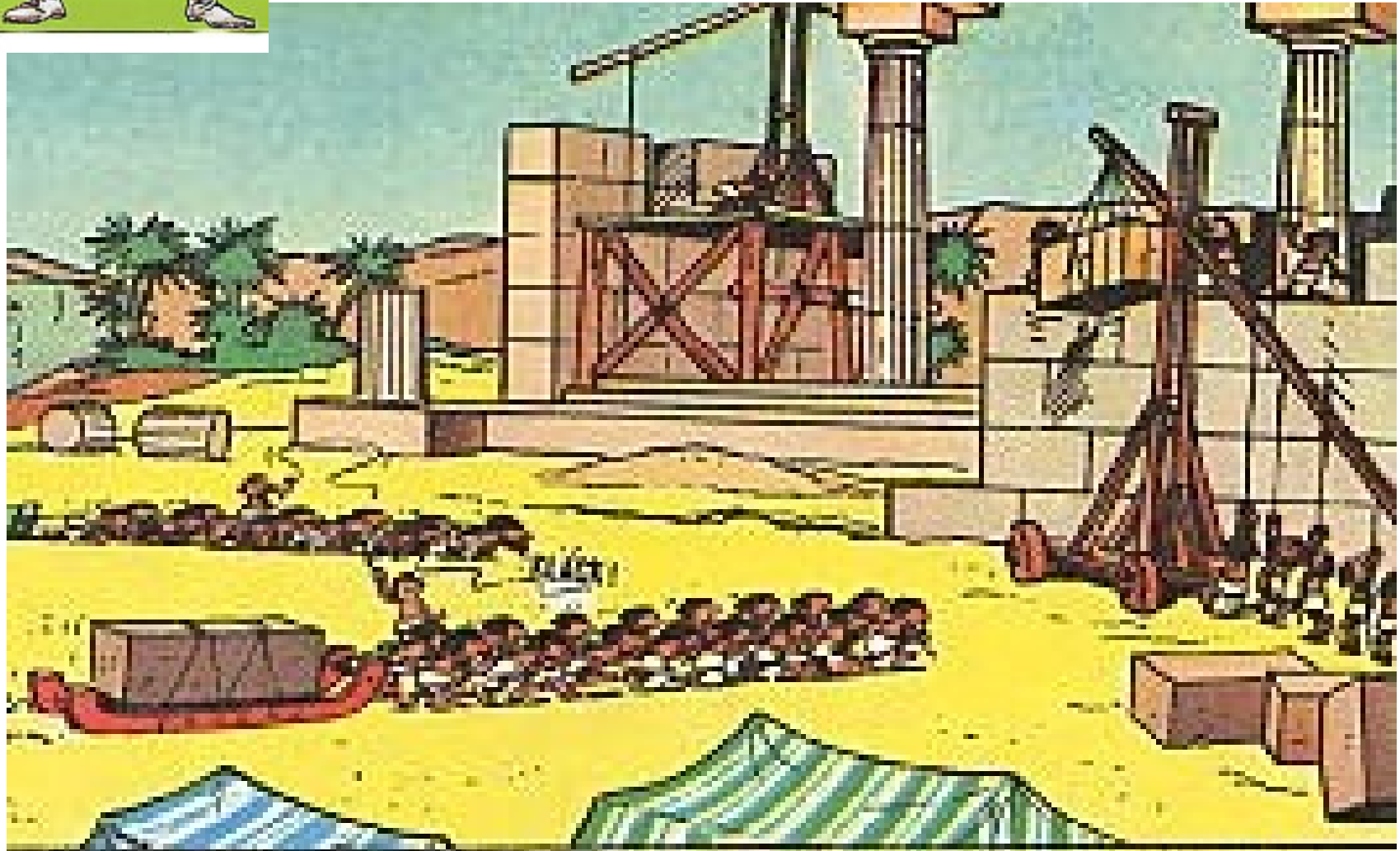
Men Power



In former times men and sometimes animals like donkeys did the work.....

as it presently is the fact, too.

Rolls, levers and inclined plane helped for achieving better force effects, but saved no work.



This it was....
 Besides water,
 wind and fire.

Die grundlegenden Erfindungen

Jede Maschine, egal wie kompliziert und ausgeklügelt sie auch ist, basiert auf einer oder mehreren der sechs grundlegenden Erfindungen. Erst sie ermöglichten unsere modernen Geräte:

1 Der Hebel

Man unterscheidet drei Anordnungen von **Drehpunkt, Kraft** und **Last**.



■ Einseitiger Hebel A



■ Einseitiger Hebel B



2 Rad und Achse

Eigentlich handelt es sich um einen drehbaren Hebel. Die über die Kurbel ausgeübte Kraft wird auf das um die Achse gewundene Seil übertragen und dabei verändert.

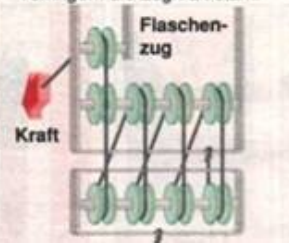


3 Der Flaschenzug

Die einfache Rolle verändert die Kraft nicht, lenkt sie aber in eine günstigere Richtung.

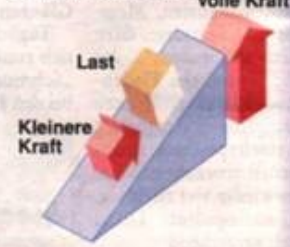


Großer Flaschenzug: mehrere lose und feste Rollen verringern die Zugkraft stark.



4 Die schiefe Ebene

Um eine Last eine schiefe Ebene hinaufzubefördern, ist viel weniger Kraft nötig als für senkrechtes Heben.



5 Der Keil

Eine Art schiefe Ebene, welche z. B. ein Stück Holz auseinanderdrücken kann.

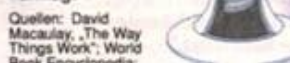


6 Die Schraube

ist eigentlich eine schiefe Ebene, die um einen Zylinder bzw. einen Kegel (bei der spitzen Holzschraube) gewickelt wurde.



Ein **Wagenheber** kombiniert die Wirkung von Hebel und Schraube. Er kann Kraft bis zum Faktor 50 vergrößern, so daß man leicht ein Auto zu heben vermag.

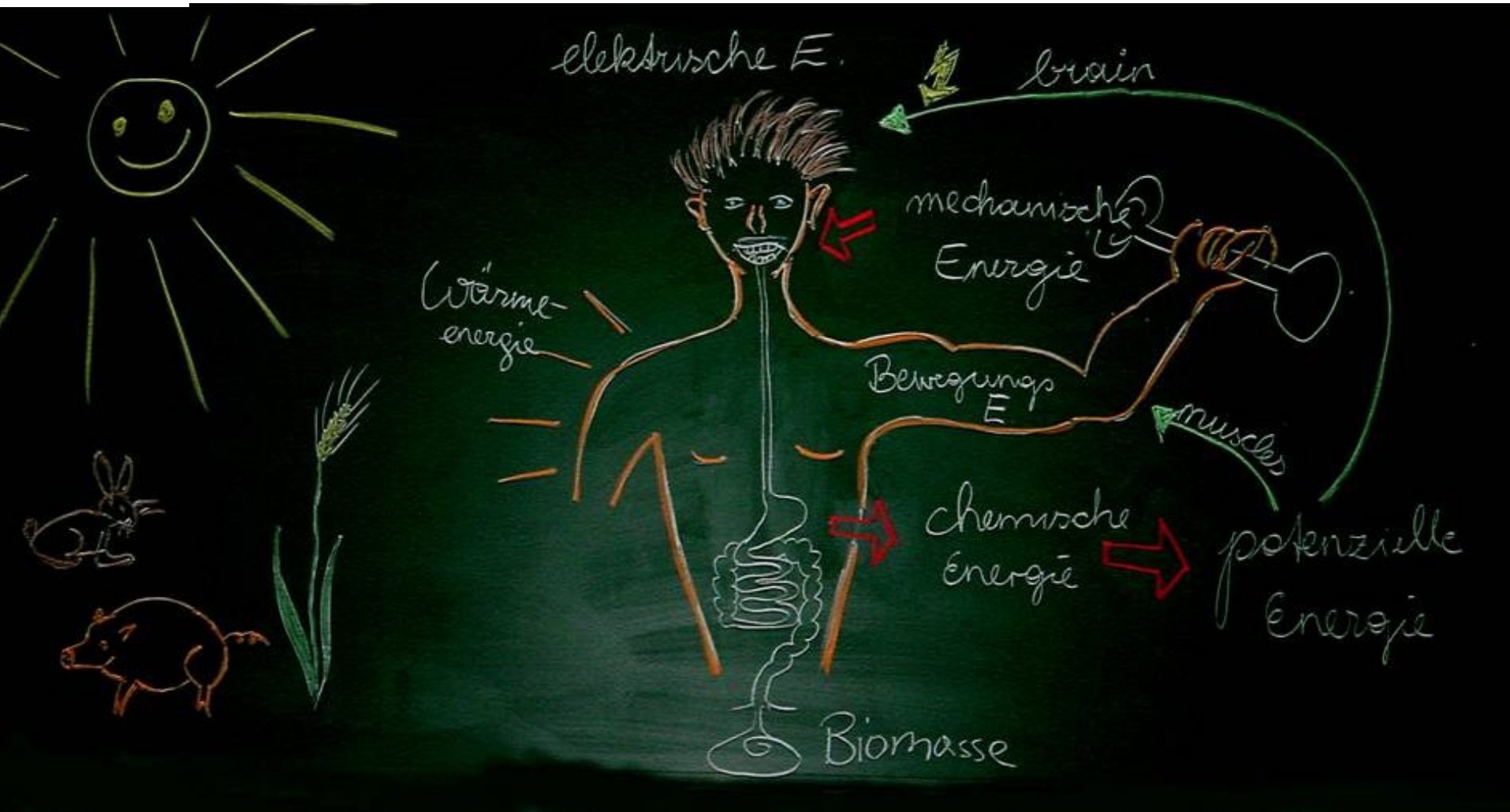


Quellen: David Macaulay, „The Way Things Work“; World Book Encyclopedia

More modern tools are added.

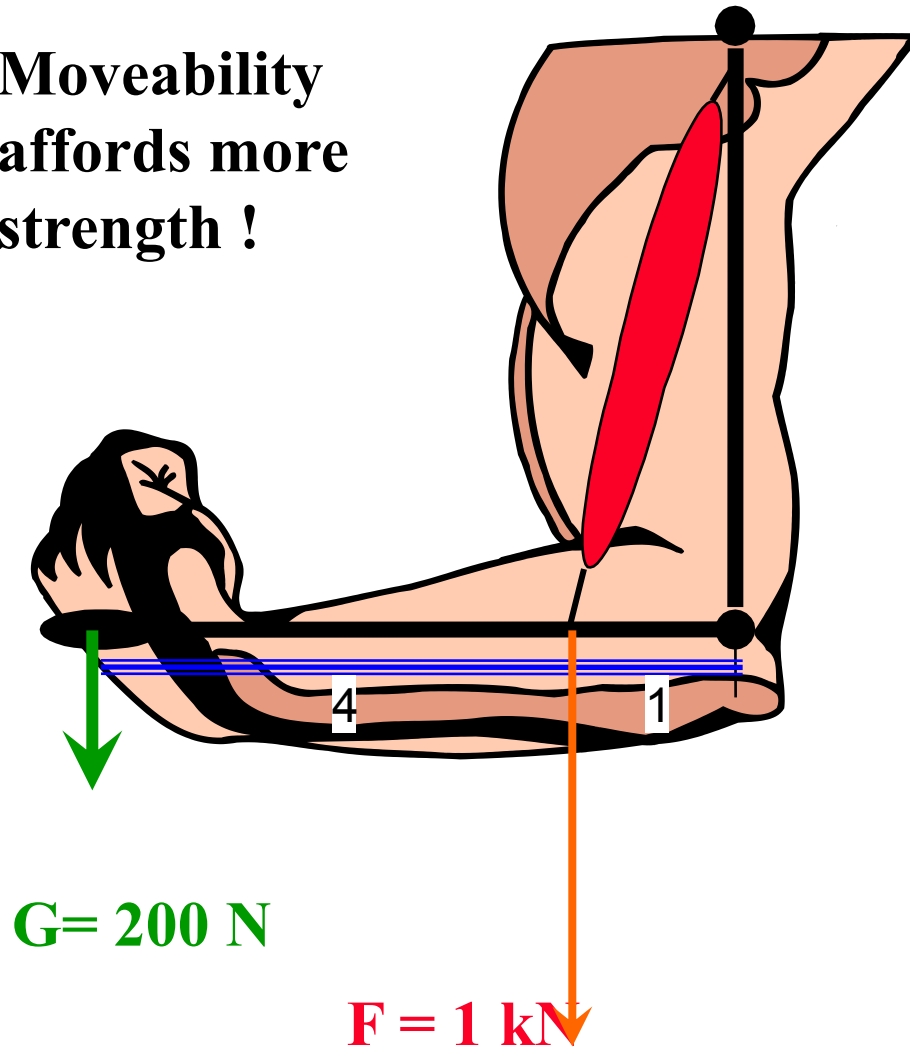


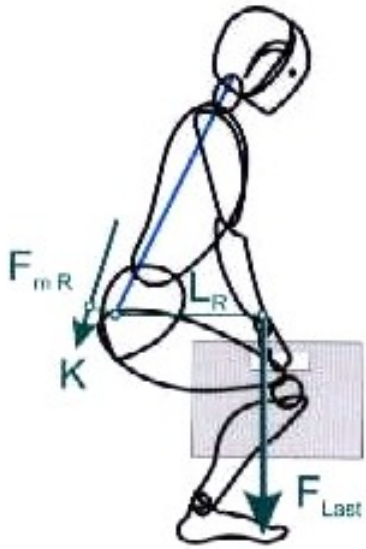
„Human Energy“, once upon a time pictured by our students



Human Lever

Moveability
affords more
strength !





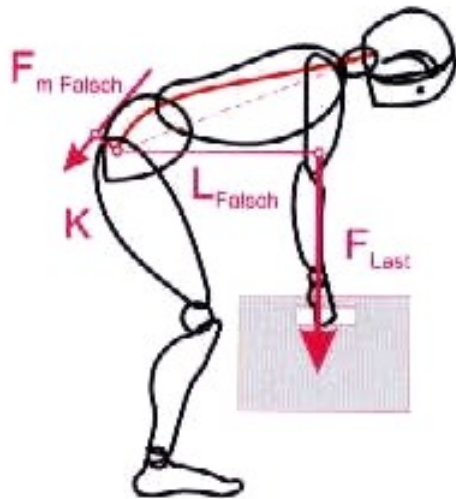
$$K = 0,05 \text{ m}$$

$$L_{\text{correct}} = 0,20 \text{ m}$$

$$F_{\text{LOAD}} = 700 \text{ N}$$

$$F_{\text{STRENGTH}} = 2800 \text{ N}$$

Damaged disc
Slipped disc

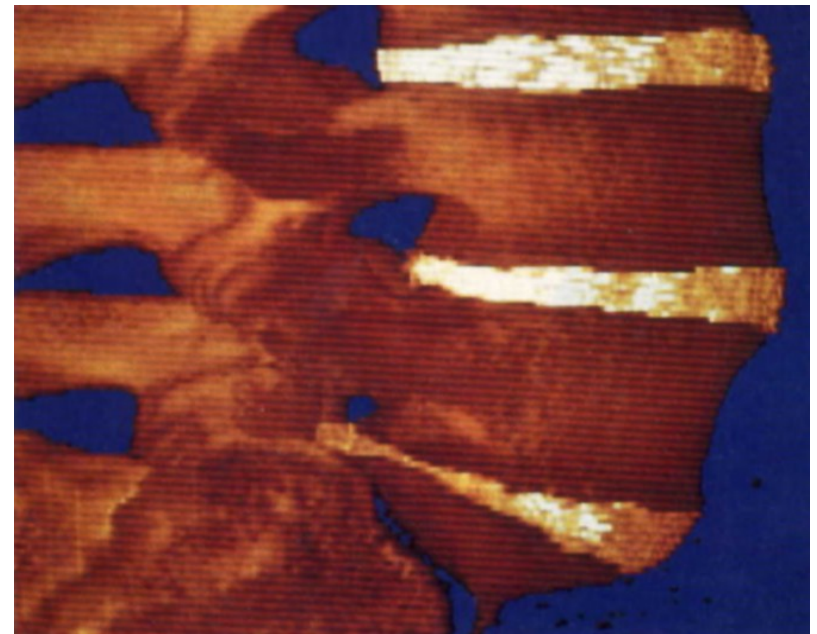


$$K = 0,05 \text{ m}$$

$$L_{\text{wrong}} = 0,30 \text{ m}$$

$$F_{\text{LOAD}} = 700 \text{ N}$$

$$F_{\text{STRENGTH}} = 4200 \text{ N}$$



HUMAN BEING NEEDS...

Energy

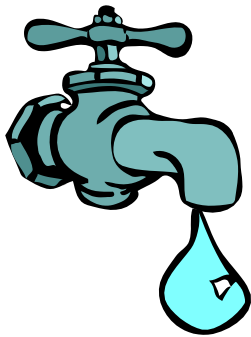
Food:

Adult: 500 kg/a

Child, one year old:

340 kg/a,

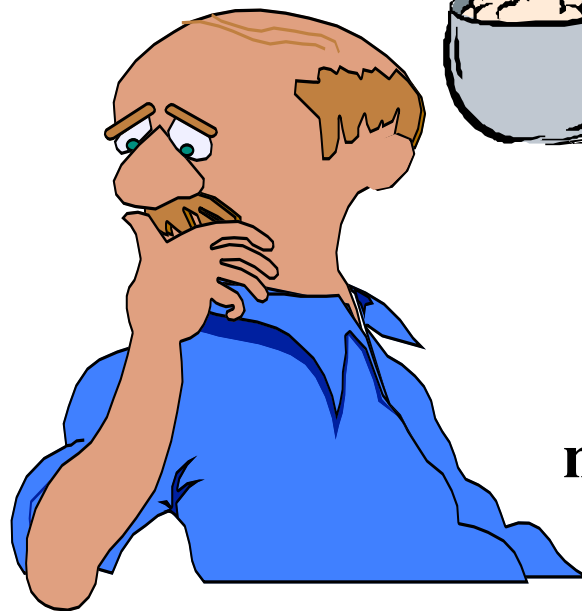
from this 50% milk



Water:

2,2 litres / day

**Solution, Concentration
in the cells**



m = 70 kg

**Transfer to
Energy (ATP)**



**Air:
20 l air / minute
30-40 m³ air / day**



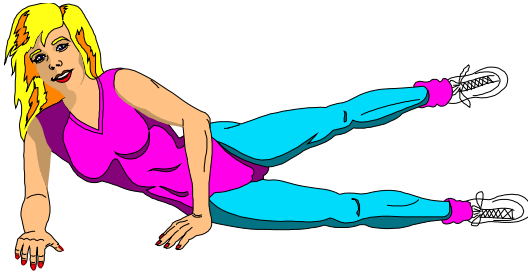
1 l air ... 1 kJ energy

Drinking water
5-12 °C
colourless
clear
odourless
neutral
well tasting

Without water:
death after some days

Human being consists of about
70 % water
reducing the bodily water by
2 %: thirsty
5-12 %: you must drink, otherwise
headache, burning of the mucous
membrane of eyes, nose, mouth,
throat, fever
15-20 %: kidneys stop working,
death.





aerobic energetic turnover (respiration):



6 mol O₂ ... 6x22,4 l = 134,4 l

regarding to 2830 kJ

**1 l air 20% O₂ from this 25%
used ...**

1 l air → 1 kJ energetic turnover.

**standardized men: 200 cm³ air/breath -
20 l / min.**

anaerobic energetic turnover

(lactic acid- fermentation)

about 200 kJ / mol C₆H₁₂O₆



**daily demand about 10-14 MJ,
from this basal metabolism 7,2 MJ,
from this heart: 200 kJ
and respiration 250 kJ.**

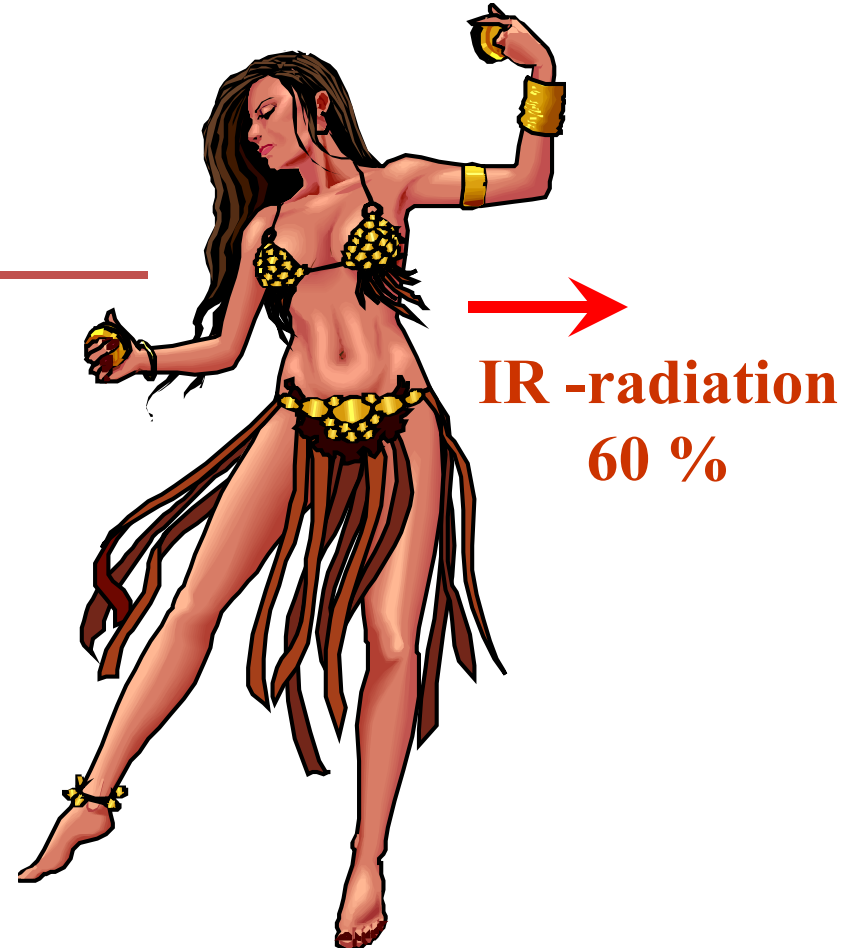
**fast
jumping up
in the morning:
1 kW !!**

Permanent work: ~ 70 Watt (small horse is better), like a lamp
Maximum high jumping ~ 3 kW or weight lifting ~ 8 kW

Air temperature: 25 °C
relative humidity: 40-60 %
wind speed: < 0,3 m/s

Evaporation:
25 %

**Heat conduction
and
heat convection:**
15 %



IR -radiation
60 %

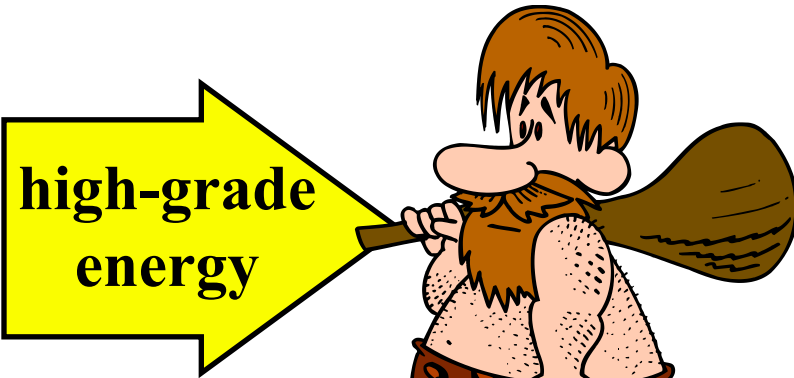
300 W till 1 kW heat emission

K-Values in W/m²K:
air no movement: 3
slight wind: 7
strong wind: 15

Clothing in winter: 4
Clothing in summer
(„light“): 12

MEN - an OPEN ENERGETIC SYSTEM

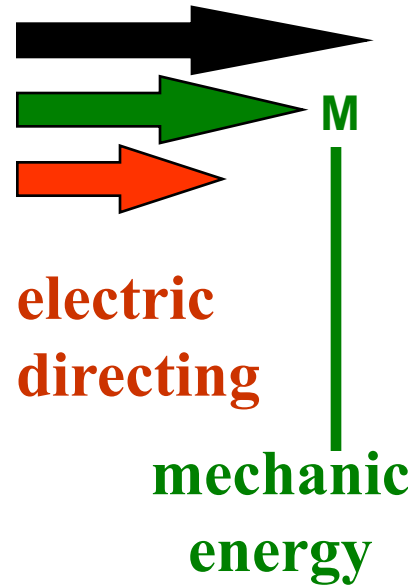
energetic transfer – energetic devaluation



formation of the system mass

energetic contents of nutrients

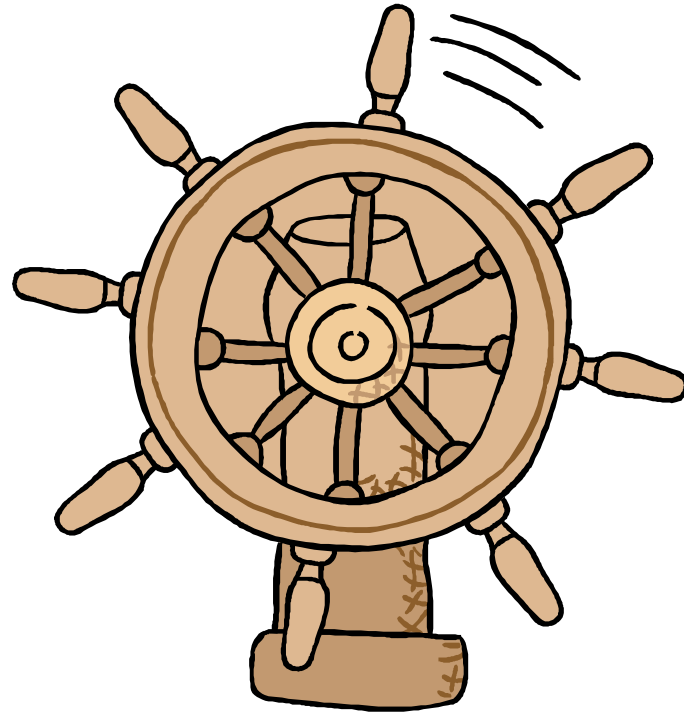
Caloric Energy



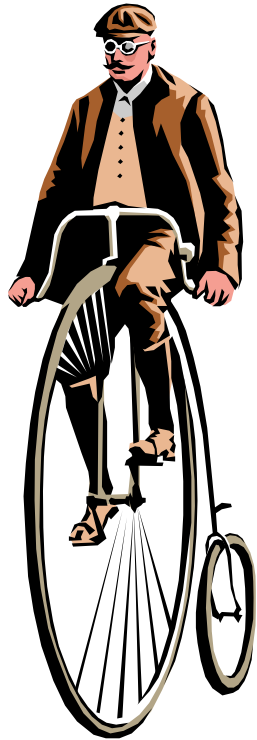
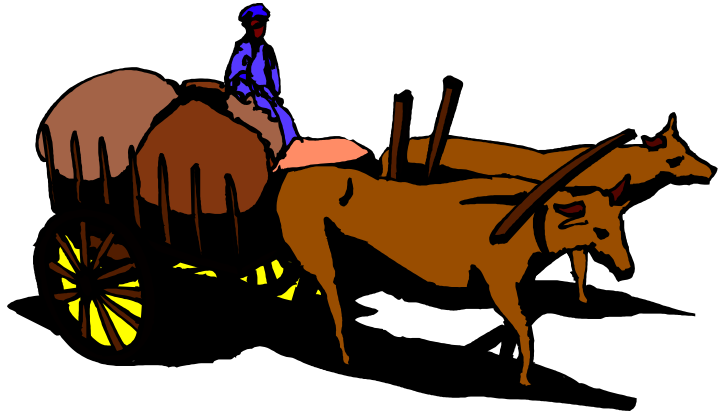
valid for maintainance of the system s temperature



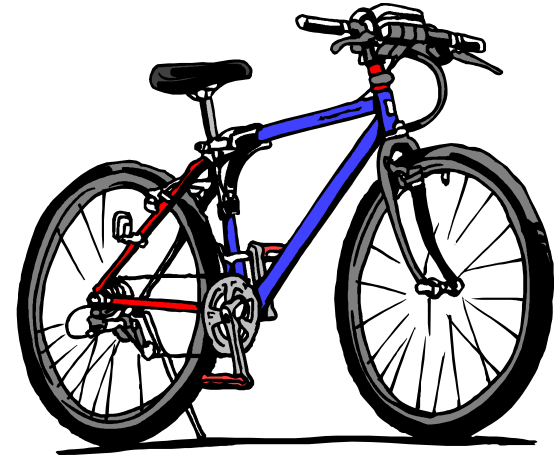
Water Pump
- Lever



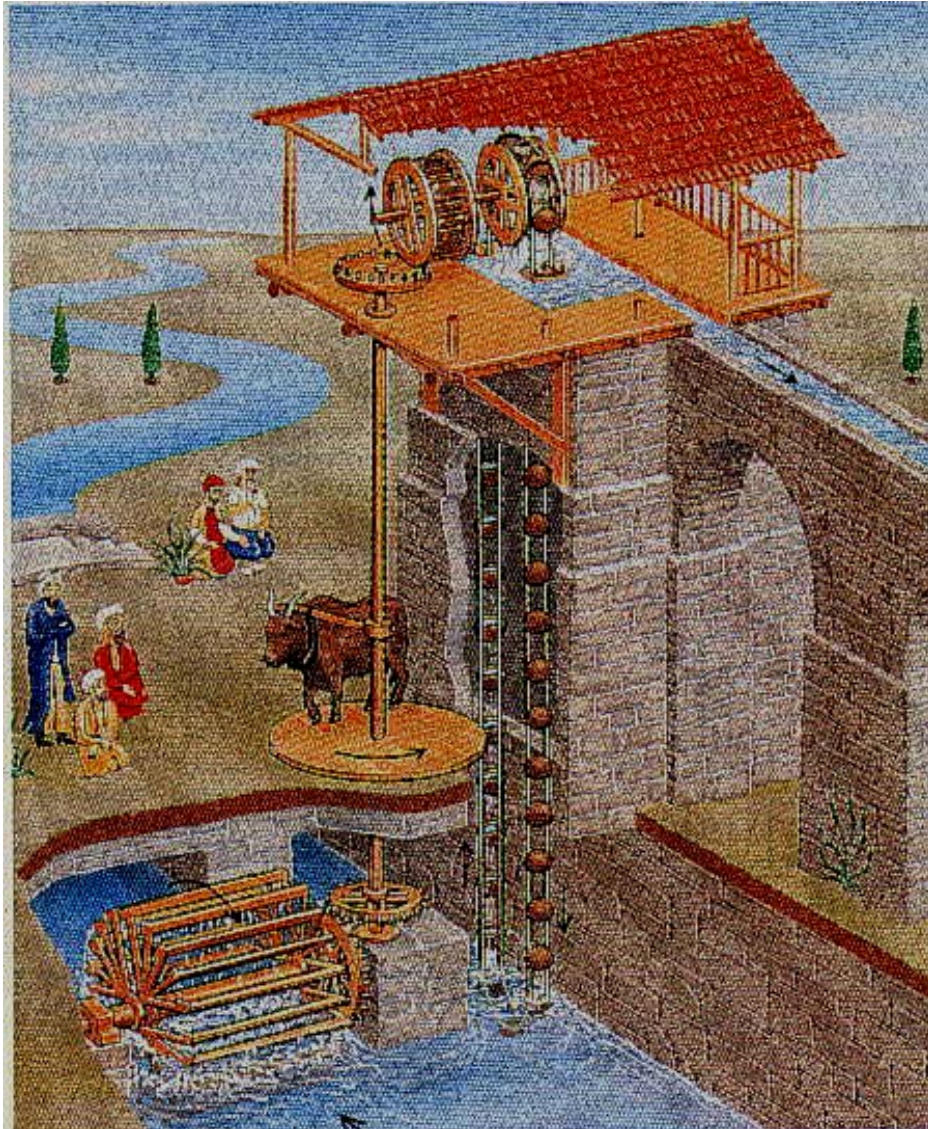
Steering wheel
- Rolls - Lever



**remaining in
modern times**



Techniques of the Near East – Lever plus Muscles and Water, sometimes Wind

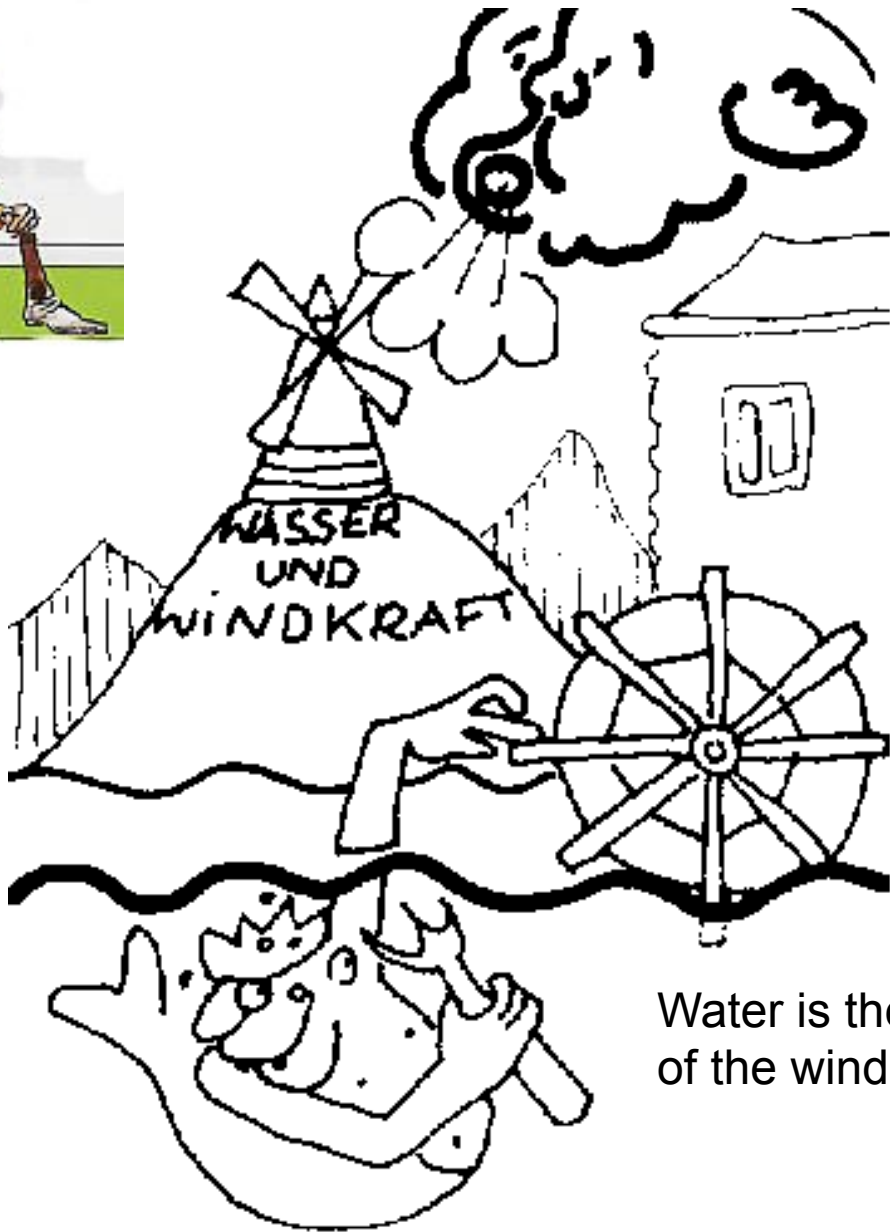


Wooden Gear

„Bottled Chain“

Wooden Gear

Water Wheel



In the wind is energy,
the wind has got
it from the sun.

This is, what they had...
this is, what we shall
use more intensively...

Water is the sister
of the wind.

Wind mills

Hurricane

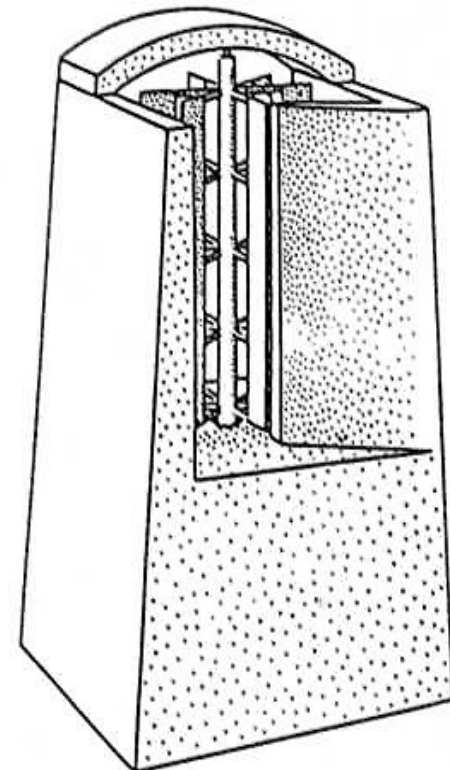


ZEICHNUNGEN: GEORGE RETSECK / QUELLE: U.S. NATIONAL WIND TECHNOLOGY CENTER

Bei frühen Formen der Windmühlen verwendete man Segel oder hölzerne Ruder, die auf vertikalen Achsen saßen. Schon im Mittelalter allerdings hatten sich Mühlen mit horizontaler Achse weitgehend durchgesetzt.



Wind mill in Mesopotamia



They had wind...





**Deutsche (German)
Bockwindmühle:
Das gesamte Haus,
gelagert auf dem Bock,
wird mittels der Stange
gedreht.**

**The whole house,
mounted on an
basement, is
turned into the wind
by a rod.**

**Grinding grains
to flour.**



Rhodos



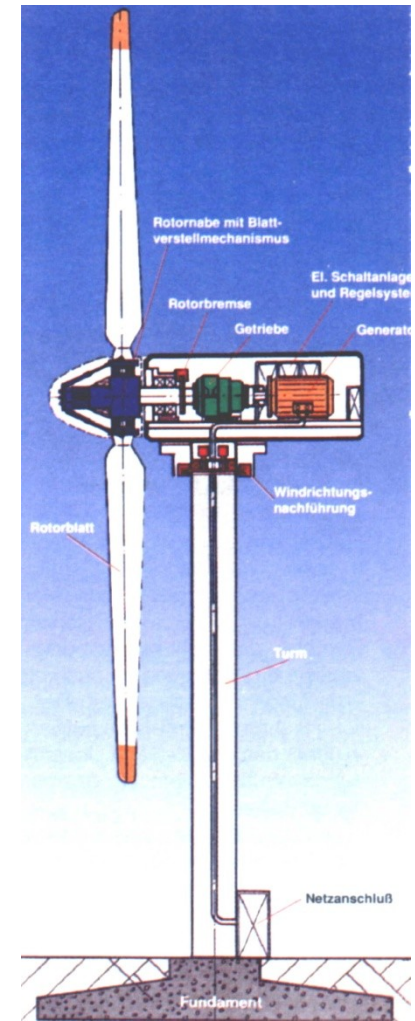
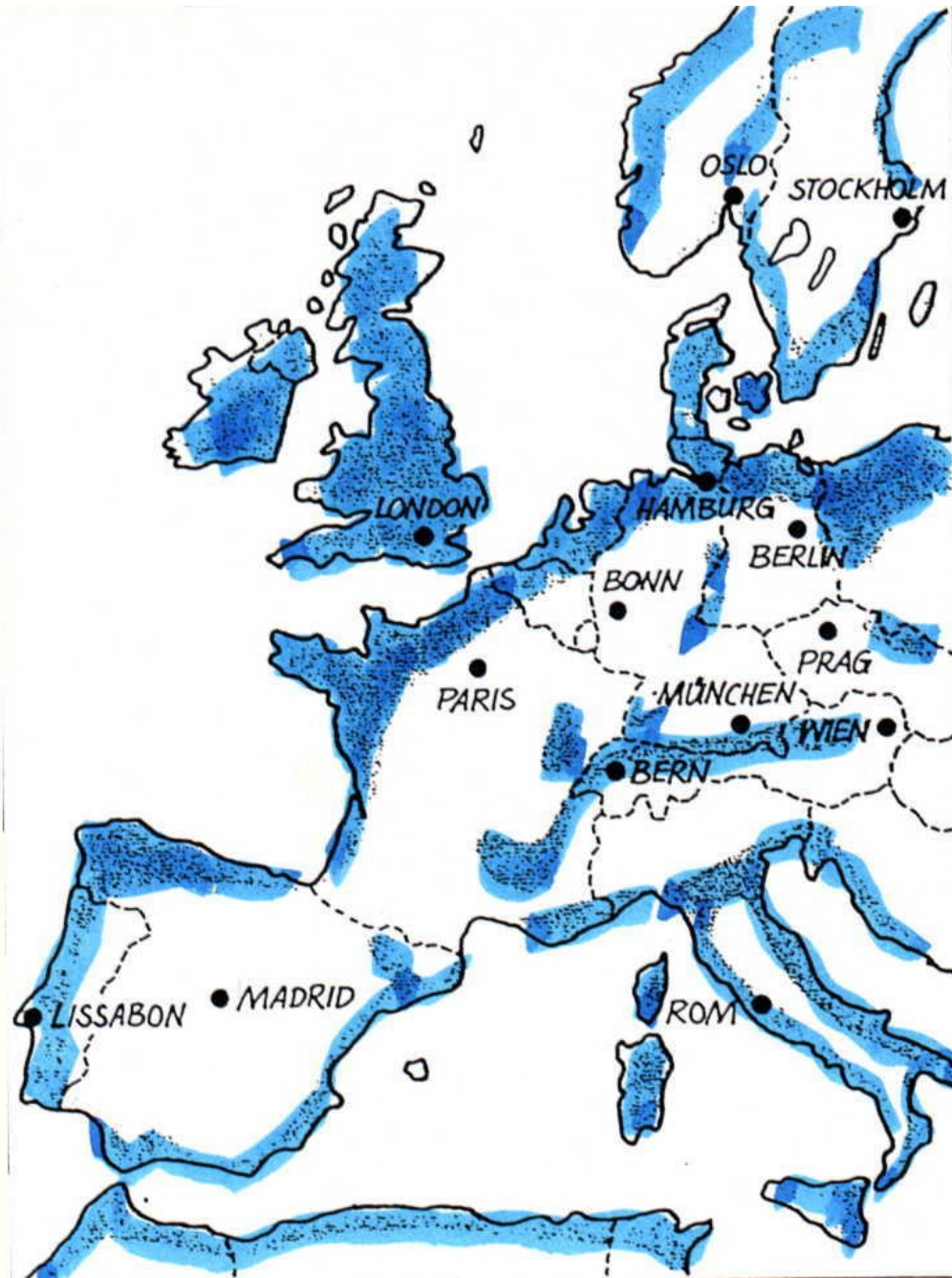
Holländische
Windmühle:
Windmill Netherland
Der Turmkopf drehte mit
den Flügeln
selbstständig
in den Wind
The side wheel turns the
Top of the tower into the
wind - automatically



Retz

Eldest Austrian Windmill

- In function for demonstration



Max. efficiency: 59 %

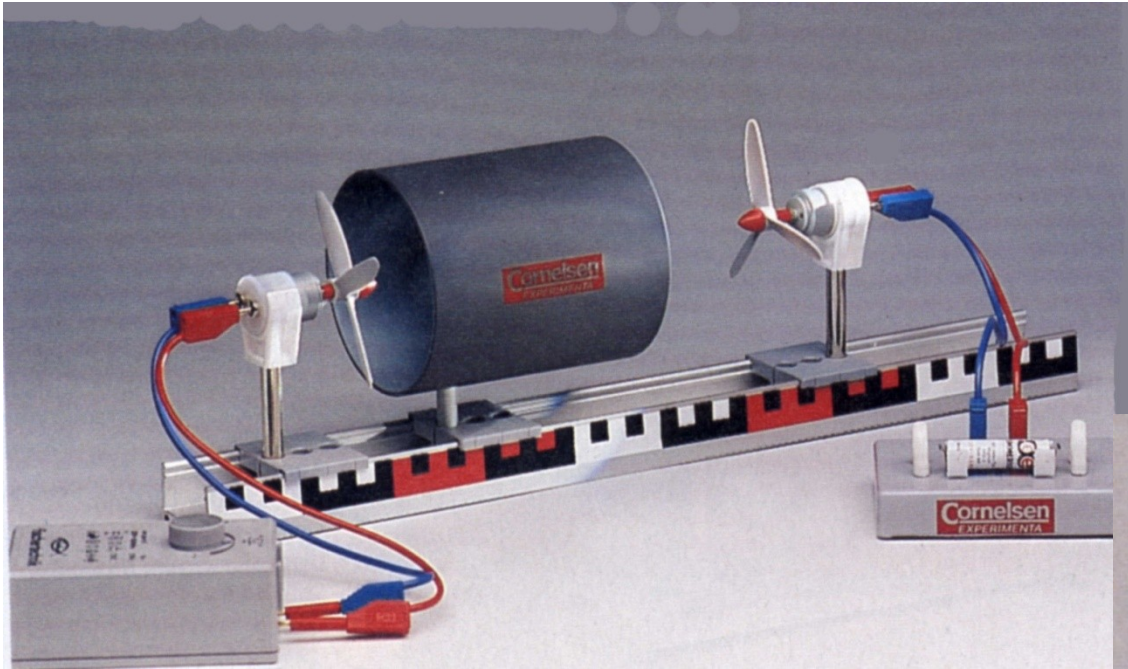




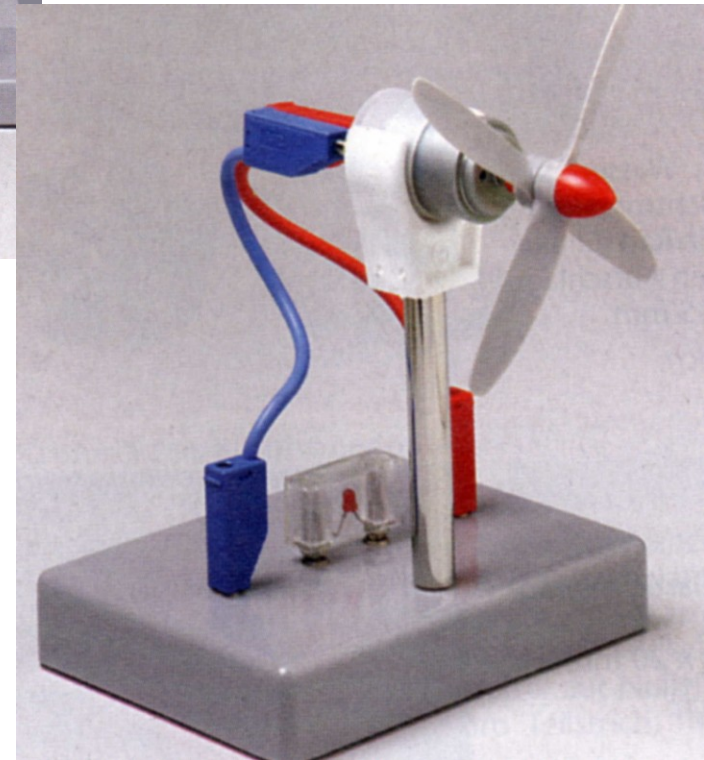


**Langsam, dafür hohes Drehmoment:
Die amerikanische Windmühle.**





Experiments.....

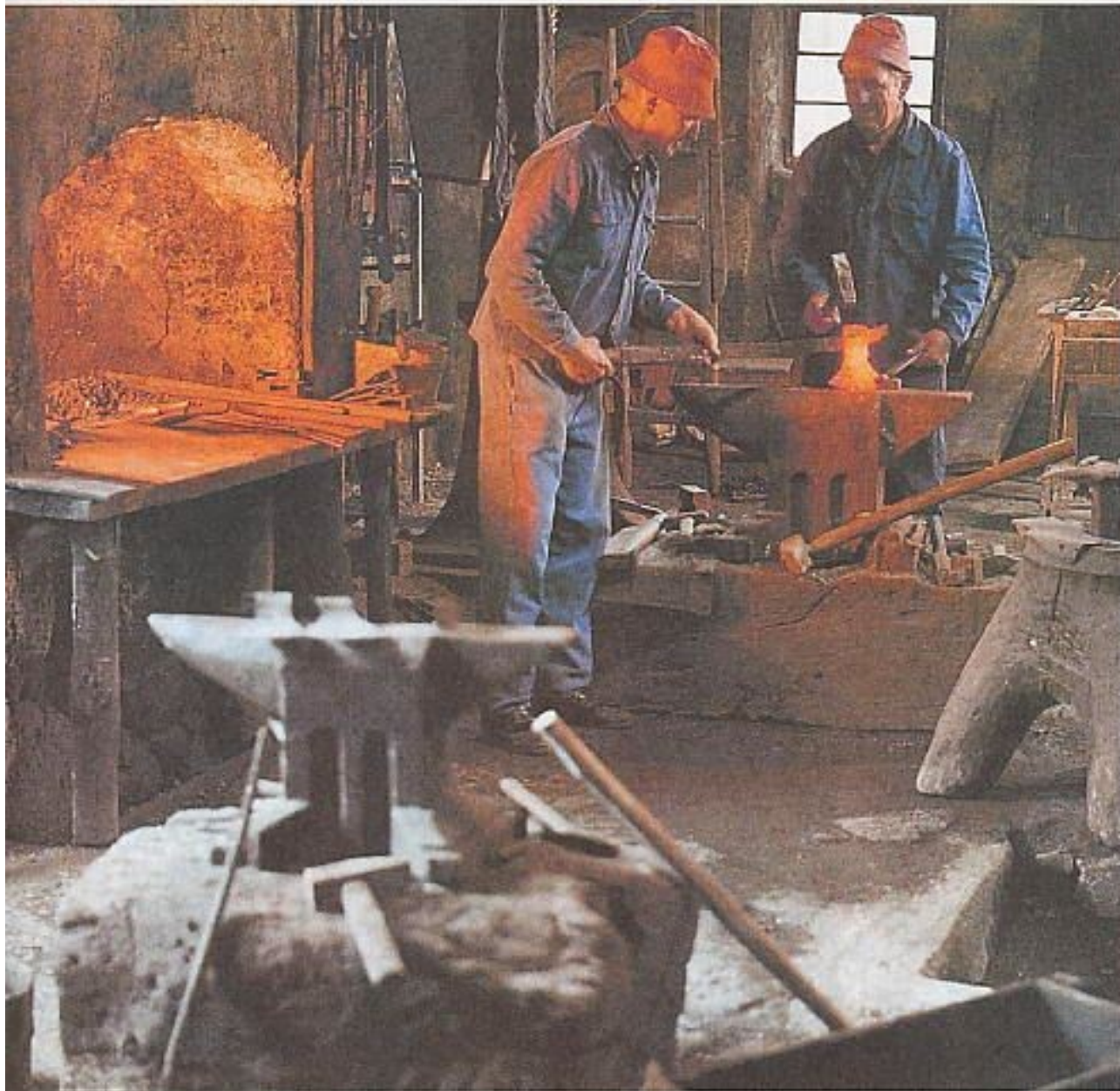


An old Austrian tradition...

Iron

and

Water for water mills





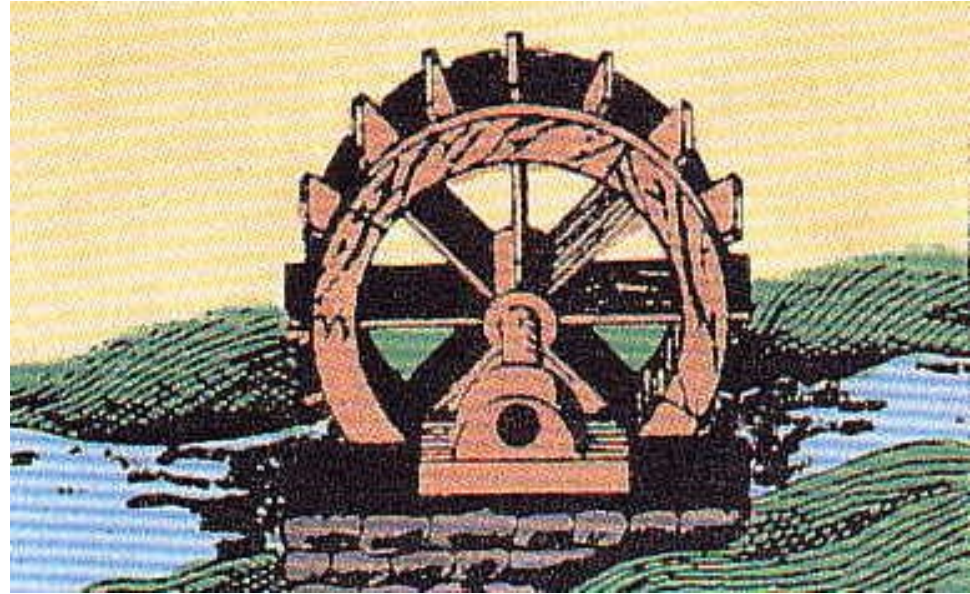
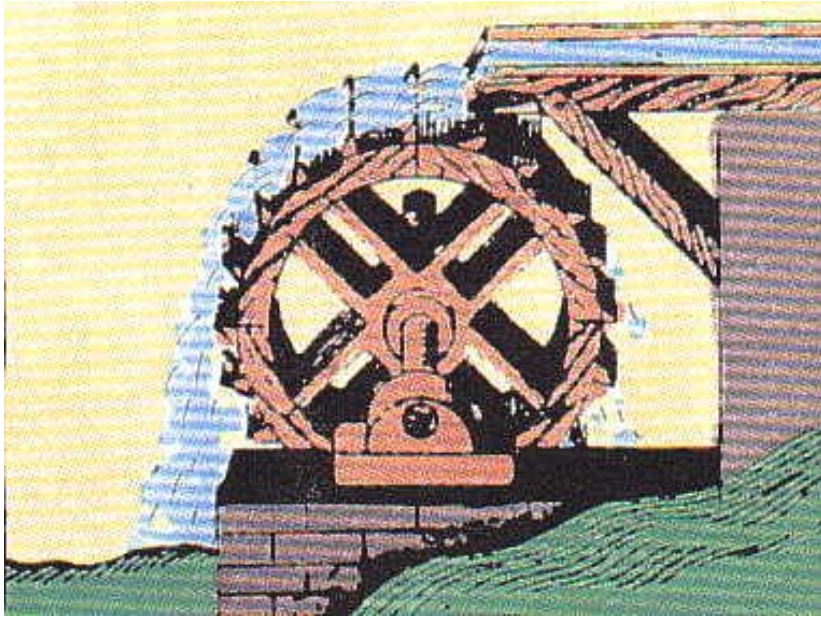
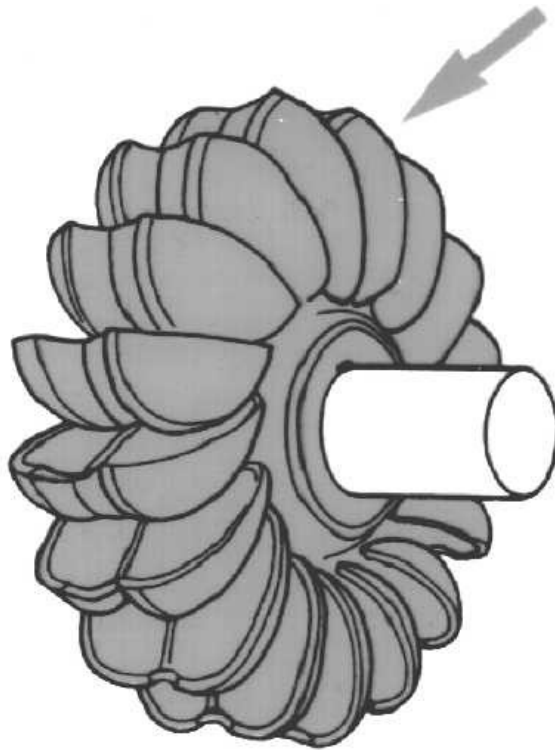


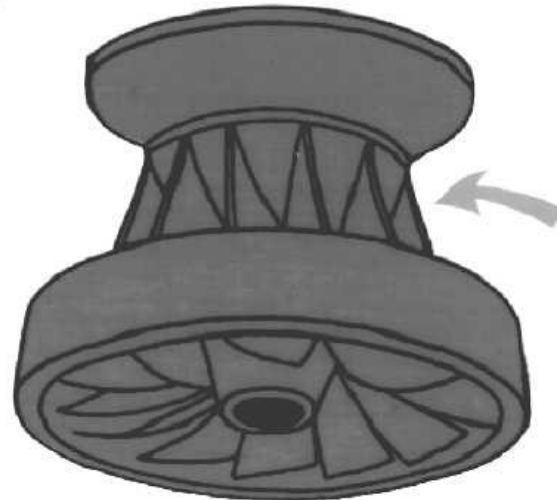


Foto: Coppenst-Werbung

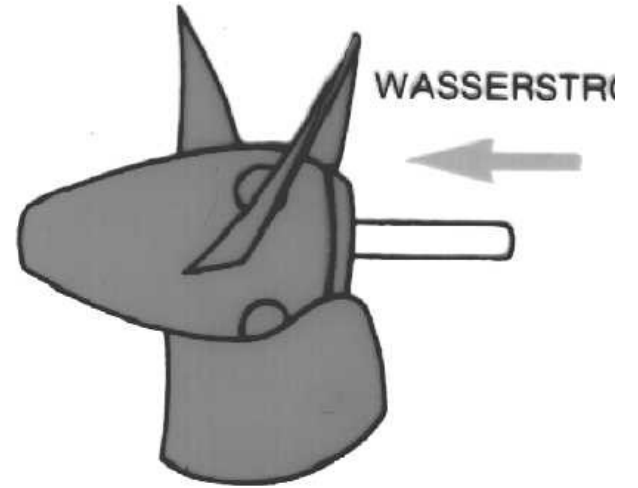
Bleiburg (Kärnten)



PELTON
Tangentialturbine



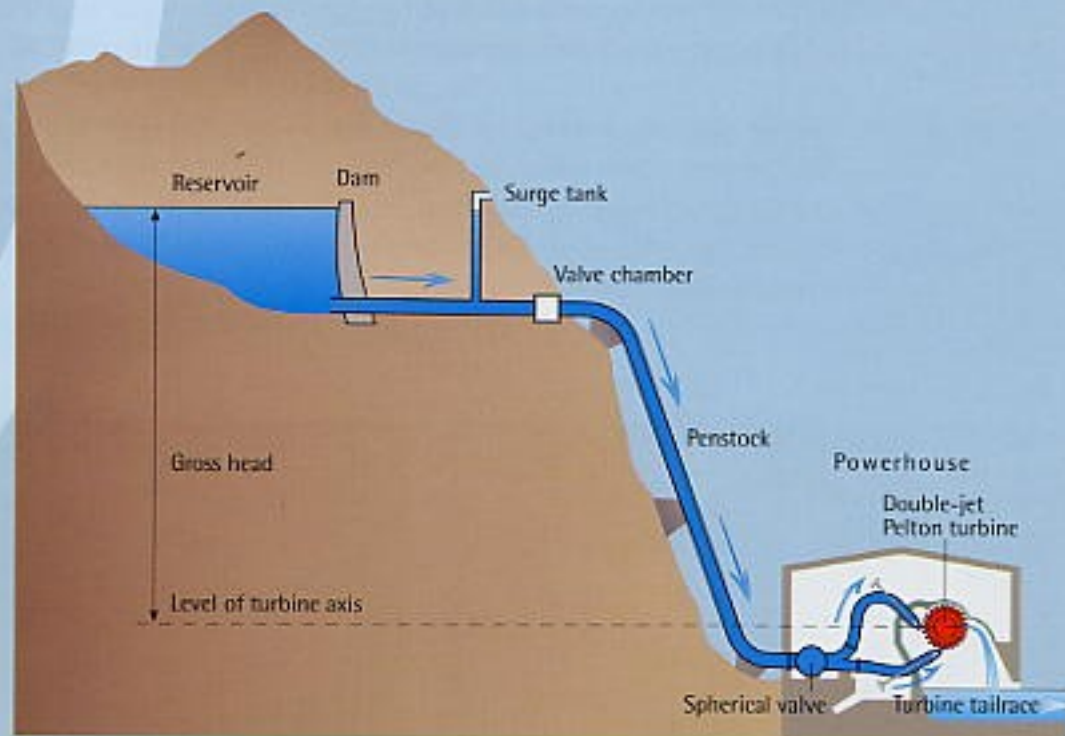
FRANCIS
Radialturbine



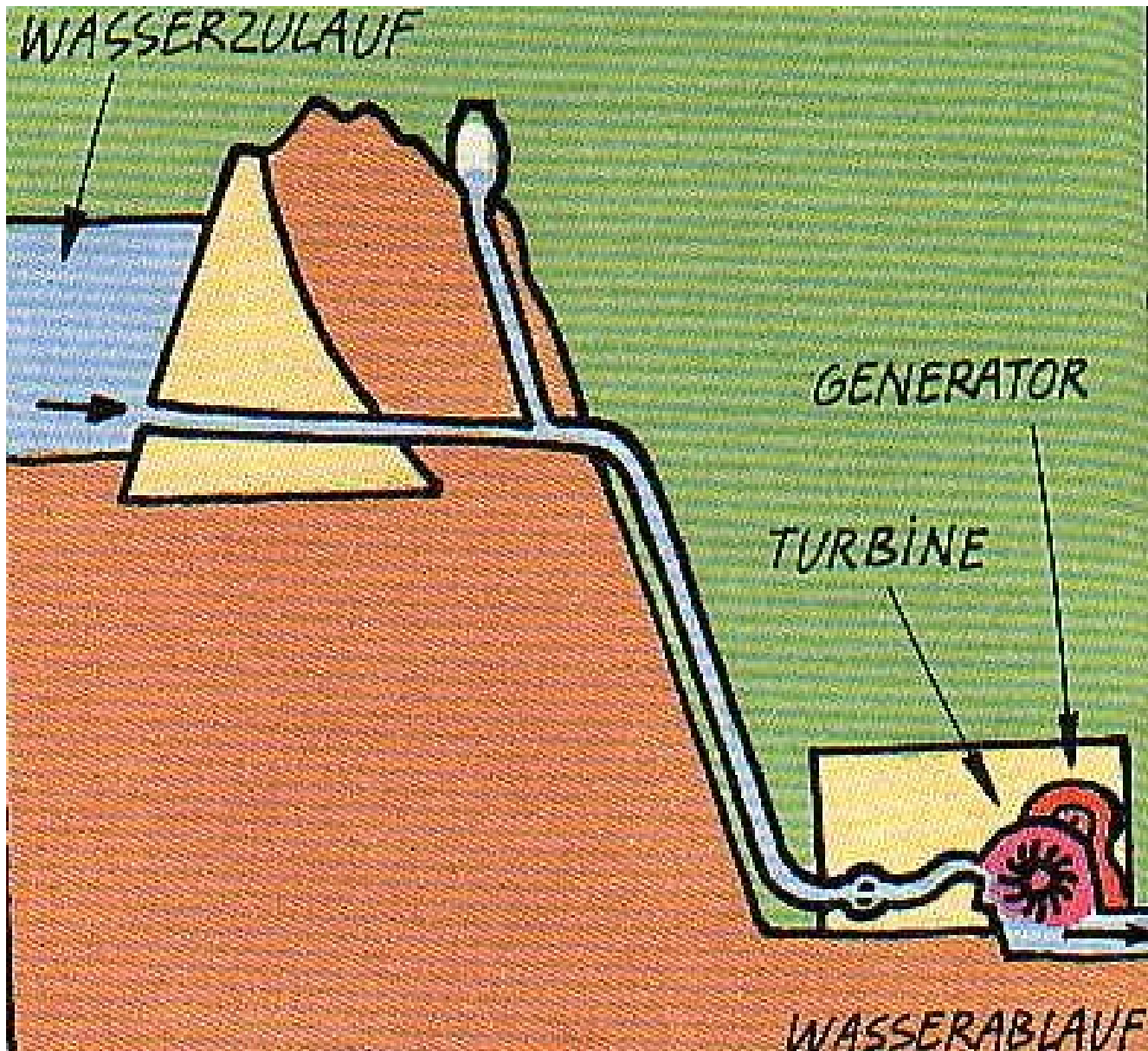
KAPLAN
Axialturbine

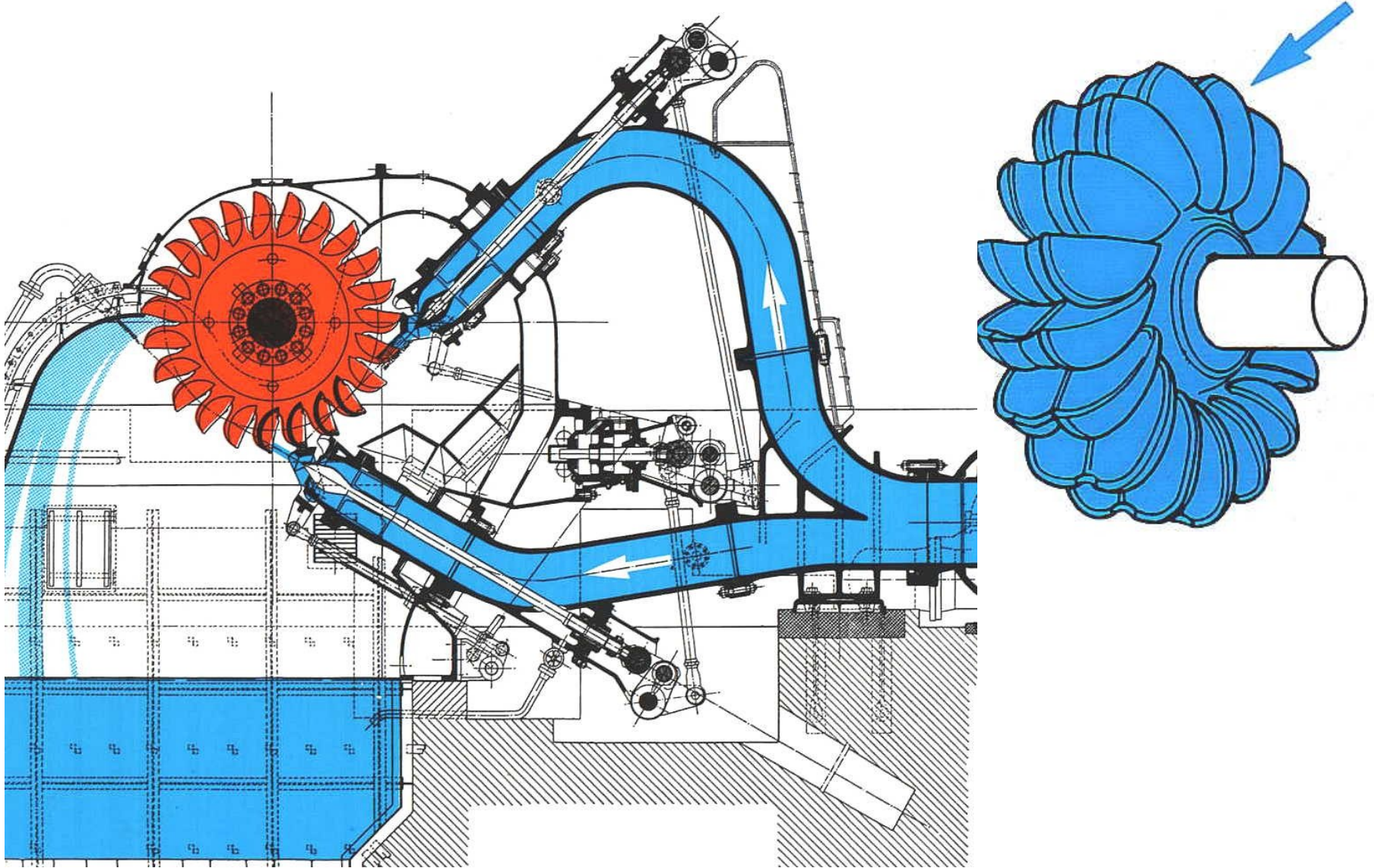
Alpine Wonderland: Reservoir Lakes

Hydro-electric power plants contribute greatly to flood control in the alpine valleys. In addition, access to alpine recreational areas has been opened up through their construction. More than half a million visitors every year enjoy the unique experience of the breath-taking alpine landscape during a visit to one of our facilities.

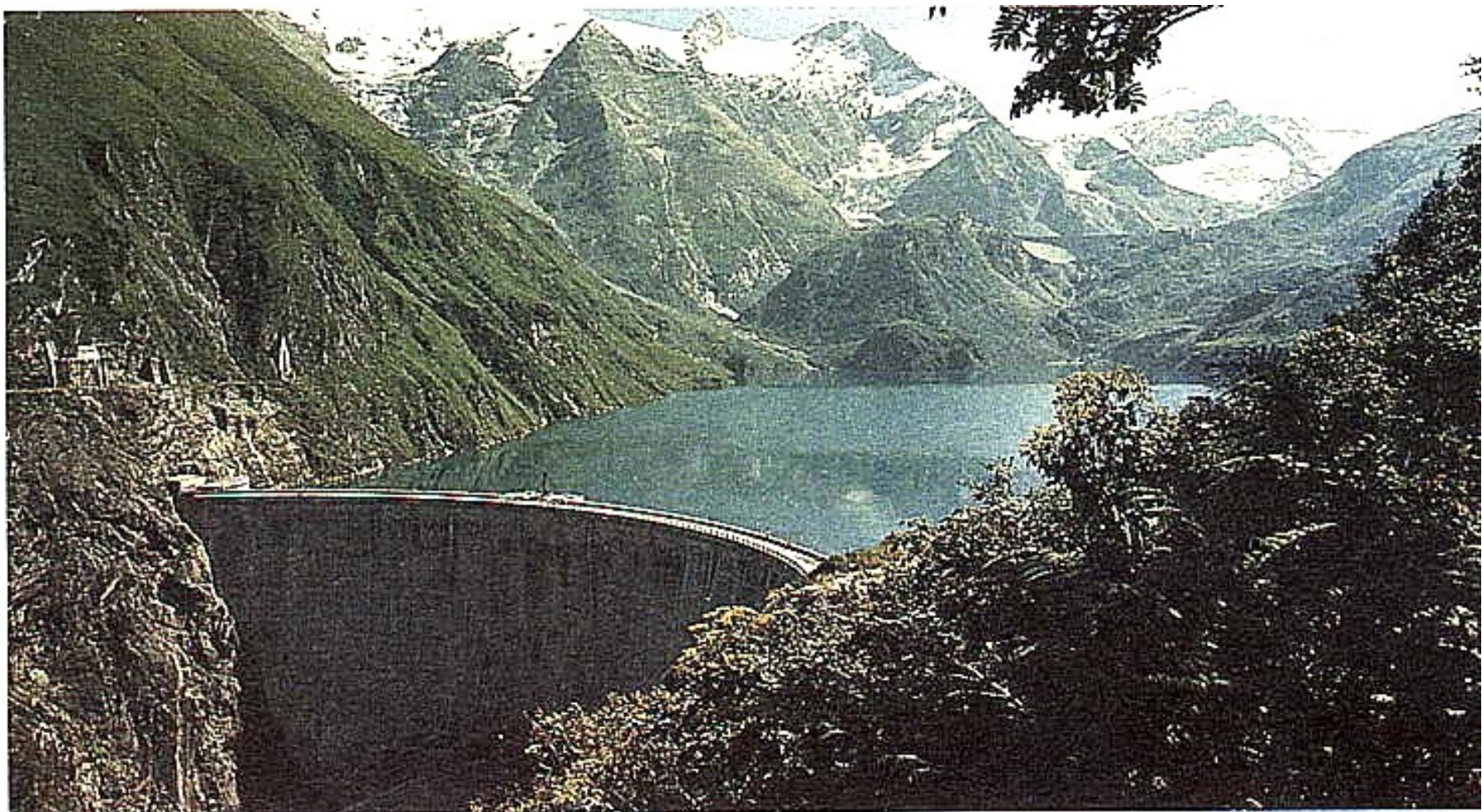


Storage power plant with Double-jet Pelton turbine

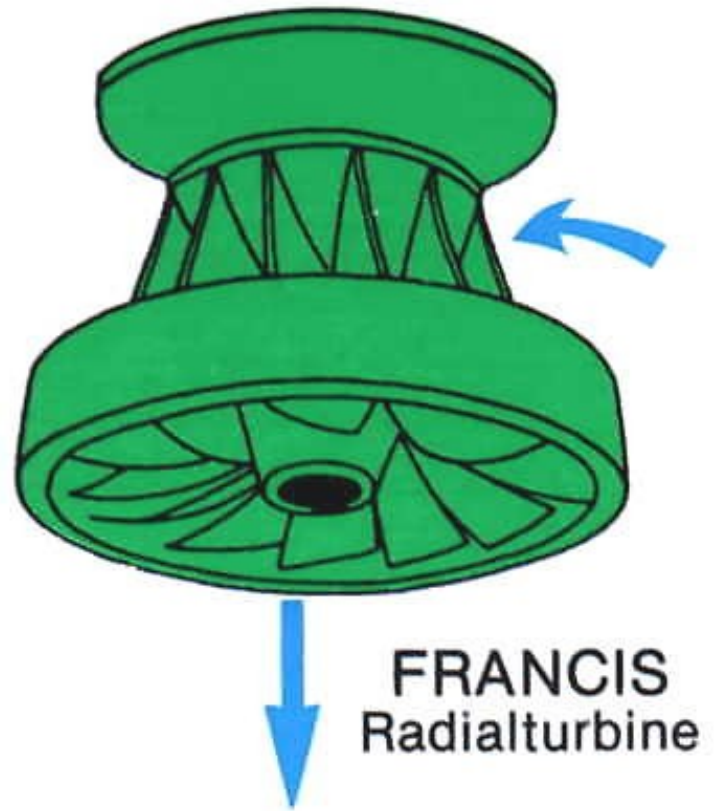
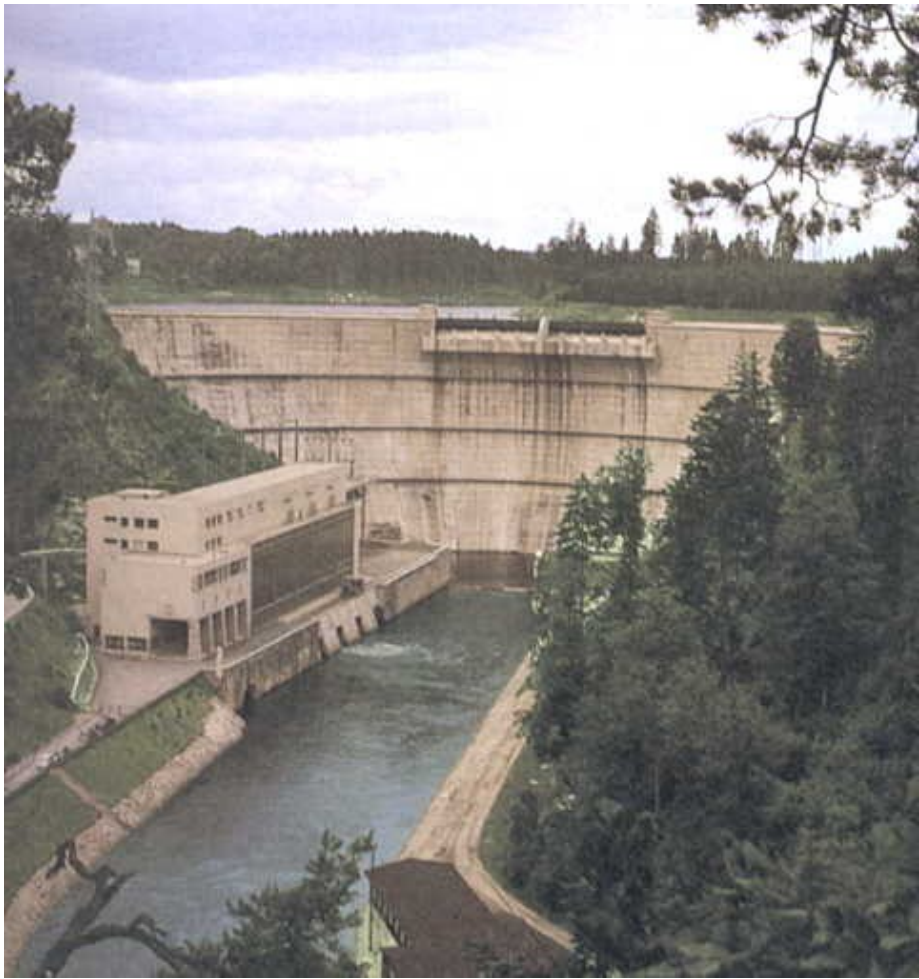




Pelton-Wheel



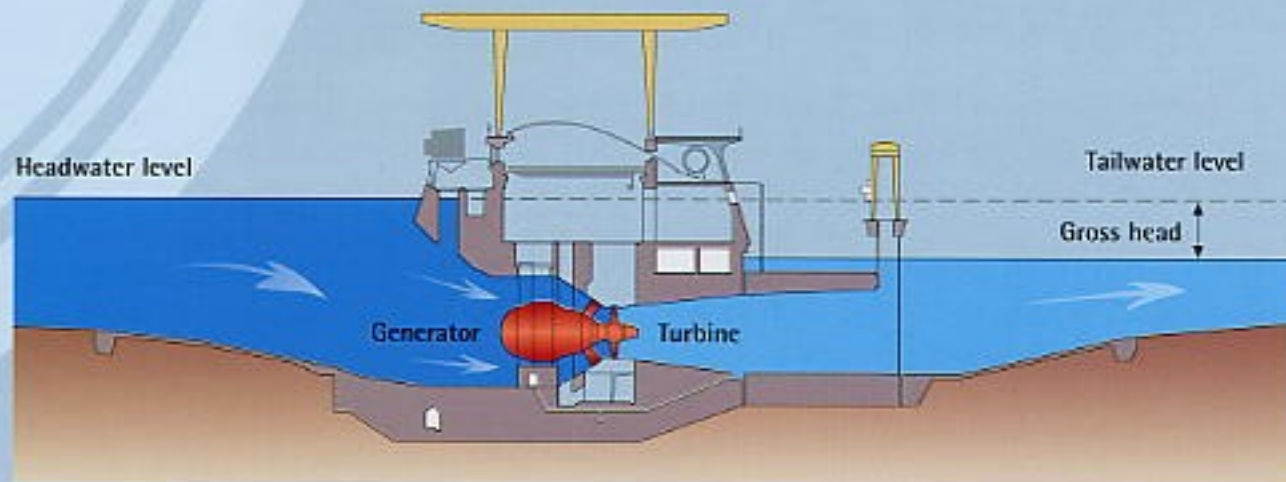
Speicherkraftwerk Kaprun: Stausee Wasserfallboden



FRANCIS
Radialturbine

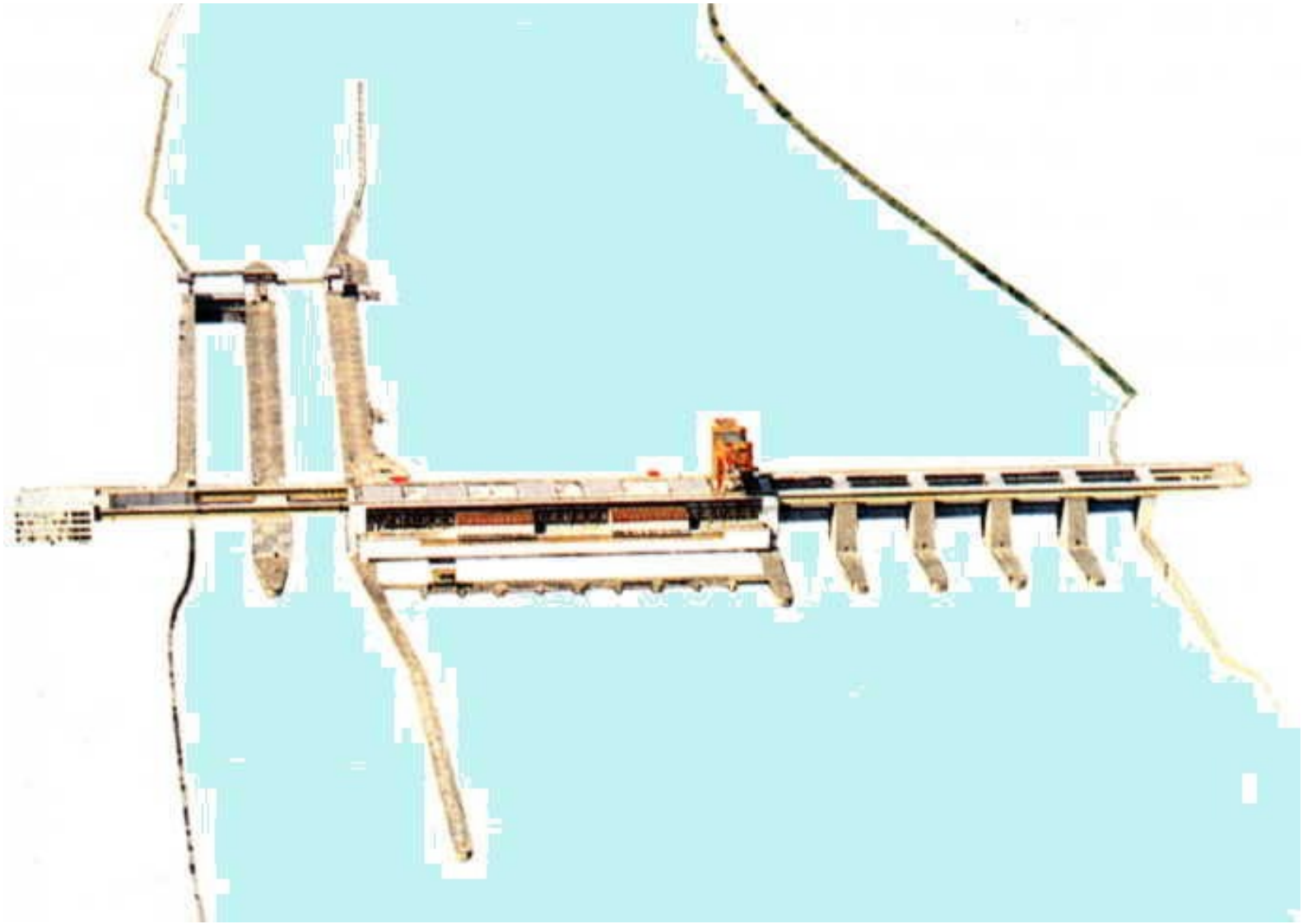
Electrical Generating Facilities with Multiple Uses

The run-of-river plants have multiple other uses in addition to their primary purpose of generating electricity, as do all power plants planned and constructed by AHP. Flood control for certain stretches of river has been increased as a consequence of plant construction. The higher water levels on the Danube due to the dams have significant advantages for ship traffic, which would otherwise be hindered by currents and seasonal low water levels. Responsible construction methods have assisted decisively in the preservation of endangered natural habitats. A substantial contribution to the preservation of nearby wetlands and riparian areas has been achieved by means of an innovative groundwater conservation and management program. Additionally, many recreation areas have been created, which have received a favorable reception from nearby residents and visitors.

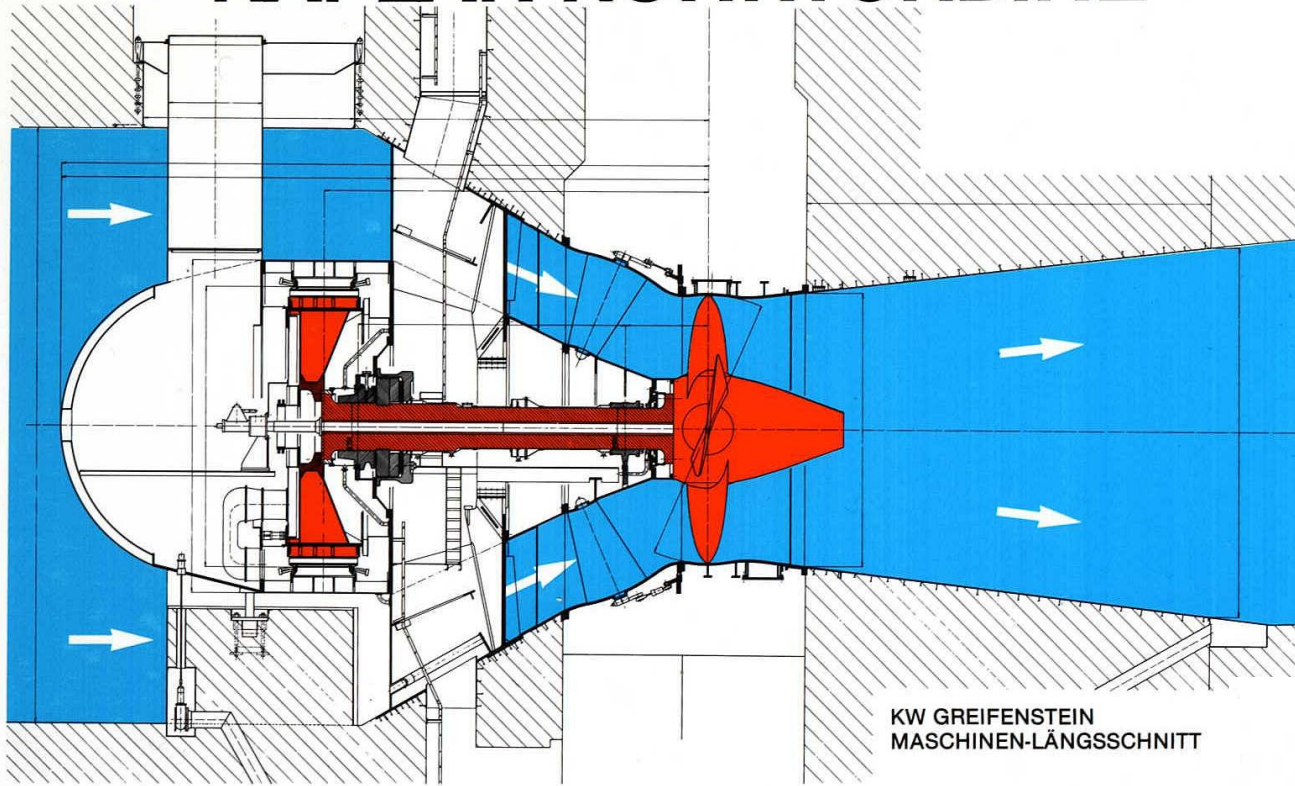


Kaplan turbine with horizontal shaft

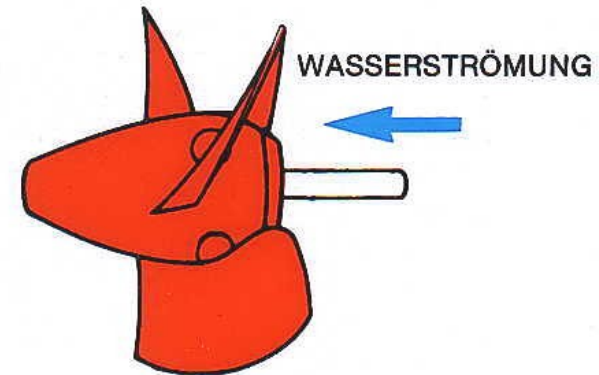




KAPLAN-ROHRTURBINE



KW GREIFENSTEIN
MASCHINEN-LÄNGSSCHNITT



Ancient Greece....

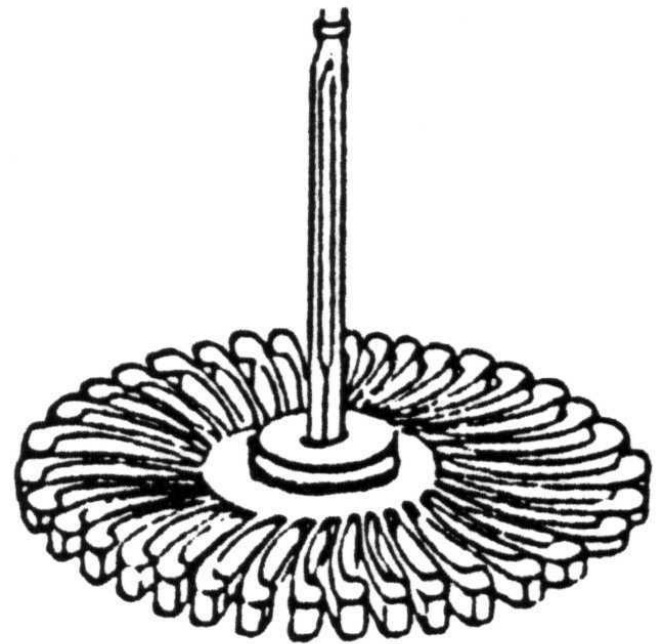
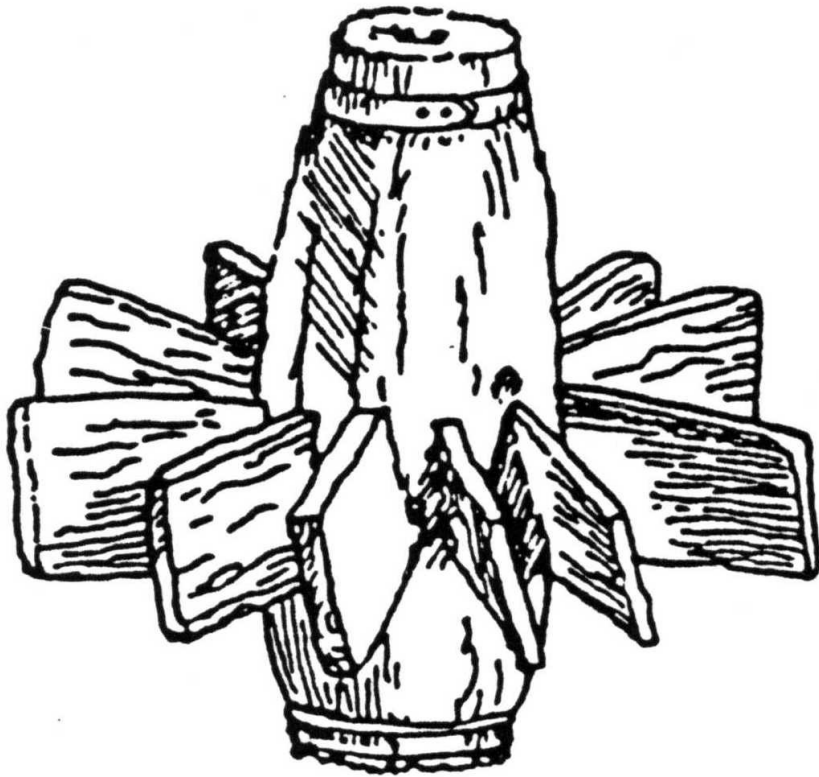
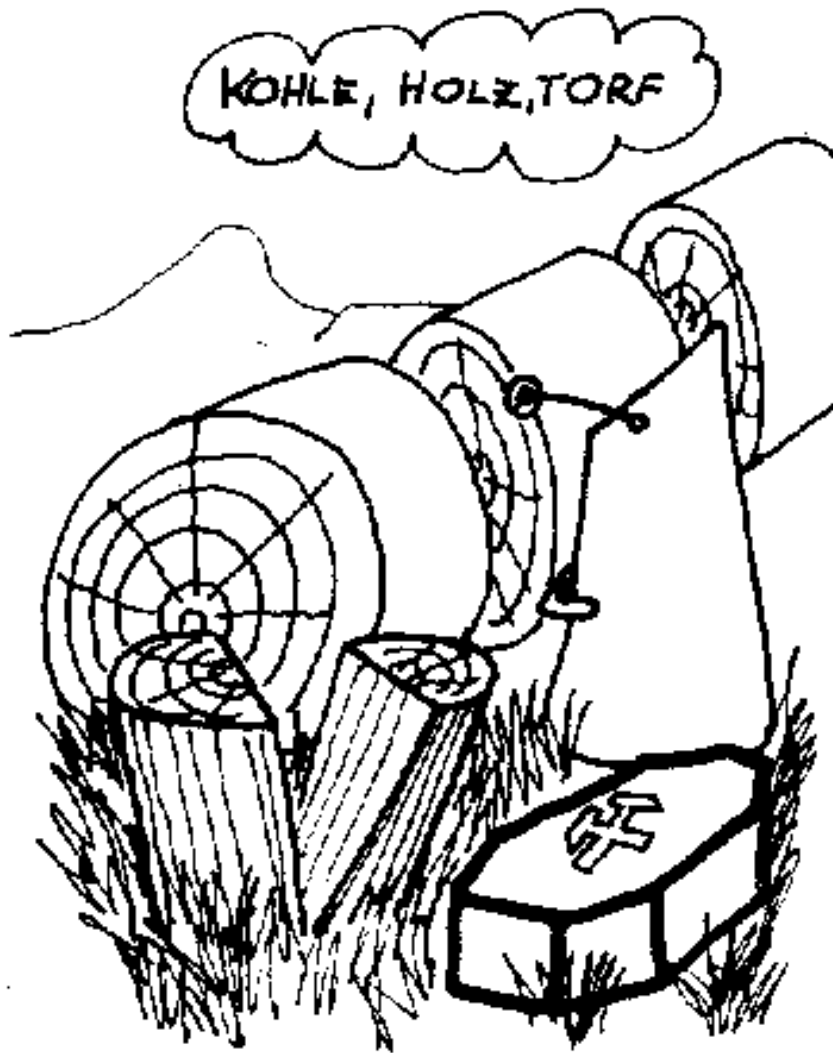




Abb. 2: Der bundesrepublikanische Pro-Kopf-Umsatz an elektrischer Energie (ca. 700W) entspricht einer Dauerbeschäftigung von 7 bis 10 „Sklaven“.

Picture: Praxis der Physik, 1998

We are accustomed to use 700 W electricity / person.
Between 7 and 10 electric slaves always work for us.



Vapour at work.....
High pressurized vapour –
The steam engine

1 cm³ water →

1700 cm³ vapour

The steam engine

1705...Newcomen - first engine

1784....James Watt – reverse steam engine

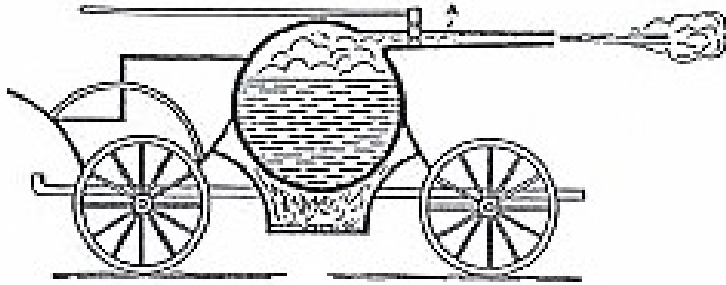
By far earlier: Heron of Alexandria:



Heron's aeolipile



„Actio est reactio“ by steam



Newton's steam car – explain the principle of it !



Vapour (steam) makes independent of Wind !

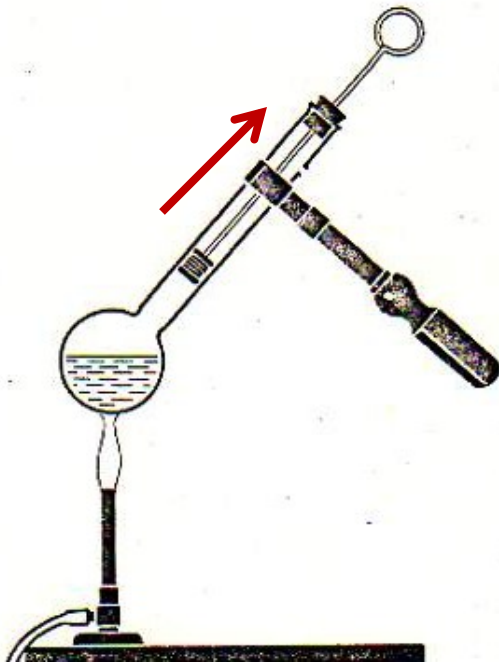


1862:
Locomotive
running on the
street without
railway.

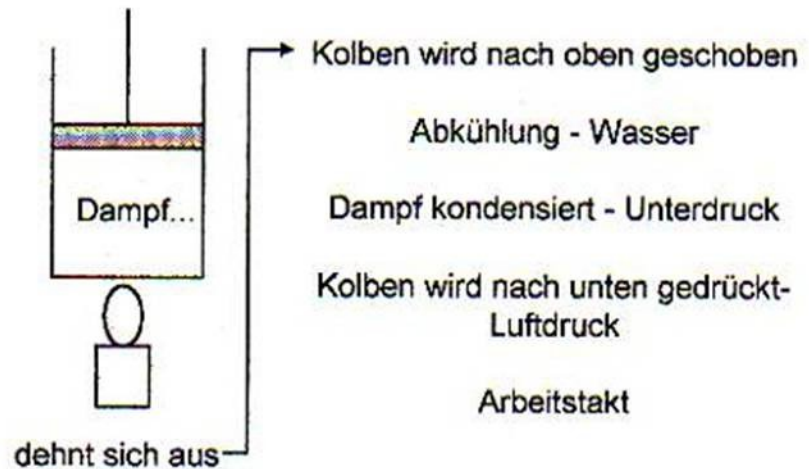


First Austrian Locomotive

Till about 1930 tractors are run by steam



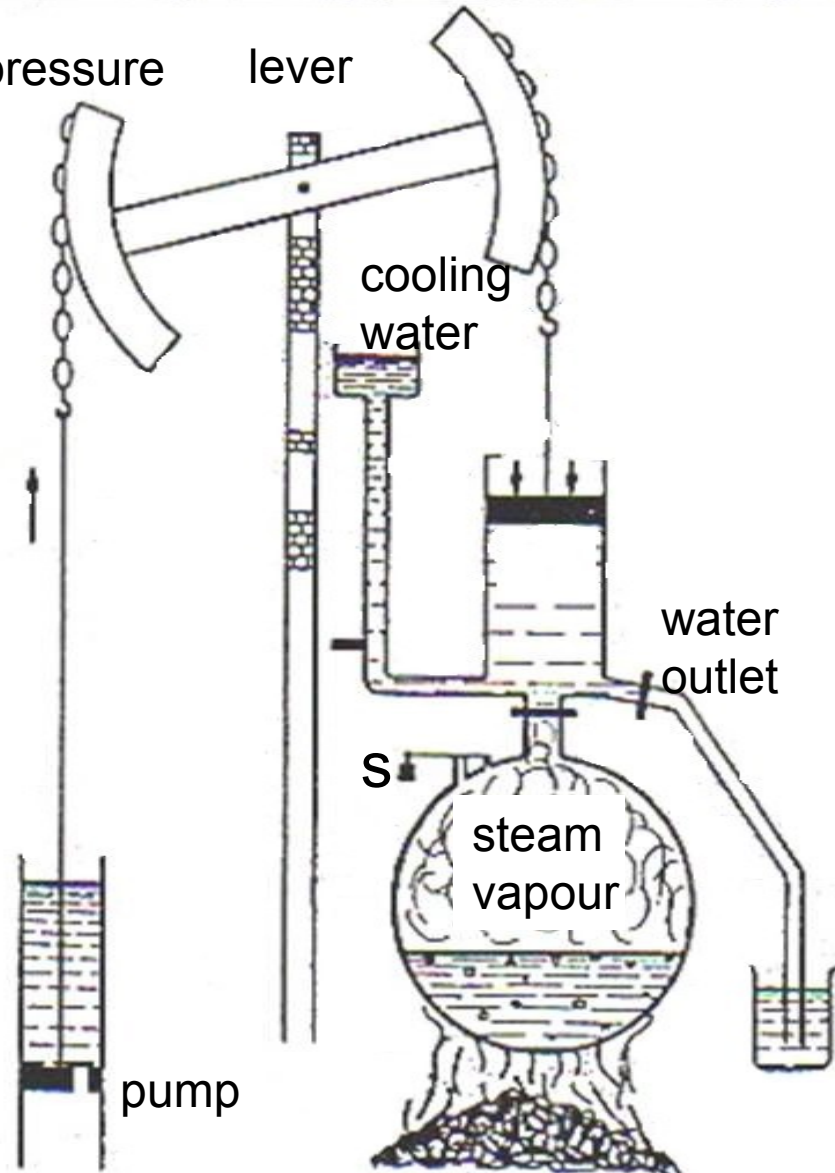
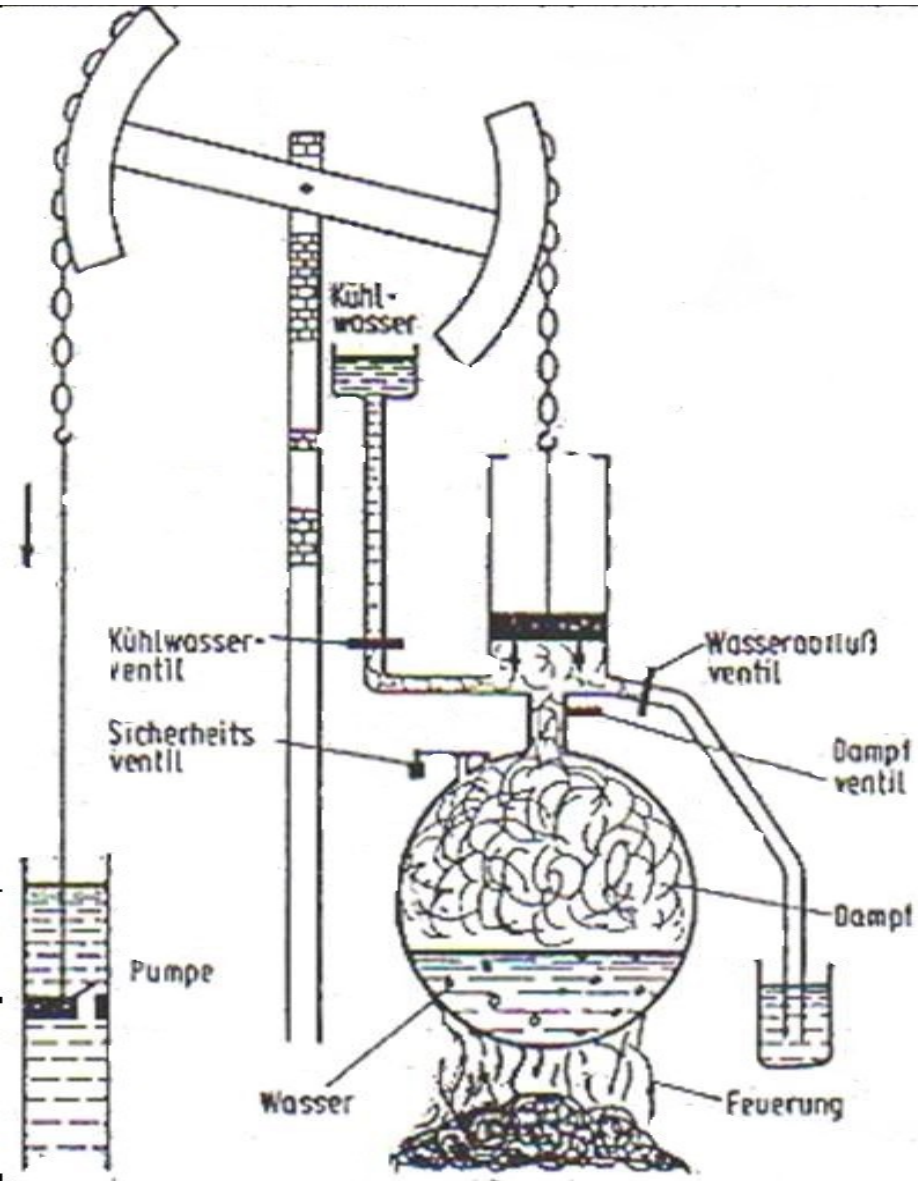
ATMOSPHERISCHE DAMPFMASCHINE - NEWCOMEN



Water is boiling –
the vapour pushes
the piston upwards;
by cooling the piston
moves back

**This was Newcomen's steam engine –
vapor expands – piston was pulled upwards
water cooling – vapour condensates →
subpressure – atmospheric air pressure
depresses the piston.**

S...safety
valve
(overpressure lever
)



Picture Source: NiUPC 1984

Newcomen ...how it works

The heavy balance pulls the piston in the cylinder upwards, the pump sinks down

The cylinder is filled with vapour

Cooling water is pumped into the cylinder, the vapour condensates, liquifies

Subpressure

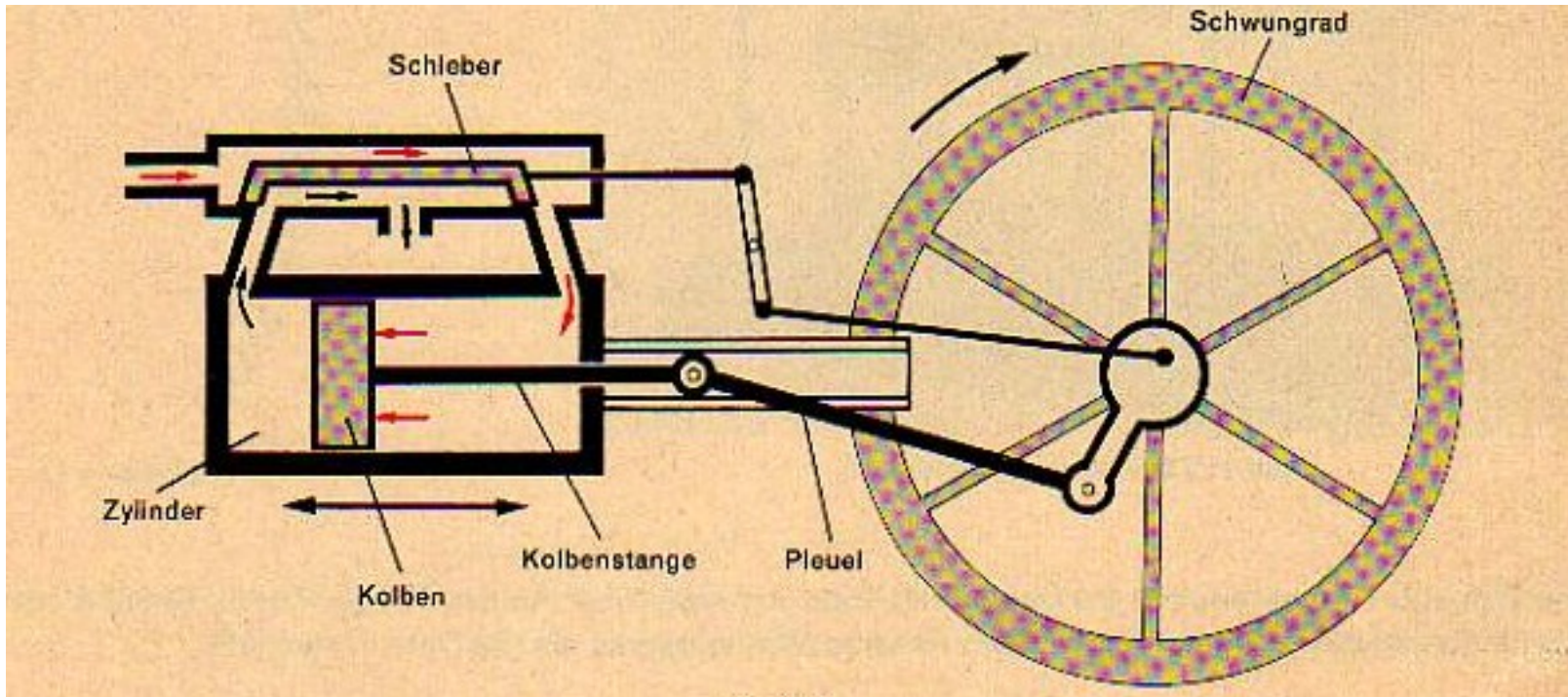
The piston in the cylinder is pushed down by the air pressure, because in the cylinder is subpressure

Cooling water leaves through the water outlet, new vapour equalizes the subpressure-

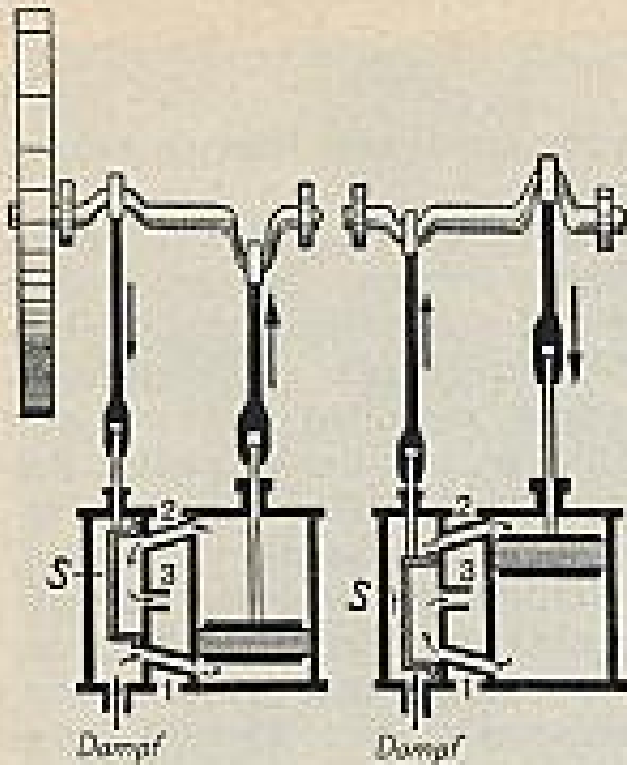
Next working stroke-----

No overpressure, therefore called atmospheric steam machine.....

James Watt – The Steam Engine



This is the drawing of a steam engine dating from an old textbook. By this drawing you should be able to explain, how this engine works. This engine was used at steam locomotives.



Abt. 16.61. Dampfmaschine.

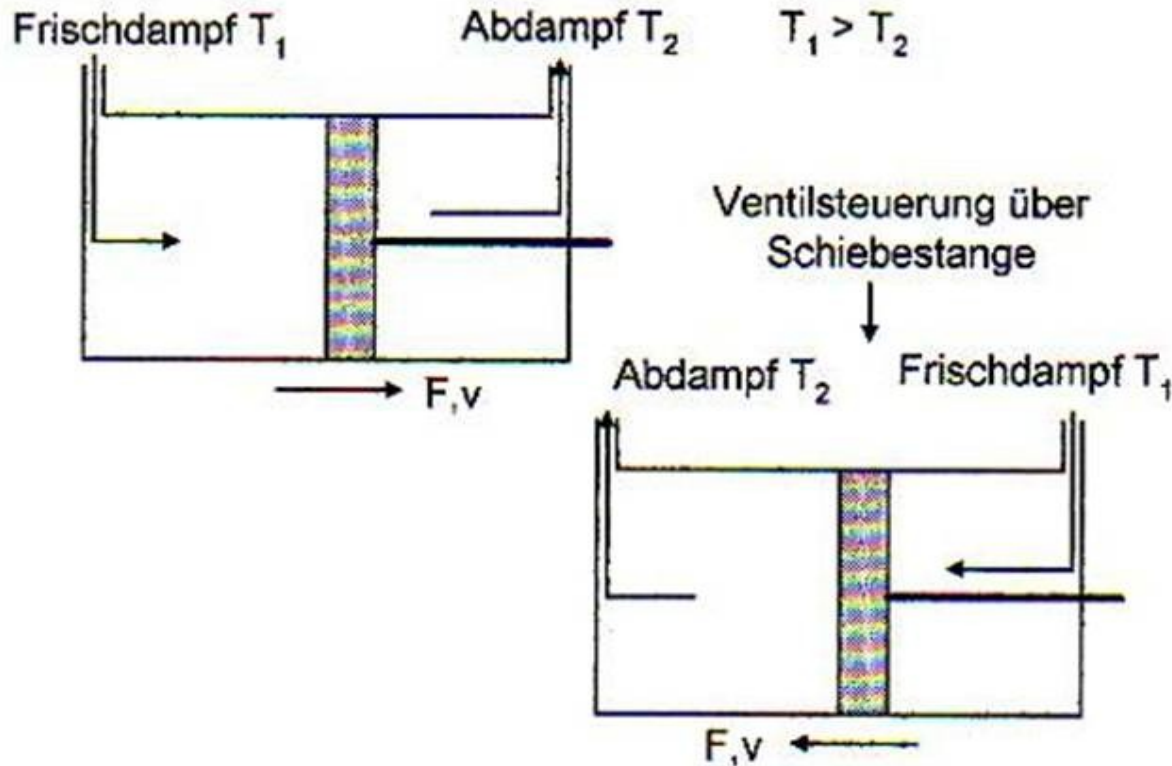
S = Schieber, 1, 2 = Verbindungs-
röhre, 3 = Auslaßkanal.

In old textbooks you find the
schedule of a steam engine;
try to explain it !

(assistance: on one side of the
piston high pressurized – because
overheated – steam comes into
the cylinder; on the other side
used steam, which has done his work,
is pushed out – the stop valve is
the regulator)

- S...gate valves or stop valves
- 1,2...connection tubes
- 3.....outlet or exhaust vapour

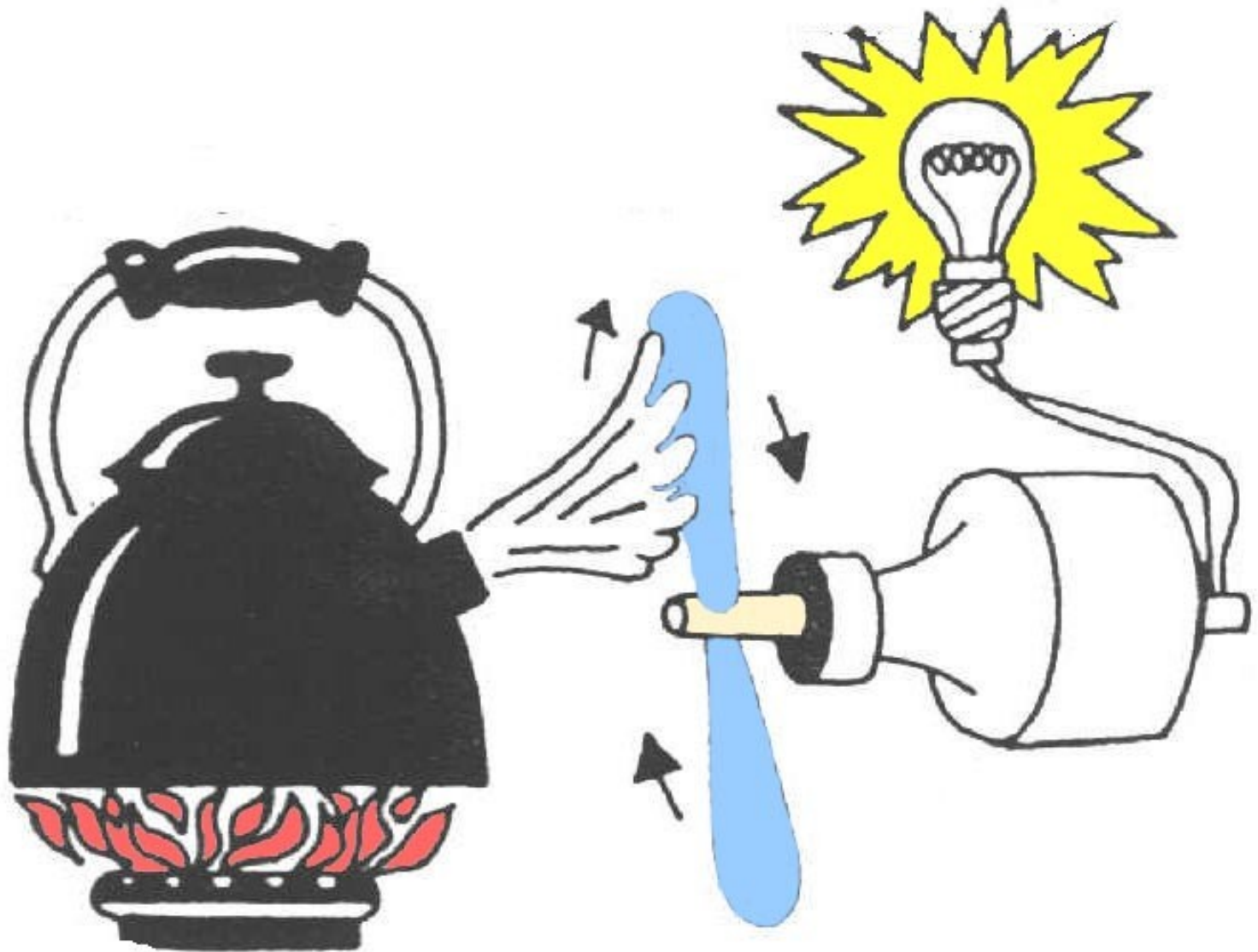
GEGENDRUCKDAMPFMASCHINE - WATT:



T_1fresh hot overpressured steam

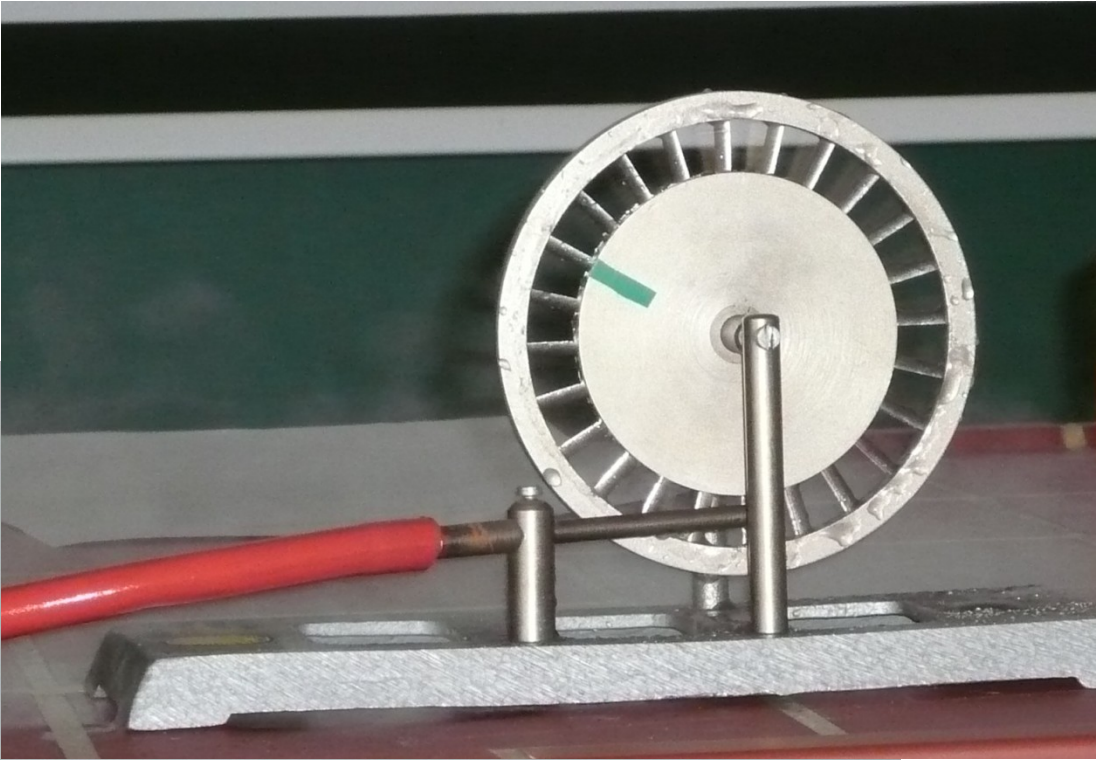
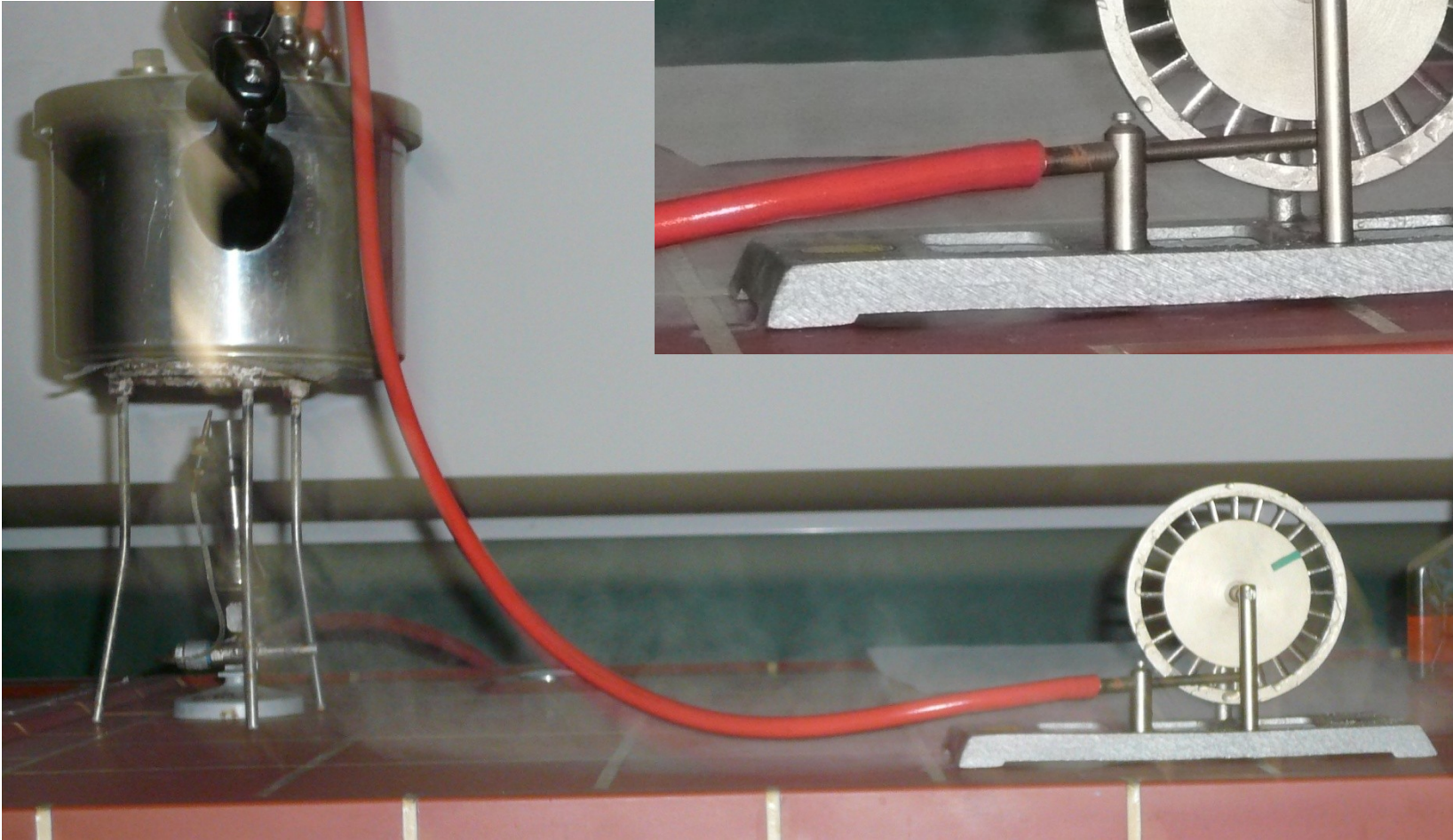
$T_2 < T_1$used steam leaving through the exhaust pipe as vapour

The stop valve controls where fresh steam streams in



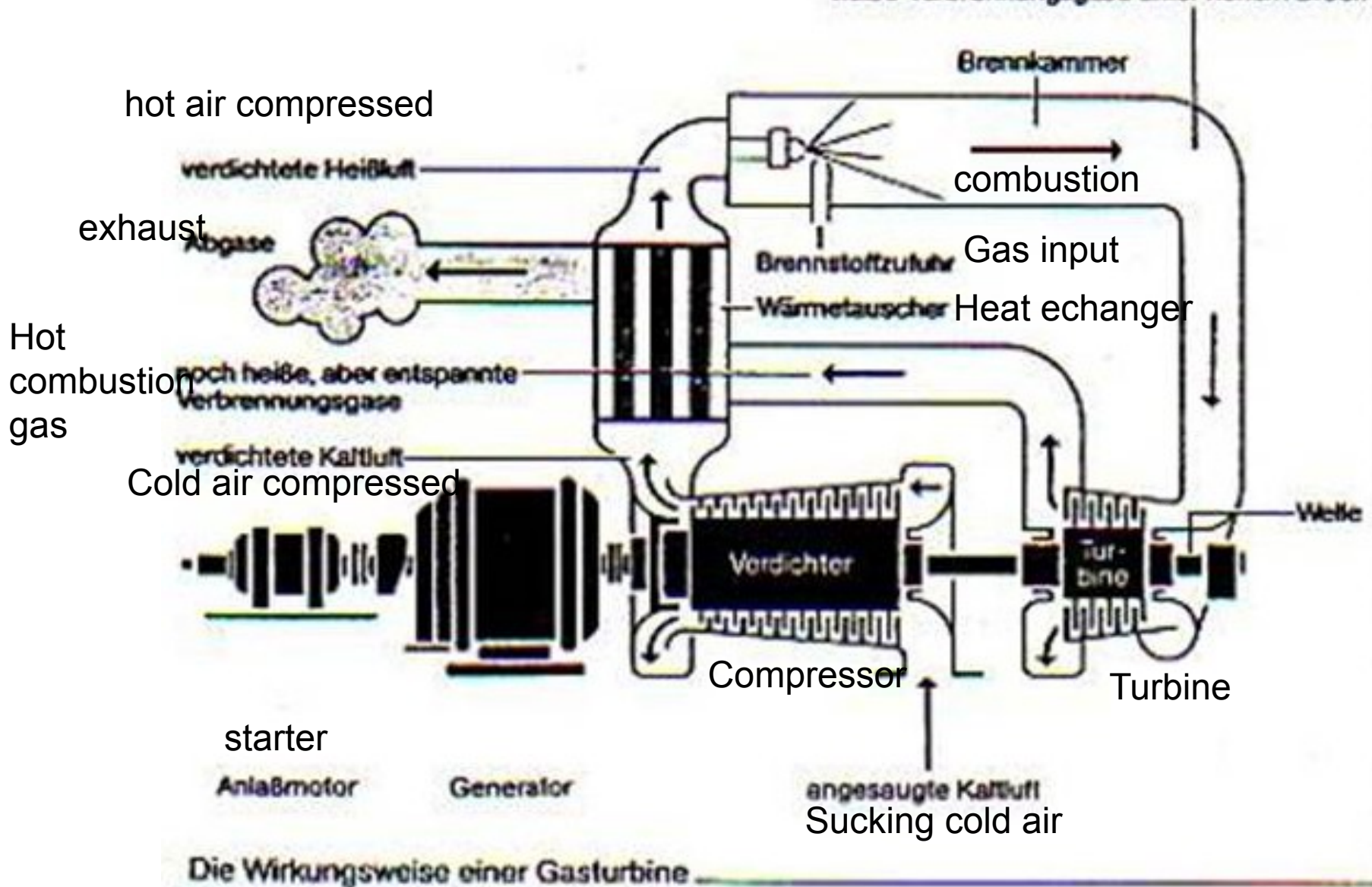
The steam turbine for youngsters

The steam turbine as experiment.



Explain the function of a gas turbine !

Hot combustion gas, highly pressurized

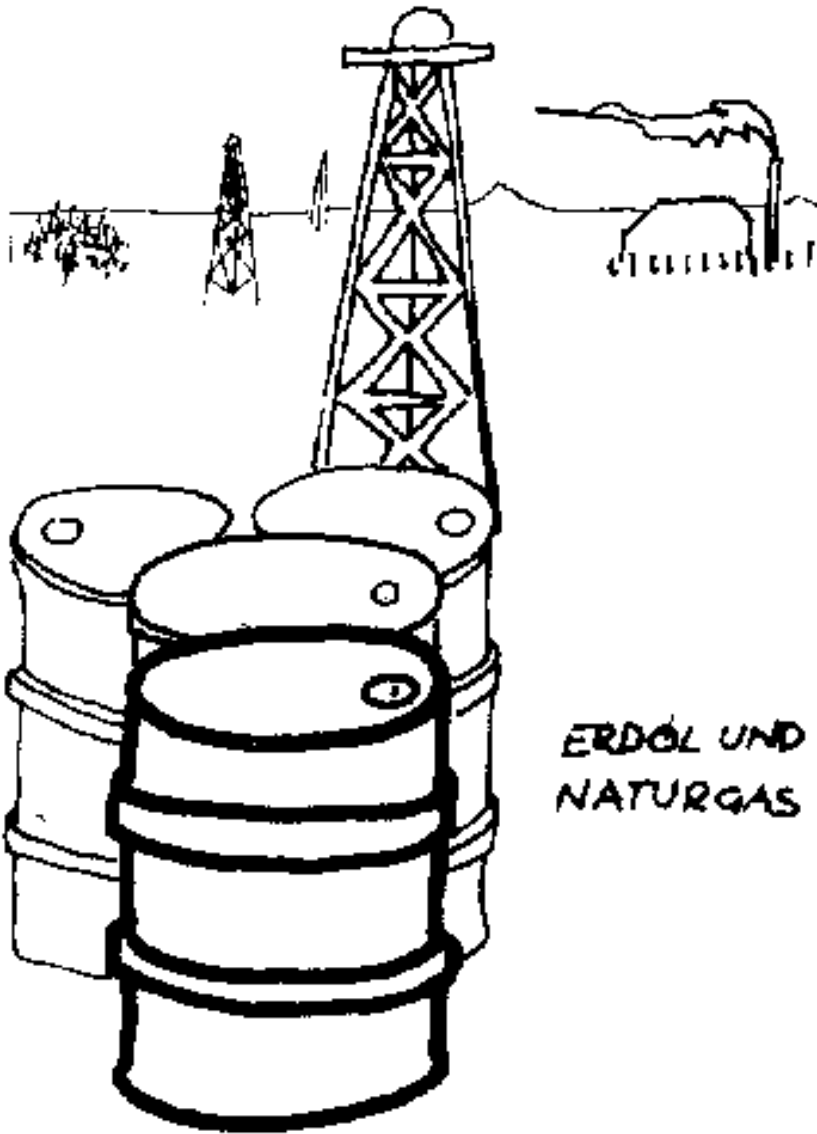


Burning waste.....

...using waste
as energy !

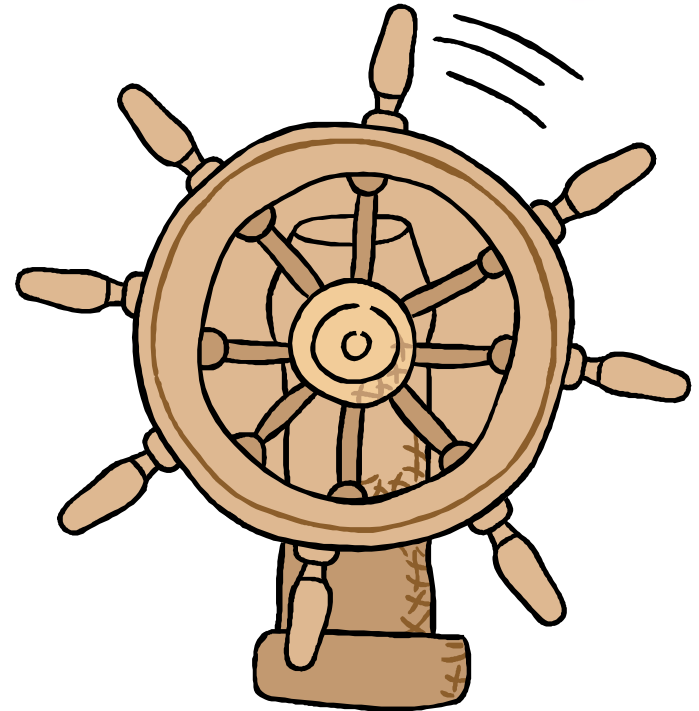




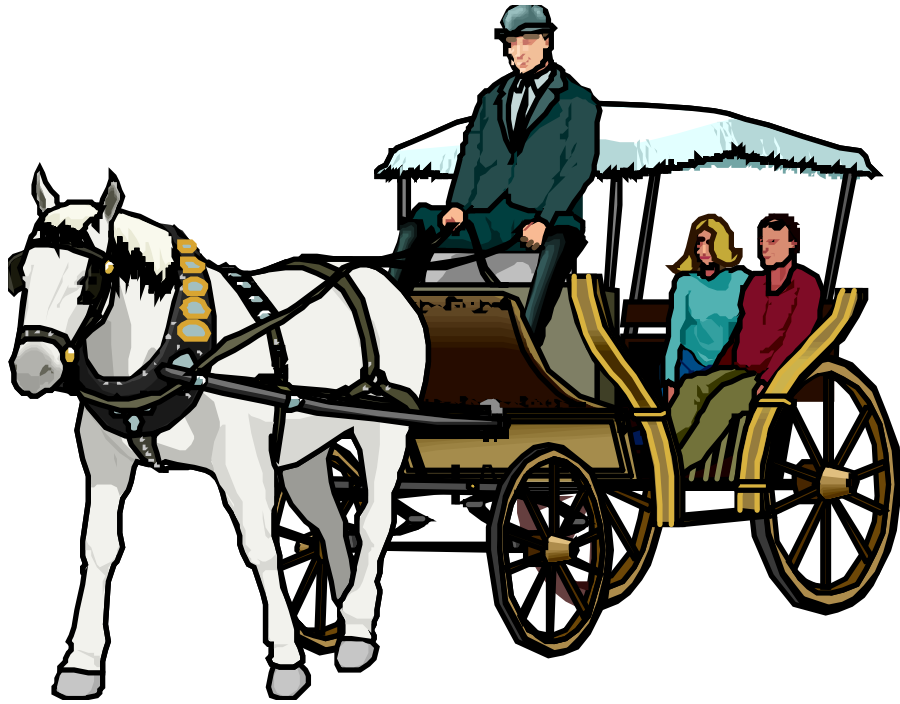


Oil, Gas, Gasoline,
Diesel, Kerosine

ERDÖL UND
NATURGAS



Only Menpower.....



Animal power.....

The famous horse-train from
Upper Austria to the czech Republic
(today)

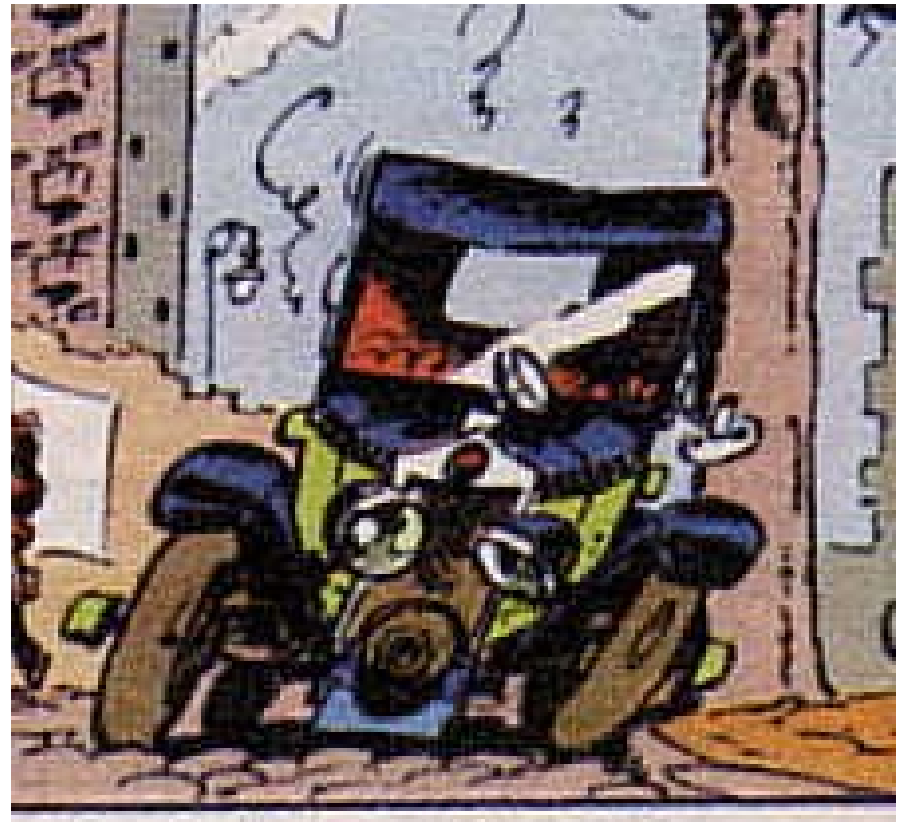


Natural Oil and Natural Gas will be exhausted.....

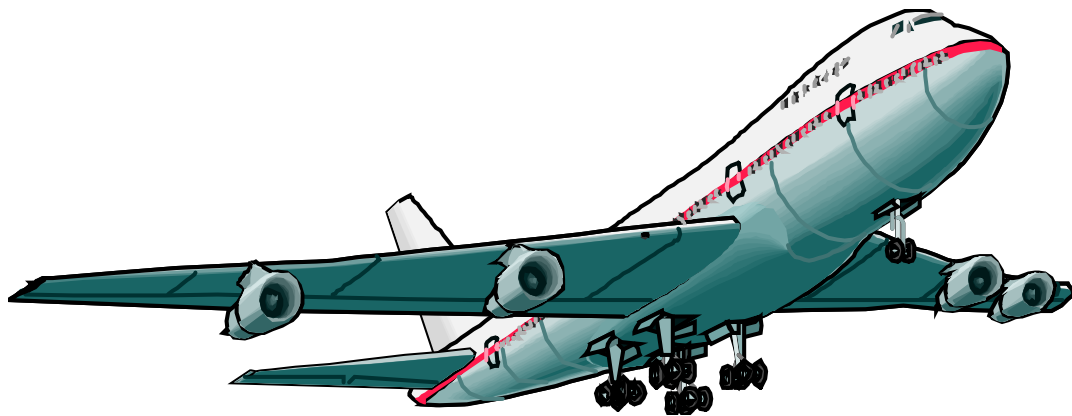
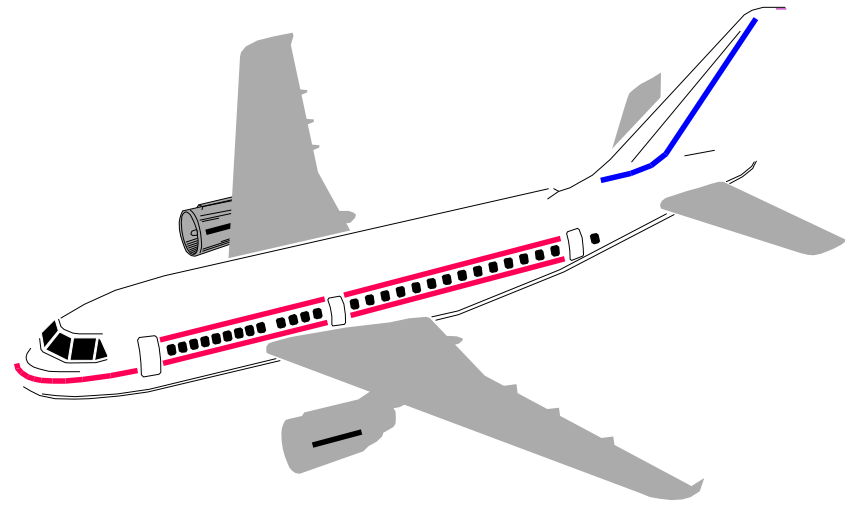
Nikolaus August Otto
(1832-1891) – 1865

Rudolf Diesel (1858-1913)

Felix Wankel (1902 - ?)



Not flying with a steam engine....





Natural Oil is first....
Its utilisation releases
 CO_2 to the atmosphere
enhancing the
greenhouse effect.

A lot of substances are dating from natural oil, but they must be separated by fractional distilling and furthermore by cracking.

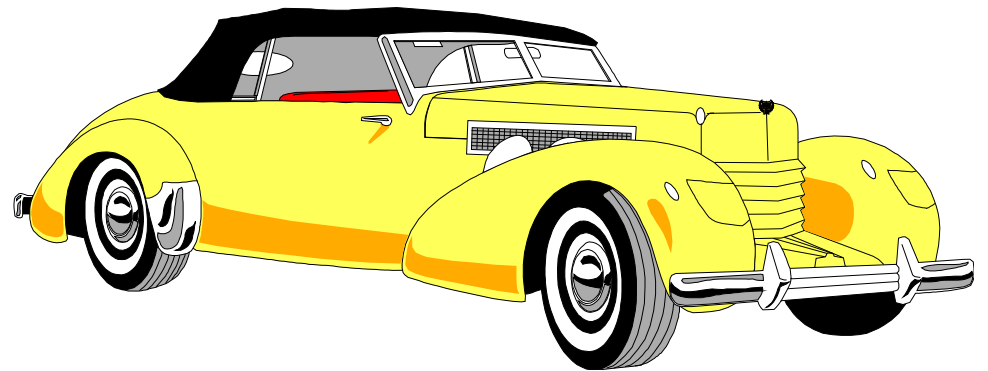
Cracking ... breaking complex compounds down to simple ones.

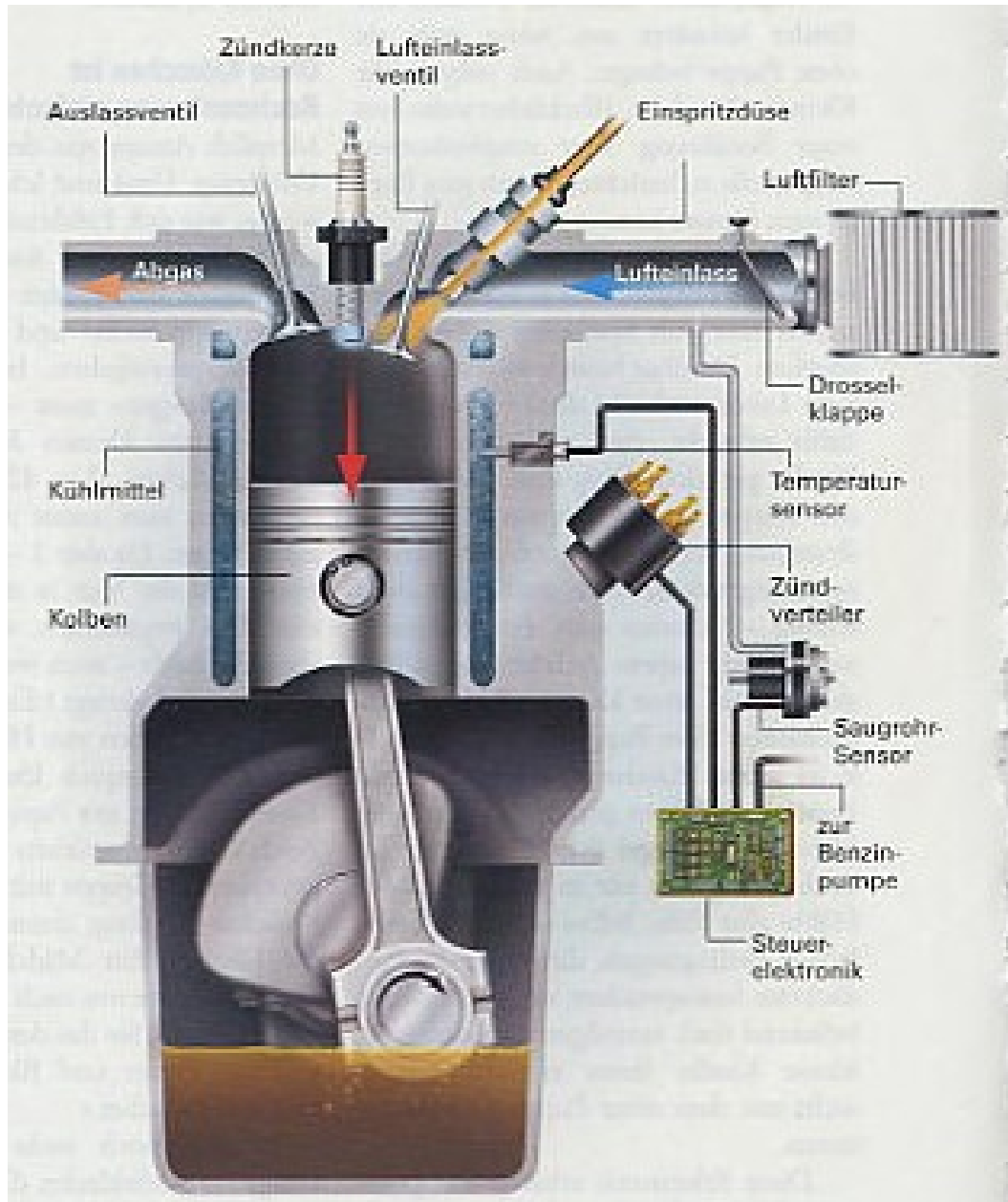




The first car in Austria, the Ottomobil from 1866. Gasoline was bought in the pharmacy.

An oldtimer needs by far more gasoline than a new car.

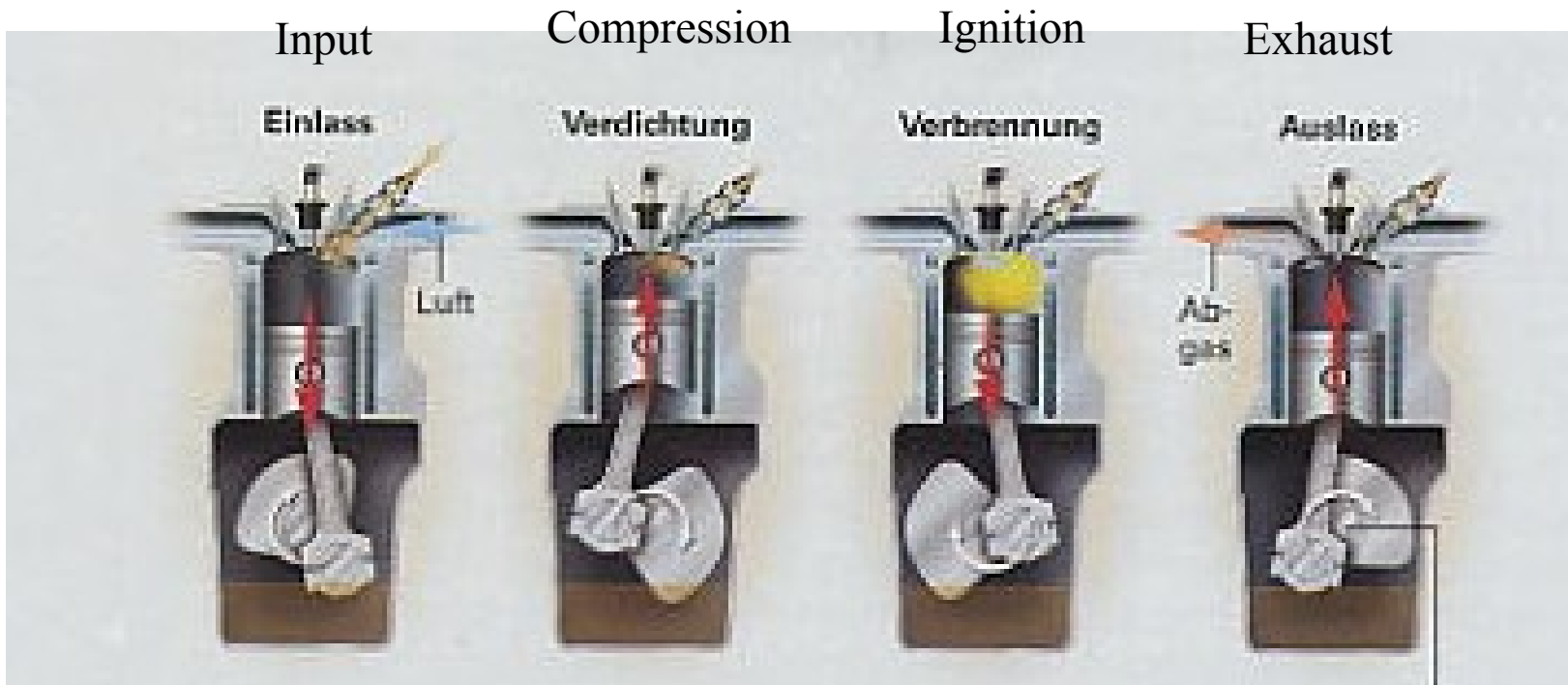




The four-stroke-engine,
everybody can explain.

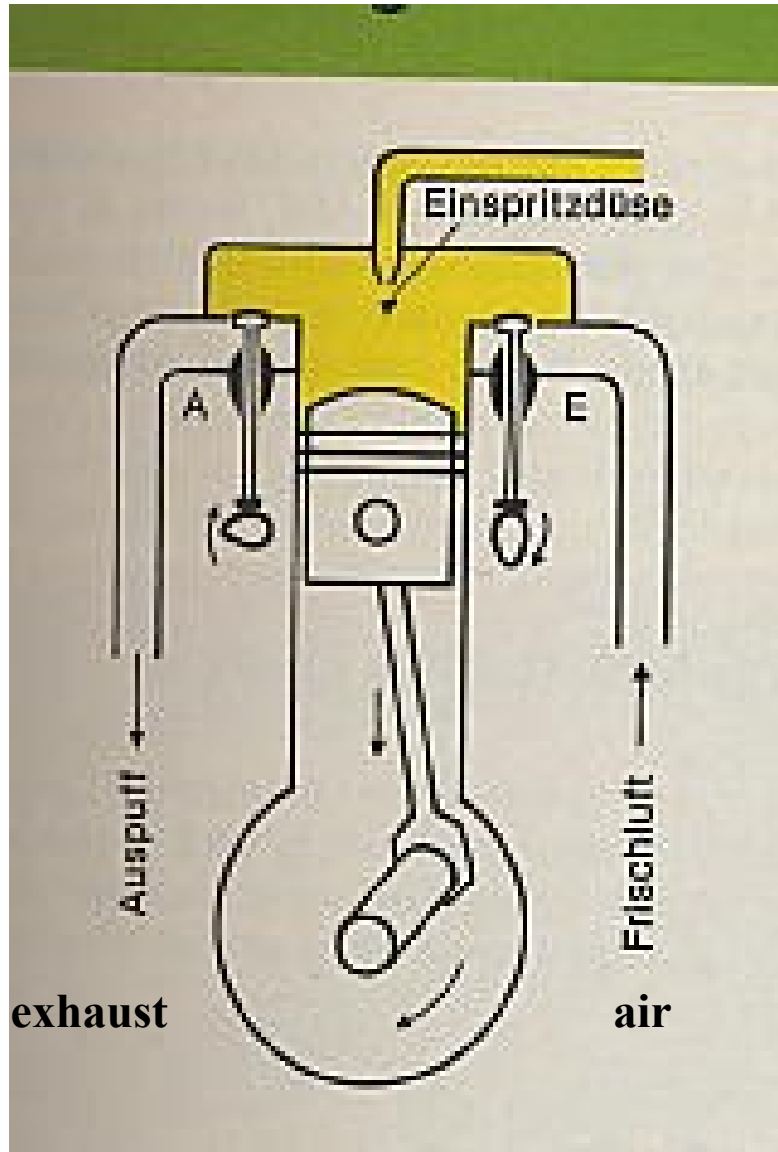
What was Wankels idea ?

Quelle: Spektrum der Wissenschaft



Sucking air
Gasoline
Injection

Source: Spektrum der Wissenschaft



Diesel engine:

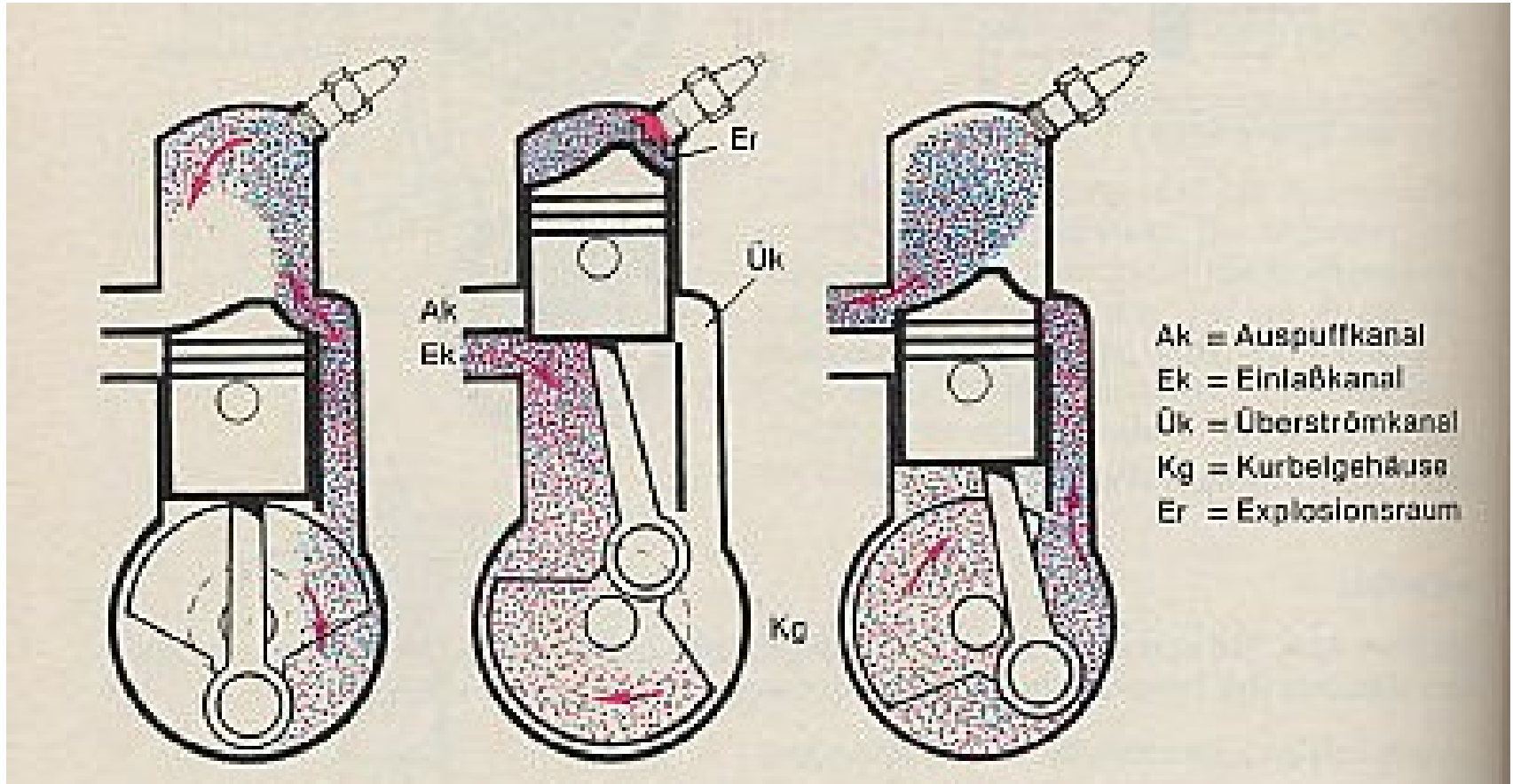
Only air is compressed,
then Diesel is injected.

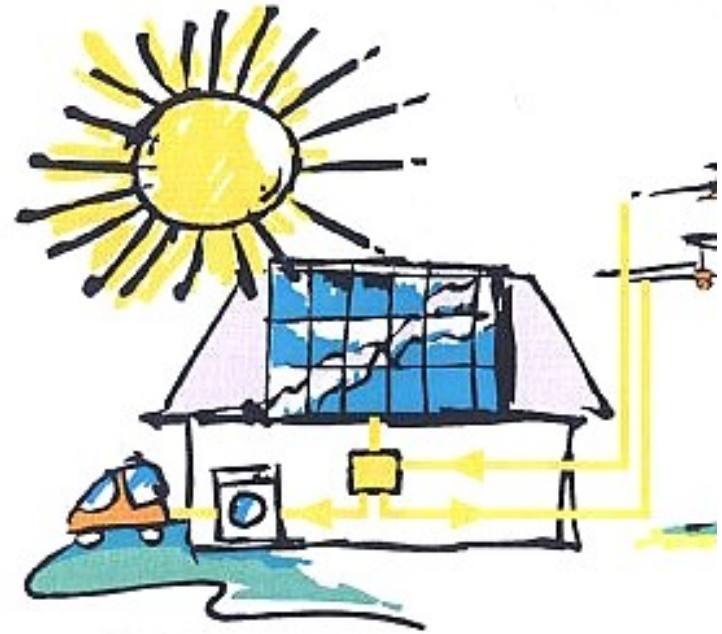
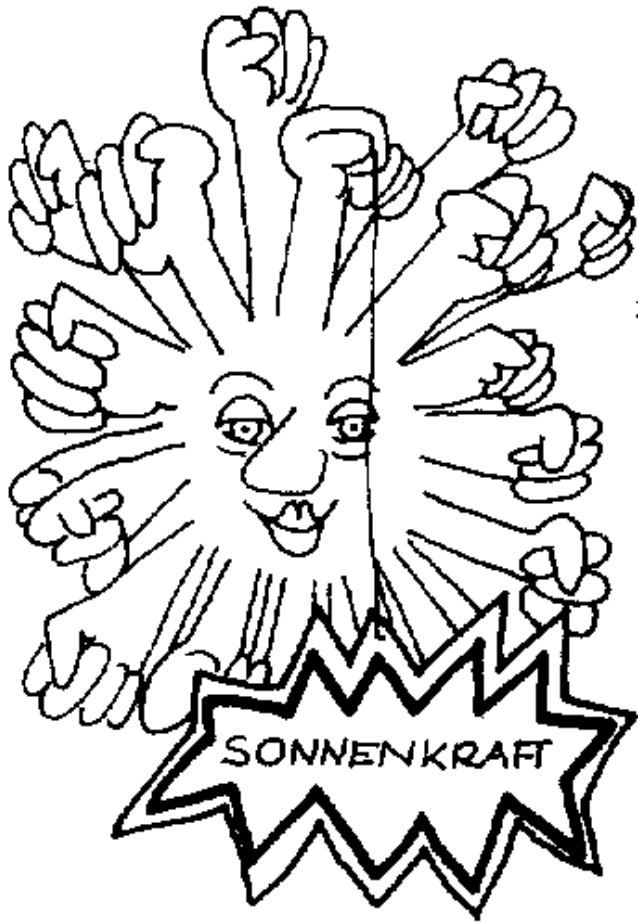
Self-ignition.

What is missing compared
to a gasoline-engine ?

By which the Diesel-engine
starts if it is rather cold ?

Two-stroke-engine – a very rare engine, a small engine
The shape of the piston and one pipe for moving waste gas from the upper part of the cylinder to the lower part of it provides four strokes in a two stroke-machine.



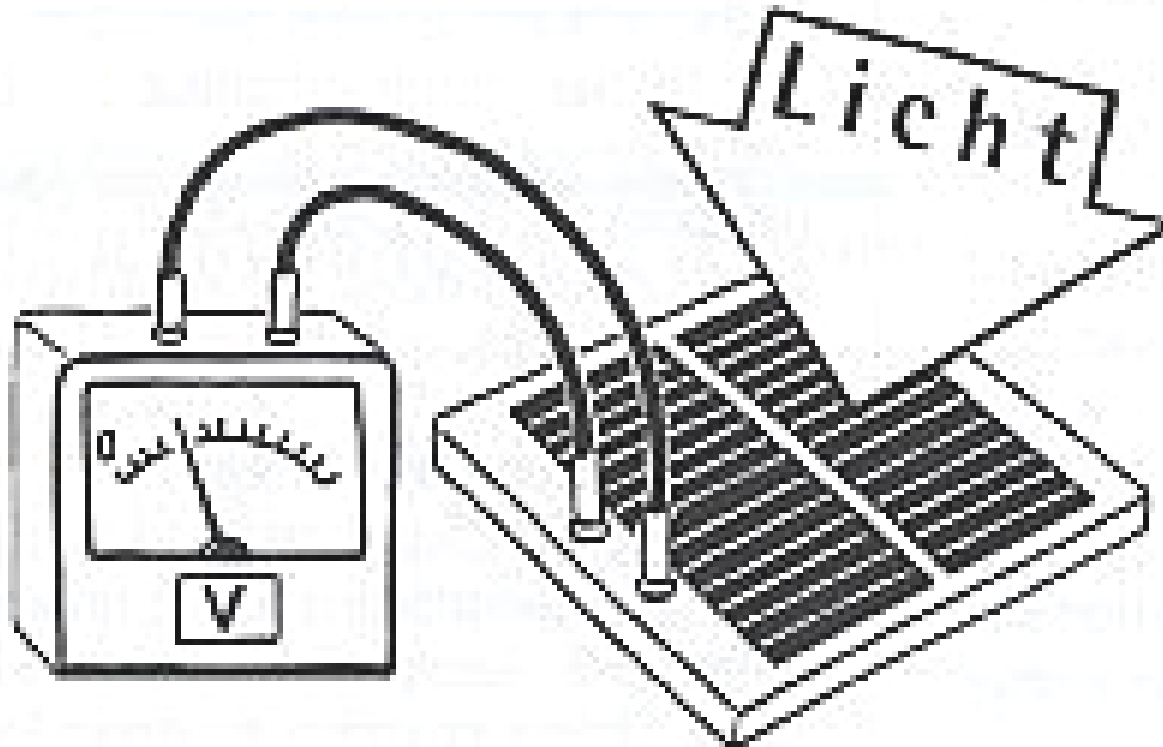


Is it...
a flat panel..
or a photovoltaic cell ?

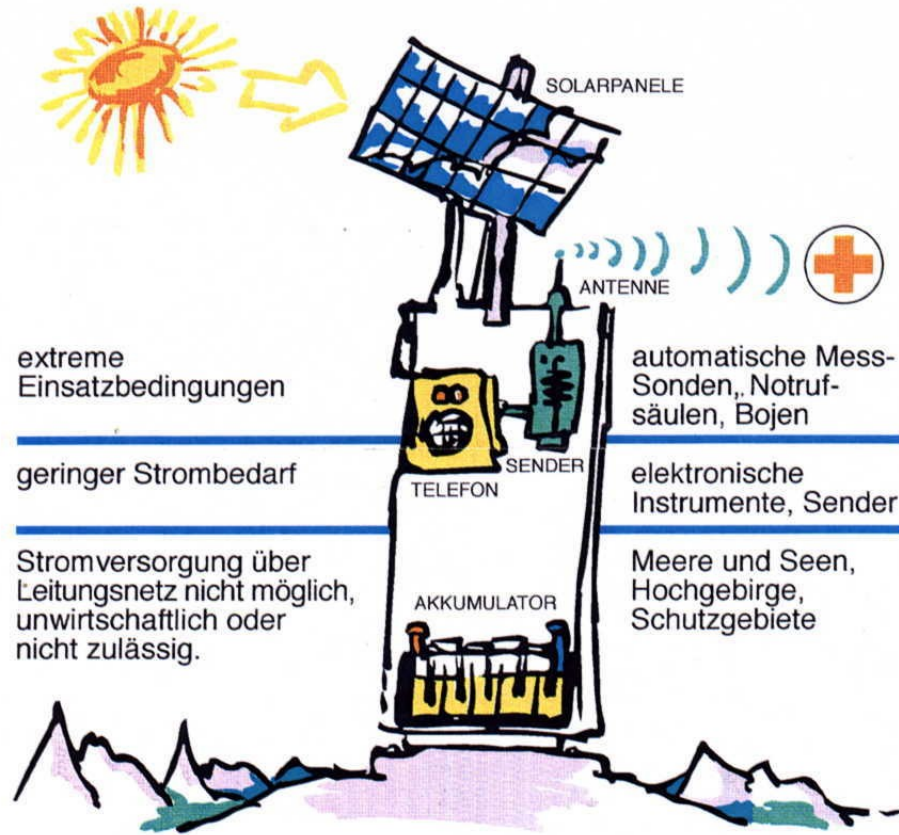
Use the Sun s Power directly !

Photoelement

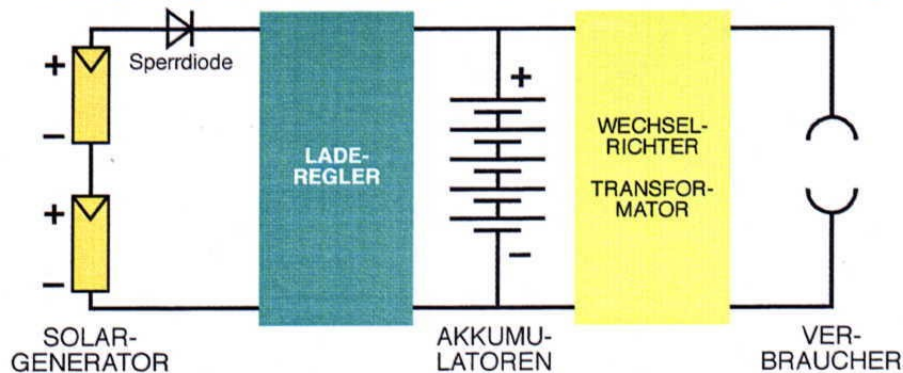
A. E. Becquerel 1839, Willoughby Smith 1873,
R. E. Day/W. G. Adams 1875



Usual about 0,5 V per cell



Aufbauprinzip einer solartechnischen Stromversorgungsanlage

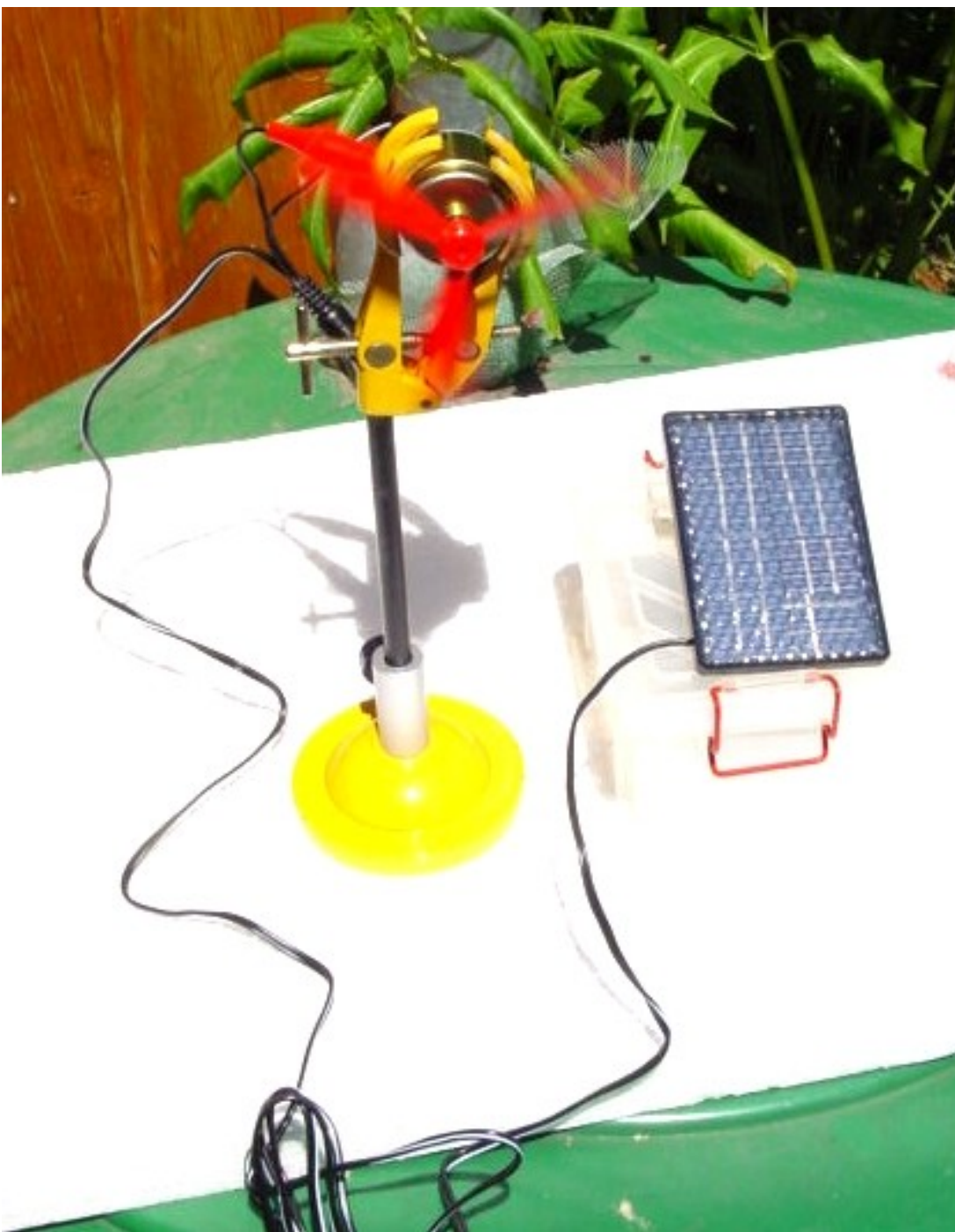


What s run by photovoltaic ?

Mostly where it is used ?

Under which conditions it is used ?

The principle of photovoltaic supply !



Solar Cell:

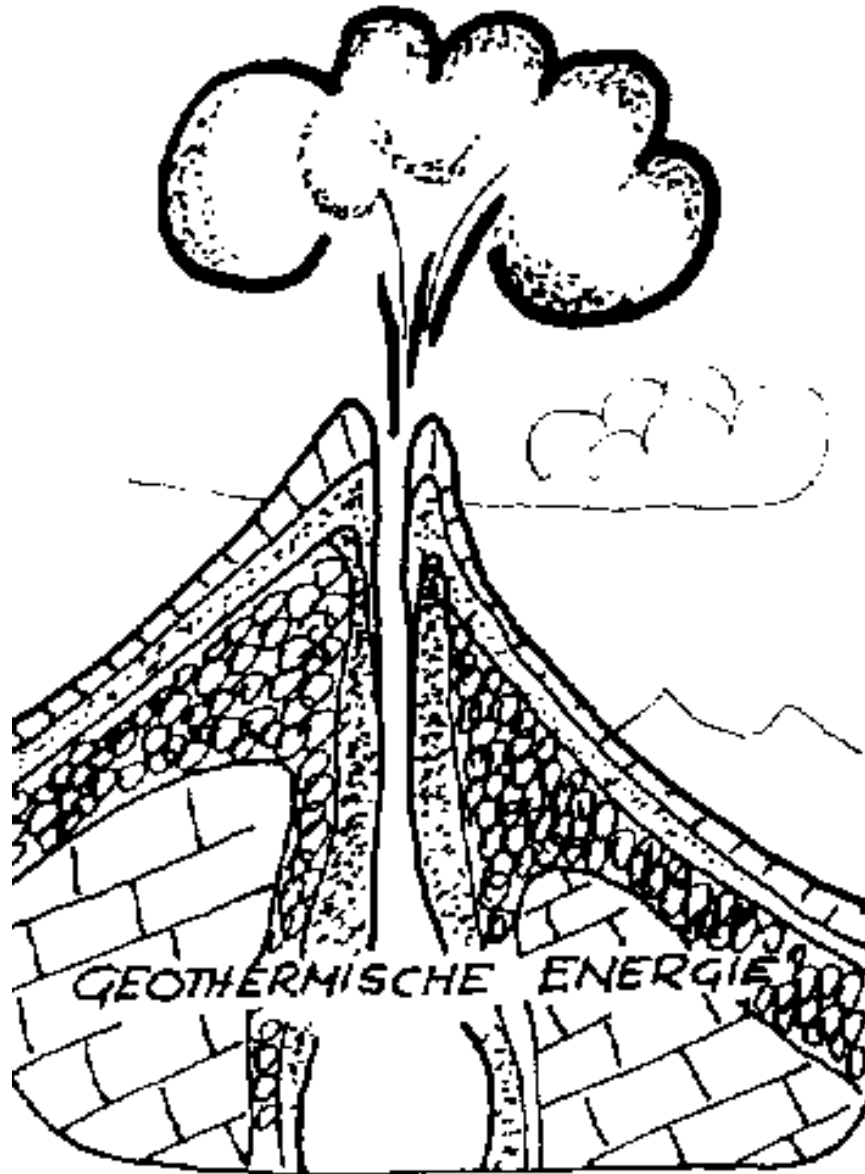
$U = 0,55 \text{ V}$ and

$I \sim 100 \text{ mA}$.

Engine starts with

$U = 0,2 \text{ V}$ and

$P = 40 \text{ mW}$.



The deeper the warmer.....
Iceland has it s advantages.

Iceland s hot spots !
In Austria:
Heat pumps
Hot dwells for bath !

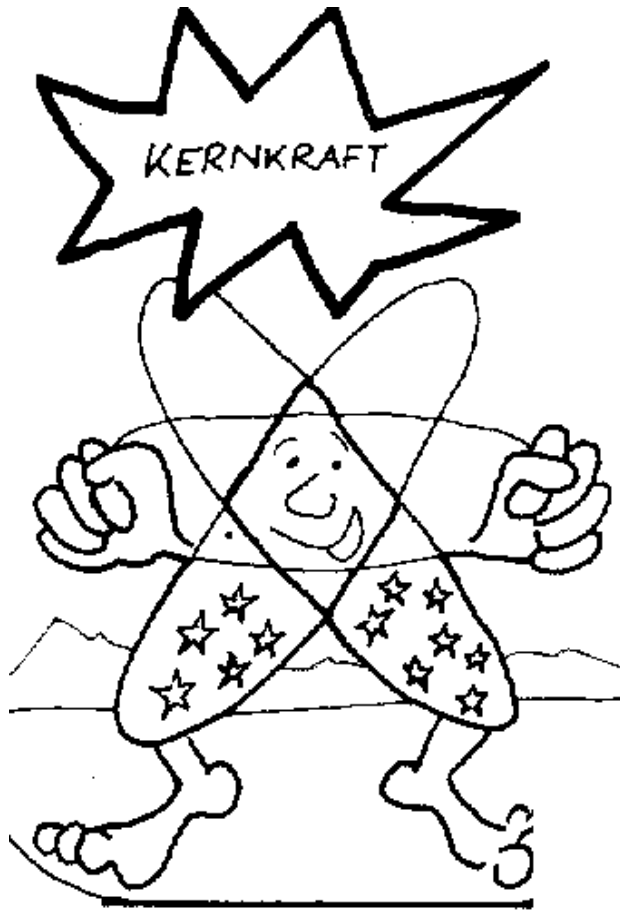


Iceland



Hawai





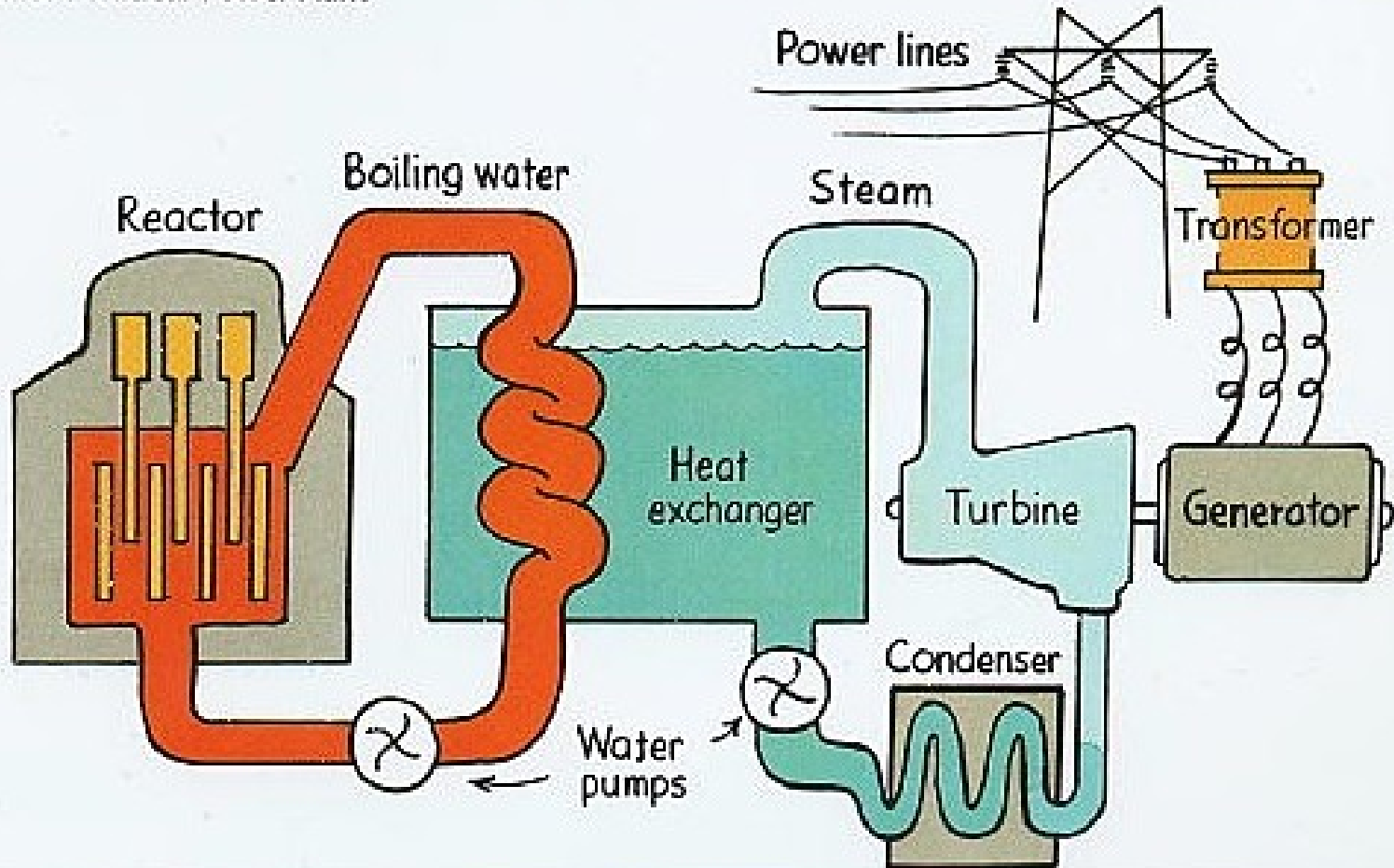
Much energetic density,
Greenhouse-effect only during the
Construction....and the Breakdown

Dangerous ?
Radioactivity ?
Radioactive waste ?

All clear ?

Then describe for pupils !

System of a Nuclear Power Plant



This is Petru Stiucas work (Suceava) !
Explain to the children !

This is by far not all !

This never can be complete !

But we wanted to tell a story !

All the best to you, Ingrid and Hans