The museum of Ancient Greek Technology presents

The Hi-Tech Inventions of Ancient Greece

The Origins of Our Modern Technology

An exhibition at the European Patent Office

European Patent Office

Museum of Ancient Greek Technology
Katakolo, Greece

Archimedes' Museum
Ancient Olympia, Greece

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Welcome

Inventions established in Ancient Greece

The European Patent Office in Munich and the Culture Club in the EPO are delighted to have the possibility to get an insight in inventions established in Ancient Greece. This is due to the initiative and due to the research provided by Mr Kostas Kotsanas for the Museum of Ancient Greek Technology in Katakolo – Greece.
It is well known to this authority, but also to the public, how important inventions are to support and enable the technical progress in a society and to make lives more comfortable.
Everybody has learnt essential basic sentences from Ancient Greek mathematicians. It might be reminded of Pythagoras and his statement on right triangles, or of Thales from Milet and his findings on triangles and circles, or of Euklid and his conclusions on segments and lines. The ancient Greeks were the first to question and to prove their mathematical conclusions and statements. From this point of view it is not surprising that Ancient Greece developed a culture for physical, agricultural and geological innovations to make the individual lives easier, more pleasant and more precise. Mr Kostas Kotsanas and the Museum of Ancient Greek Technology succeed in demonstrating working models which represent the power of imagination and invention in antique times. Those include calculation machines, automatic theatres, hydraulic clocks, ingenious wine-jugs for mixing water with wine, spherical astrolabes, fire pumps, automatic temple gates, hydraulic endless screws, hydraulic telegraphs and a hodometre (measurement of road distances) or a cryptic (Laconian) relay. The old prior art can be admired which has proven to be the basis for further improvement, progress and novel questions.
We are grateful to Mr Kostas Kotsanas for his initiative to build up an exhibition on 30 models and inventions here in the premises of the European Patent Office in Munich. They impressively show the strength of innovation in Ancient Greece, as we could already recognize due to basic rules and relations in geometry. Simultaneously they make us curious about any inventions established and formed in the antique world, which might further stem from Sumerian, Babylonian and Assyrian periods and empires as well as from the Egyptian world.
Current exhibition enables the spectator to experience the innovations not only in a theoretical, but also a practical manner.
We wish all the public to be curious to discover them!

Dr. Hermann Schifferer
for the Culture Club in the EPO / Munich
In February 2016

Konstantinos Kotsanas

The creator of the Museum

Konstantinos Kotsanas was born in 1963 in Aigeira - Seliana, Achaia. He studied in the Department of Mechanical Engineering at the Polytechnic University of Patras (Greece).

He has dedicated his life to the study of ancient Hellenic culture, particularly in the field of ancient Hellenic technology. A lot of his research, studies and reconstructions that concern Ancient Hellenic Technology have been presented at international conferences with exceptional success.

He has set up, at his own expense and with his personal exhibits (without any funding from any public or private body), the "Museum of Ancient Hellenic Technology" and the "Museum of Ancient Hellenic Musical Instruments and Toys" operating in Katakolo (Greece), the "Archimedes' Museum" in Ancient Olympia (Greece) and in University of Connecticut (USA).

Approximately 350 functional models of ancient Hellenic inventions are displayed in the museums and their aim is to reveal an unknown aspect of ancient Hellenic civilisation and to prove that the technology of the ancients, just before the end of the ancient Hellenic world, was extremely similar to the beginning of our modern technology.

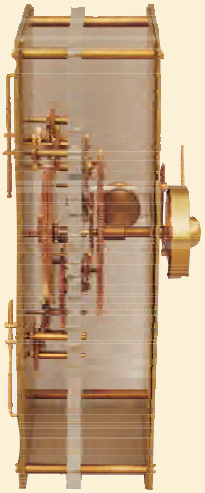
He is a member of the Association of Ancient Hellenic Technology Studies while the Technical Chamber of Greece has assigned him the study and reconstruction of significant mechanisms of antiquity.

Ancient Hellenic Inventions

This exhibition and the museum aim to demonstrate that the technology of the ancients, just before the end of the ancient world, was shockingly similar to the beginning of our modern technology.

For example, the bolts and nuts, gears and rules, pulleys and belts, sprockets and roller chains, pistons and cylinders, springs, hydraulic controllers and valves and programmers (all parts of the engine of a modern car) are just some of the inventions of the ancients which were the foundations of their complex technology. These legacies, identical and irreplaceable, continue today to constitute the building blocks of our modern technology, the development of which would be doubtful without its effortless and undemanding adoption.

The exploration of this age, when ownership for peak technology was not claimed, demonstrates without a doubt, how ancient Greeks have contributed to modern Technological Civilisation.



The Antikythera calculating mechanism

an analog computer | 2nd century B.C.

It is the first calculating machine in history. It was used to determine and forecast important astronomical and calendar events. Its remains were found accidentally by sponge divers in 1900 in the eminent shipwreck off the island of Antikythera. Its manufacture dates from around 120 B.C. and it is probably the product of a Rhodian laboratory, which developed the tradition of Archimedes' Sphere-Making", with its direct inspirators being Hipparchus or Posidonius. It consisted of indicators, scales and at least thirty-five cooperating gear wheels that were moved by a handle. At the front it had a circular scale of the 365 days with the possibility of adding one additional day every four years. At the back it had the spiral scales of the Metonic and Saros cycles and also the Callippic cycle, the "Exeligmos" cycle and the Athletic Games cycle. With the rotation of the handle, and consequently the choice of a date on the front scale of 365 days the remainder indicators give us all available astronomical information on this (e.g. position and phase of the moon, matching solar-lunar calendar, etc.). Reversely, if the operator of the mechanism brings the indicator to some particular astronomical or calendar events, (e.g. an eclipse of the moon or a performance of the Olympic Games) he can see the date that this will happen in the future or happened in the past. Solla De Price and Michael Wright were the most important researchers of this mechanism. This reconstruction reflects the constructional opinion of the exhibitor that was based on the new data from the International StudyTeam of theAntikythera Mechanism.

SOURCES: "TheAntikythera Mechanism Research Project"

The “stationary” automatic theatre of Philon

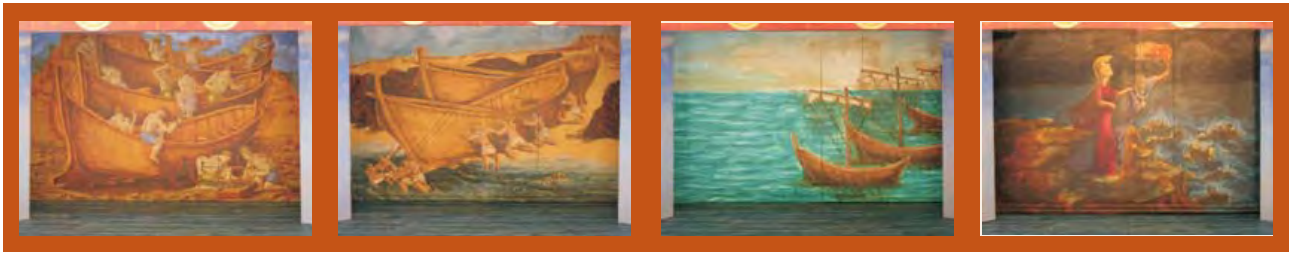
the “cinema“ of the ancient greeks | 3rd century B.C.

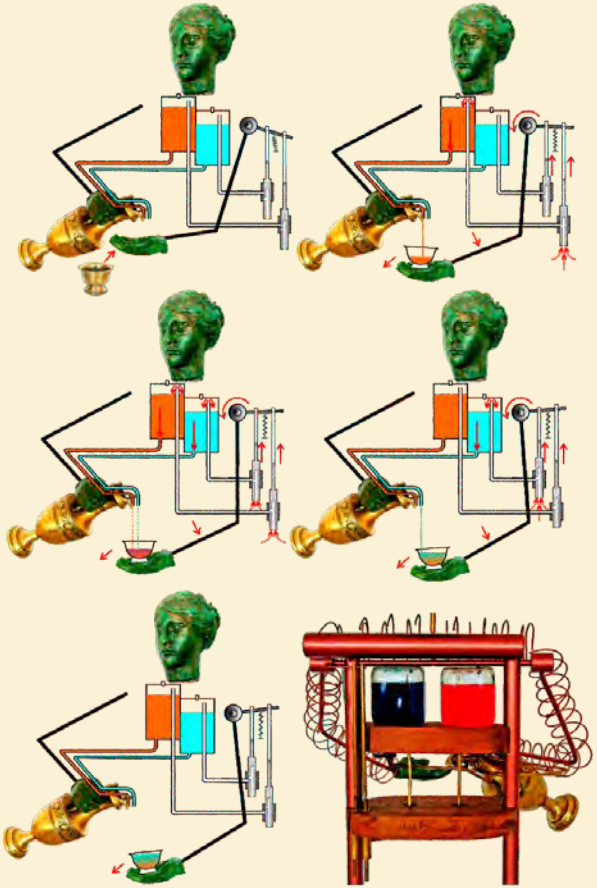
It is an accurate reconstruction of the static automotive theatre of Philon of Byzantium (3rd cent. B.C.) which is described in detail and improved by Heron of Alexandria in his work Automatopoetike. Automatic theatres were miracles of the classical and Hellenistic era, works of the miracle workers of antiquity. The theatre of Heron presents, automatically with moving picture and sound, the myth of Nauplius who wants revenge on the Achaeans for his son s death in Troy.

1st scene: Achaeans repair their ships - we can see figures moving, hammering and sawing and we can hear the sound made by the tools as if they were real.
2nd scene: Achaeans push their ships into the water.
3rd scene: Ships suddenly appear in the sea. We can see them sail as a fleet, progress and finally disappear - the sea gets rough - the ships reappear in the rough sea dashing on and on. Occasionally, dolphins emerge from the sea.
4th scene: Nauplius, standing at the foreland, with a lit torch, sends a false signal to the Achaeans abetted by goddess Athena.
5th scene: We can see scattered remains of the wrecked ships and Aeas swimming in the sea. Athena appears (as deus ex machina), crosses the stage and disappears. While lightning strikes and the sound of thunder is heard,Aeas’ figure is lost.

The stage gates open and close between scenes. All the above take place without any human intervention, solely with the force of a lead weight which descends at a steady pace in a sand clepsydra. The only manual movement required in order to put the automatic theatre into operation is to pull a string!

SCALE 1:1, SOURCES: Heron of Alexandria, Automatopoetike





The automatic servant of Philon

the first operating robot | 3rd century B.C.

This was a humanoid robot in the form of a servant which in her right hand held a jug of wine. The ancient Greeks used to mix the wine with water. When the visitor placed a cup in the palm of her left hand, she automatically poured wine, initially, and then she poured water into the cup mixing it when desired.

Inside the servant, there were two airtight containers (with wine and water, respectively). At their bottom there were two tubes leading their content through her right hand to the lip of the wine jug. Two air pipes started at the top of the containers, went through their bottom and led curved into her stomach. Her left arm was connected, through the articulation, to her shoulders while a helical rod (spring) that was positioned in extension of the restraining rod raised it. Two pipes started at the same point (joint) and came down (penetrating and freeing the curved perforated ends of the air pipes). The pipes of the joint had two holes or cracks at their ends, with the hole that communicated with the wine container preceding that which communicated with the water container. When the cup was placed into the servant's palm, her hand came down and the tubes of the joint lifted. The hole in one pipe was aligned with the air pipe of the wine container, air entered the container and wine flowed from the tube into the cup. When the cup of wine was half-full, the hand (due to weight) descended further, the passage of the air pipe of wine obstructed and the flow stopped. At the same time the other tube was aligned with the air pipe of the water container and it began to flow, thus, diluting the wine. When the cup was full, the hand (due to weight) descended further, the passage of the air pipe with water obstructed and the flow stopped. Also, if the cup was removed at any moment, the left hand rose, the tubes of the joint descended, cutting off the air pipes, creating vacuum in the containers and stopping the liquid flow. The servant then filled the cup with wine or diluted with water of desired quantity depending on the time it was pulled from her palm.

SOURCES: Philon of Byzantium, "Pneumatics"

The moving automatic theatre of Heron

a programmable "puppet show" | 1st century A.C.

A precise reconstruction of Heron's mobile automatic theatre which presents the myth of Dionysos.

Act 1: The mobile theatre moves automatically to another programmed position (doing compilations of rectilinear and circular movements).

Act 2: Fire is lit on the altar in front of Dionysos. Water springs from his holy stick and wine from his cup is poured onto the small panther.

Act 3: The place around the four columns of the base is crowned with flowers. The sound of drums and cymbals are heard while the six Bacches move dancing around the temple.

Act 4: The musical instruments stop and Dionysos turns to the other side of the temple.The winged Nike (Victory) turns with him.

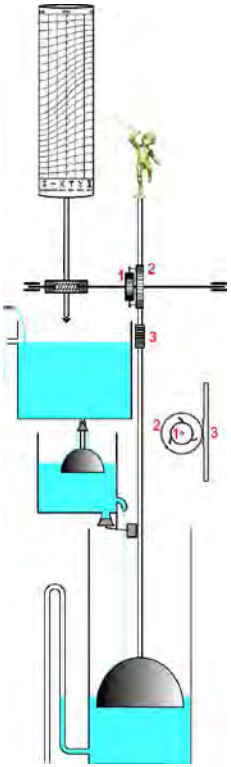
Act 5: Fire lights on the other altar of the temple and from his holy stick, water springs again and from his cup, wine is poured onto the small panther.

Act 6: The sound of drums and cymbals are heard again while the six Bacches move backwards dancing around the temple.

Act 7: The musical instruments stop and the mobile theatre moves automatically to its initial position (by moving backwards doing compilations of rectilinear and circular movements).

All of these are accomplished automatically by the movement of tens of metres of wisely mechanically timed (=programmed) threads that are pulled from the force of a lead weight which fall at a steady pace in a clepsydra with grain (millet). With the clockwise, the releasing and the counter-clockwise winding of threads around axles and reels, the forward movement, the clockwise turns, the stopping and the backward movement is accomplished: To start the performance, the rope from the front side of the base needs to be pulled.

SOURCES: "Heron of Alexandria, Automatopoetike"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The hydraulic clock of Ktesibios

an automatic calendar | 3rd century B.C.

It was a marvel of automation, since the clock was able to operate continuously, without human intervention, indicating the day and hour. The water from a spring supplied, through a spillway, the upper bronze container. This, in turn, supplied the smaller intermediate container which was a constant level controller through a system of a conical valve on the float to interrupt the flow. Then a dripper supplied the tall bronze container, drop by drop, with a constant water supply. With the rising of water in it, the float rose and, through a shaft, a statuette with a pointer rose turned at the same pace. The pointer indicated the hour of 24 on a rotating drum containing a trace of hours of day and night depending on the date. At the end of the 24 hours, the water exceeded the side-built siphon and drained rapidly. On the descent of the float an ingenious drive system was activated in the ratio of 1 to 365 (which consisted of a toothed rule, a pawl, two gears and a worm gear) that ensured the rotation of the drum calibrated in 1 to 365 of its circumference as the pointer of the statuette now indicated the exact time of the next day.

SOURCES: Vitruvius, "On architecture"

The hydraulic automaton of the “chirping birds” and the “turning owl”

an automatism with motion and sound | 3rd century B.C.

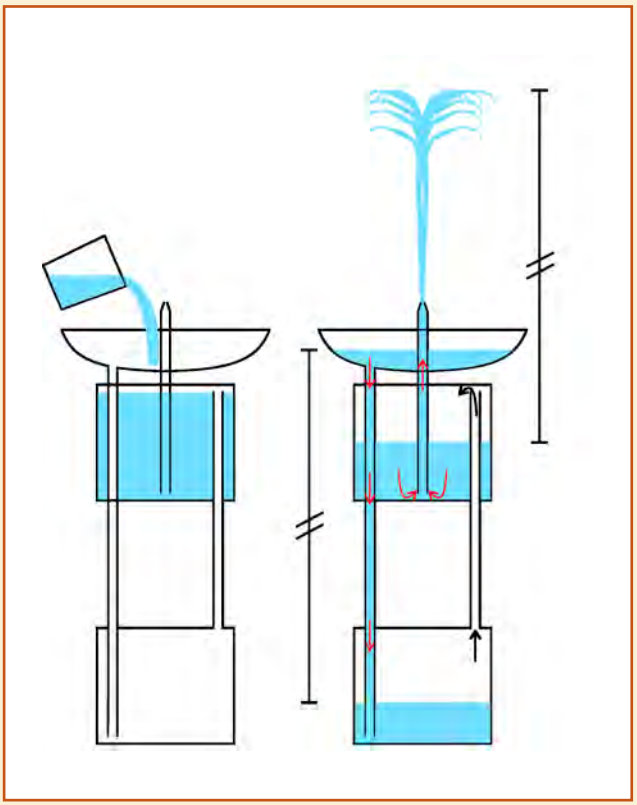
It was a conception of Philon of Byzantium and was improved by Heron of Alexandria) depicting birds chirping when an owl turned away from them and they stopped when it turned towards them. Automatically, the theme was repeated continuously.
For the operation of the automaton, water from a spring was driven inside the upper airtight container forcing the air to leave through a pipe. Because the pipe-flute led to water, the oscillating wavelength produced a chirp with notes of different frequency. Then when the water level exceeded the curved siphon of the container, it emptied through it to the intermediate container, diverting a yoke to the side. This forced the built-in rotating shaft supporting the owl to turn towards the birds that then stopped chirping. When the water level exceeded the axial siphon of the intermediate container, it emptied through to the lower container, diverting the yoke towards its counterweight, which caused the owl to turn away from the birds that then began to sing again, etc.

SOURCES: ‘’Heron of Alexandria, Pneumatics, A16”, ‘’Philon of Byzantium, Pneumatics, 61”

The magic fountain of Heron

a restless device that "breaks" the laws of hydrostatics |1st century A.C.

It was a most brilliant fountain which shot recycled water higher than the available level of its reservoir defying ostensibly the beginnings of hydrostatic pressure. It consisted of one open and two airtight containers placed one above the other. The middle airtight container was full with water and a pipette began a little above its bottom and led to a nozzle above the upper open container. When water was poured into the upper open container, this, through a pipe, flowed into the lower airtight container. The confined air in this was pressed and through another pipe it displaced the water of the middle container, forcing it to rise to the nozzle and to shape a small spurt. The spurt of water supplemented the water of the upper container (maintaining the level constant). Thus this process was self-supporting and it continued automatically until all the water from the middle container emptied.



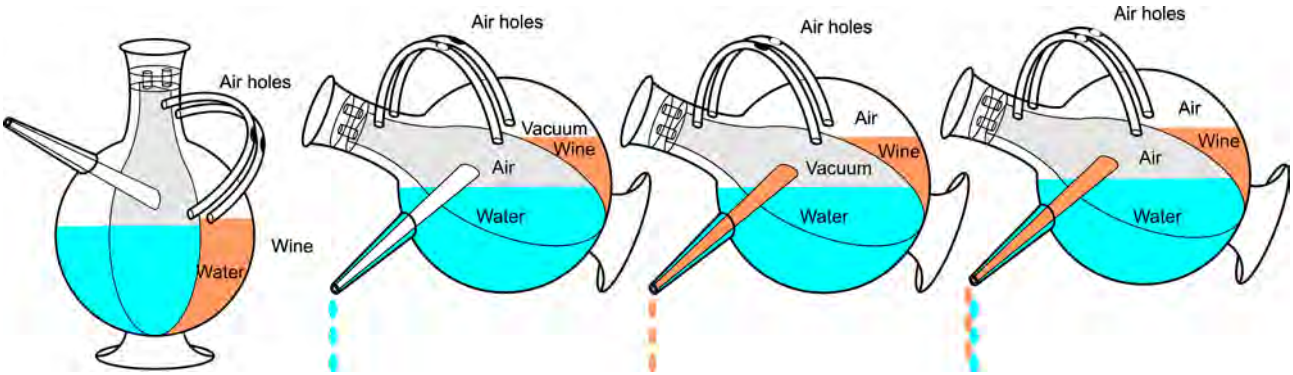
SOURCES: "Heron of Alexandria, "Pneumatics"

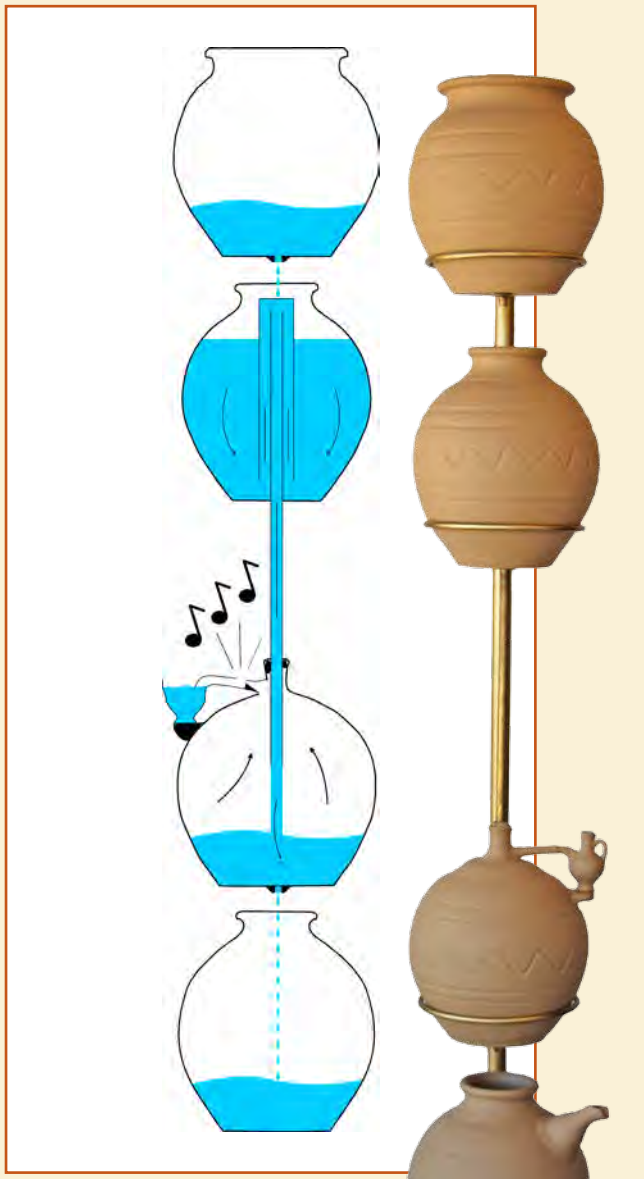
The ingenious wine-jug of Philon

a wine mixing home appliance | 3rd century B.C.

It was a jug (conception of Philon of Byzantium) from which water, wine or watered-wine, depending on the will of cupbearer, was poured automatically. It consisted of a vertical diaphragm that separated the jug into the compartments of water and wine and the outlet fluid pipes which, however, were found one inside the other so that outside the jug they appeared as one. The jug had an airtight lid which made it impossible for the fluids to flow at its inversion because of the vacuum that was created by the inability to substitute the outlet fluids with air. Two tubes began in the middle of the jug (the one communicated with the water compartment and the other with the wine compartment) and reached the neck so that they formed its handle. At the sides of the tubes there were air holes which the cupbearer covered with his finger. With the combinational disclosure of the air hole of the water compartment, wine compartment or even the two simultaneously, the cupbearer allowed the incoming air into the corresponding compartments and the flow of water, wine or watered-wine, according to the wish of the visitor.

SOURCES: "Philon of Byzantium, "Pneumatics"





The alarm clock of Plato

an awakening device with sound | 4-5th century B.C.

It was a hydraulic alarm clock which was invented by Plato. The upper ceramic vessel supplied the next vessel with water through a tap (appropriately calculated provision for each case). When the second vessel was full at the programmed moment (e.g. after 7 hours), it emptied quickly through an axial siphon to the next airtight vessel and forced the contained air to come out with pressure, whistling through a syringe at its top. Because the flute led to water, the vibrating sound length produced a chirp with notes of different frequency. After its operation, the third vessel emptied slowly (through a small hole located at its bottom) to the lower storage vessel in order to be reused.

SOURCES: : Vitruvius, "On architecture"

The spherical astrolabe of Ptolemy

a global positioning system |1st century A.C.

It was an exceptional astronomical instrument which depicted the celestial sphere and was used for the measurement of longitude and latitude of the observed stars from anywhere on Earth but also, vice versa, as locator of position (GPS) and also for the measurement of the Sun-Moon distance. It consisted of seven concentric articulated rings.

The 7th ring (external) was fixed in the level of the meridian and had four marks that defined the horizontal and vertical. The 6th was calibrated and rotated freely in

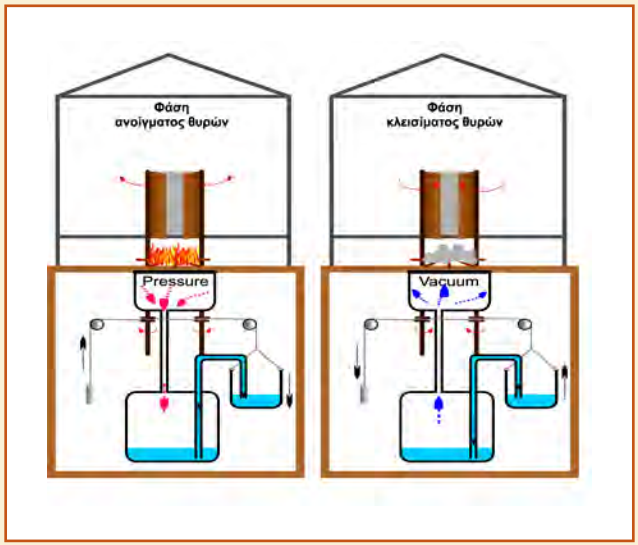
the level of the meridian with points 0° and 90° to represent the equator and the pole respectively and was placed in the direction of the Earth's axis. The 5th was directed towards the Sun. The 4th was articulated in the Earth's axis and observed the daily rotation of the astral sphere. The 3rd was calibrated and was articulated to the precedent at a distance of approximately 66° from the poles. It was placed in the ecliptic zodiac; it had the names of the star signs (zodiacs) and was used to read the longitudes of the stars. The 2nd was calibrated, revolved around a perpendicular axis in the level of the ecliptic and was used to read the latitude of the stars. Finally, the 1st ring (internal) had the aiming device.

SOURCES: "Mathematical Syntaxis, Ptolemy", "Annotation in the Books 5 and 6 of the Mathematical Syntaxis, Pappus of Alexandria"

The automatic temple gates opening

the first building automation | 1st century A.C.

It was an invention of Heron of Alexandria, which permitted the automatic opening of the temple gates after sacrifice on its altar creating in the faithful the impression of a miracle. In the underground of the temple, the balance chains were wrapped around the rotation axles of the temple doors. The balance had a container at one side and a counterweight at the other. With the fire of sacrifice, the air inside the closed container of the altar expanded and went through a pipe to a closed container with water. The water was pushed through a siphon and was led to the container on the balance that tipped outweighing the counterweight, thus, causing the diversion of the balance towards this. The chains of the balance rotated the axles and the temple gates opened. After the sacrifice, the phenomena were reversed and the temple doors closed.



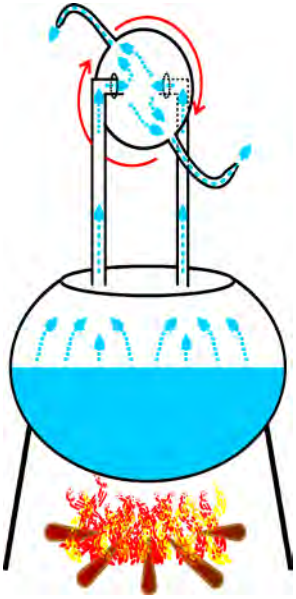
SOURCES: "Heron, Pneumatics, A38"

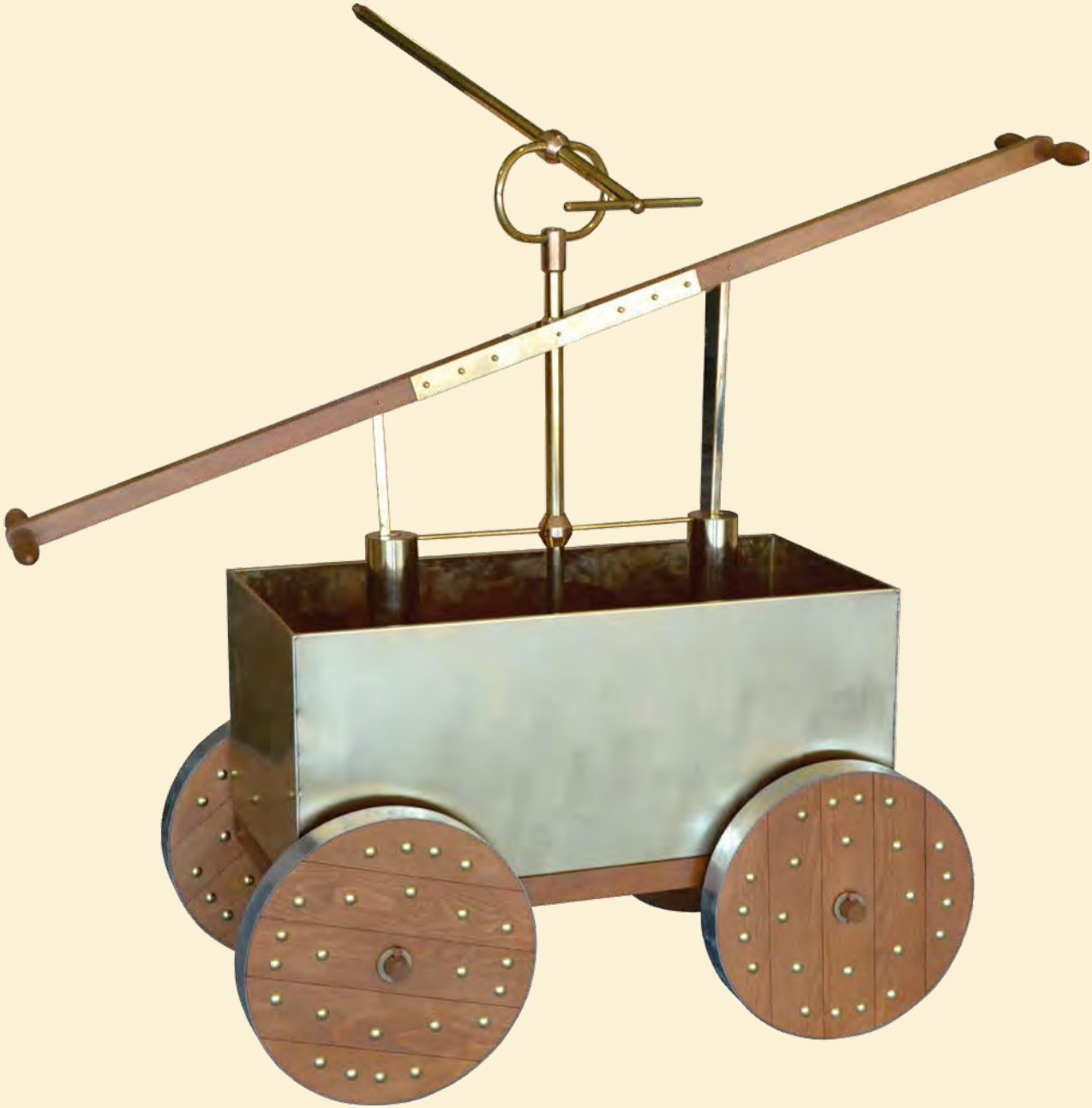
The “aeolosphere” of Heron

the first steam machine | 1st century A.C.

It is the precursor of the steam engine which, with the addition of a pulley, would have led the Hellenistic Era (had it not been interrupted by the political, economic and social factor and the Roman conquer) to the industrial revolution with unforseeable consequences to humanity.
It consisted of a sphere with two curved nozzles which rested on the curved ends of two pipes connected to the top of an airtight boiler. When the water in the boiler was heated, it turned into steam. Then, it entered the sphere and came out with speed from the two nozzles forcing the opposite continuous rotation of the sphere.

SOURCES: Heron, “Pneumatic, B11”





Fire pump of Ktesibios and Heron

a force piston fire pump | 3rd century. B.C.

It was a twin suction force piston pump of continuous water flow that was used for firefighting and continued identically having the same use until recently. It consisted of two pistons that reciprocated oppositely with the help of a pivoted common lever within two vertical cylindrical containers immersed in the (probably wheeled) water tank. The non-return valves of the incoming water were in the raised bottom of the containers and the non-return outlet valves were at the base of the discharge pipes. The pipes converged to a common vertical pipe. At the end of the pipe there was an ingenious (horizontally and vertically) rotating pipe system with a nozzle that allowed the precise aim of the target.

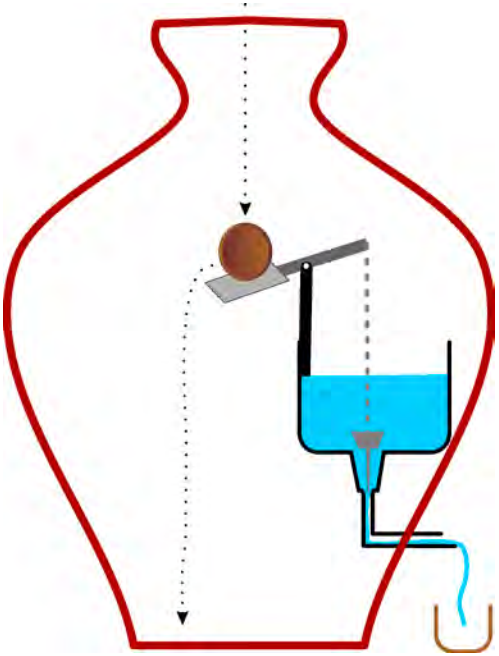
SOURCES: "Heron of Alexandria, "Pneumatics"

The automatic holy water server with coin-collector

the first vending machine | 1st century. A.C.

It is the oldest automatic vending machine in history. It was placed outside temples and allowed the faithful to obtain holy water by dropping a five-drachma coin into a vessel. The coin fell onto the disc of a balance, the diversion of which opened a conical valve and out flowed the amount of water equivalent to the weight of the coin.

SOURCES: Heron, "Pneumatics A21"

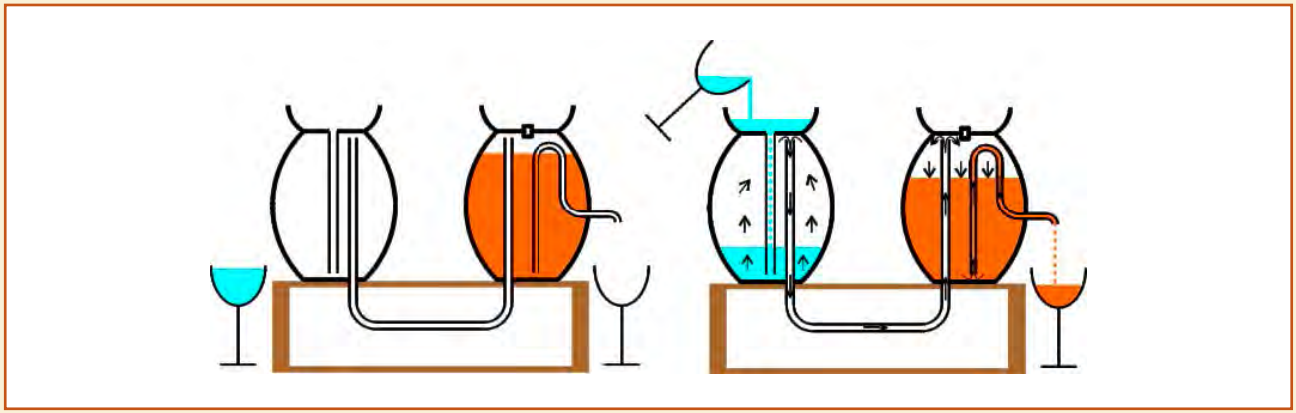


The “philosopher’s stone” of Heron

turning wine into water | 1st century A.C.

An amazing invention of Heron of Alexandria that “changed” one liquid into another, for example, water into wine. It consisted of an airtight vase of water which, at the top, had a tubular opening where water entered and reached the bottom and of an airtight vase of wine which, in the middle, had a tap in a siphon shape. The two vases were connected by an intermediate small tube that entered the bottom and reached close to their top. When a certain amount of water was poured into the first vase, the air inside went through the intermediate tube to the second vase pushing out the equal amount of wine. The tube arrangement did not allow the mixing of liquids.

SOURCES: ‘’Heron, Pneumatics, A 14’’



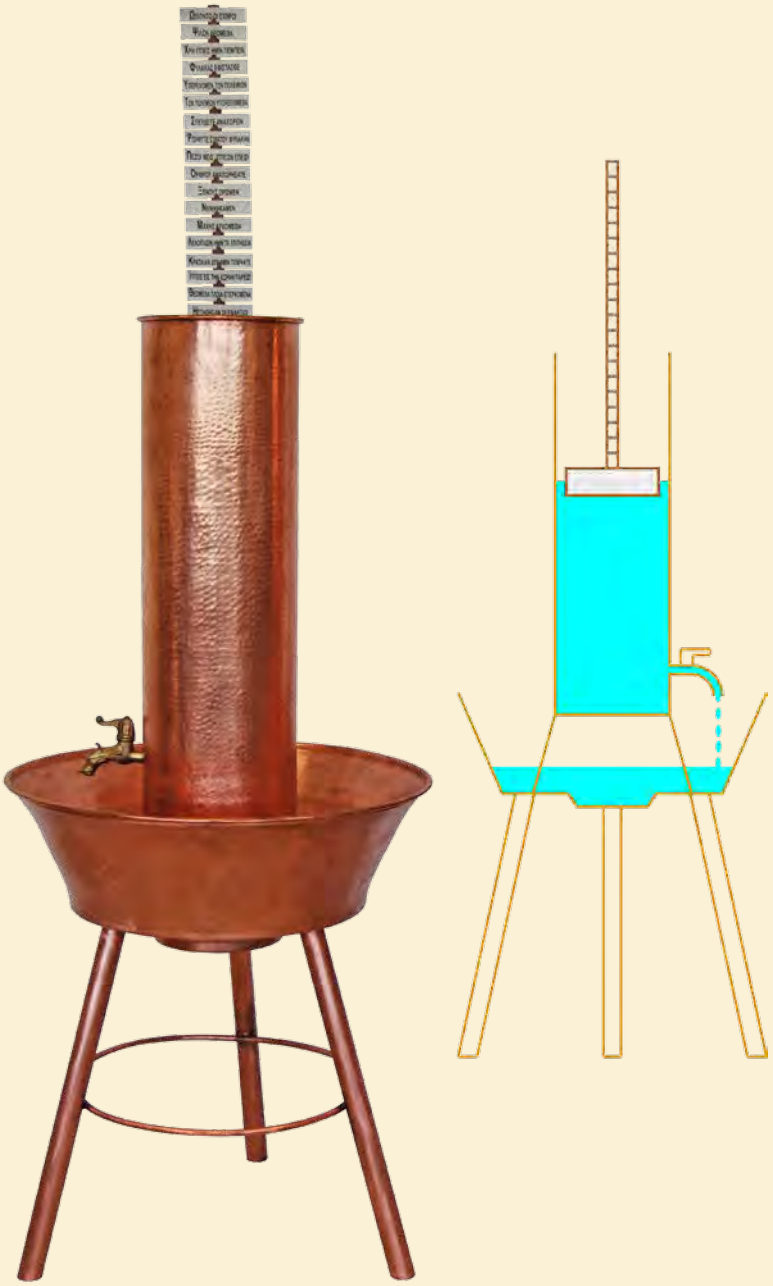
The hydraulic endless screw of Archimedes

a water pump | 3rd century B.C.

It is a mechanism for pumping water with a small difference in height still used today for transporting fluids or granular materials. It consisted of a wooden shaft which had convolutions (curves) of thin and flexible willow or wicker branches (one stuck on top of the other) so that a screw was created. The screw worked within a wooden pipe.

The device was placed in the water with an inclination of 30 degrees. With the manual rotation of the screw, the water (trapped within its coils) rose and flowed from the mouth of the pipe.

SOURCES: Vitruvius, "On architecture X"



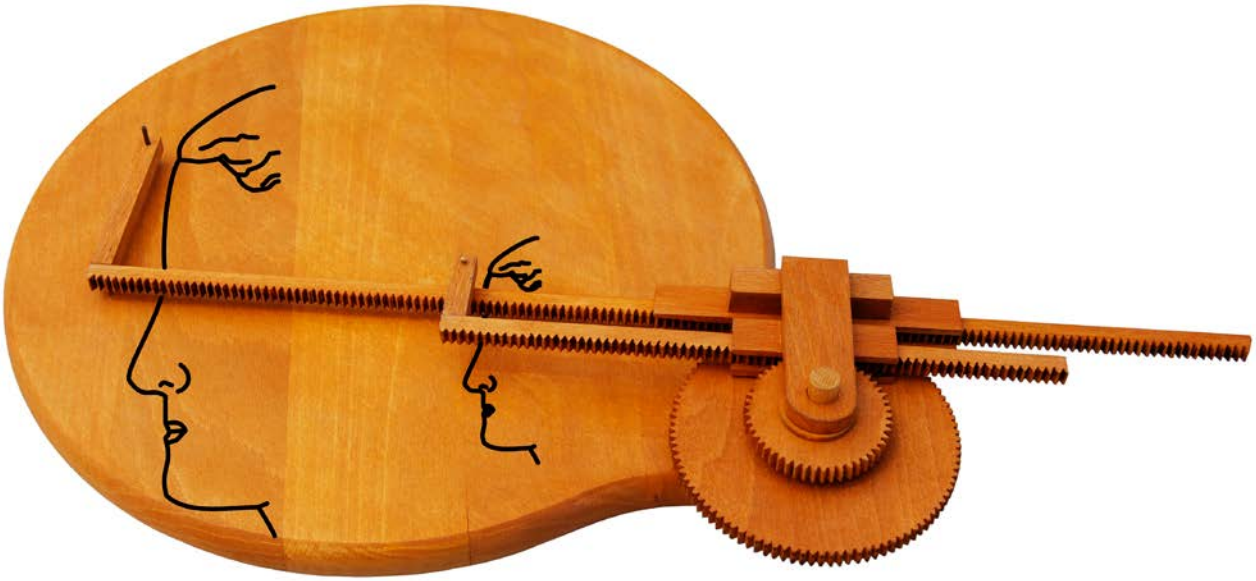
The “hydraulic telegraph” of Aeneas

the first telecommunication device | 4th century B.C.

It was a method through which pre-agreed messages were sent, described by Aeneas Taktikos (4th century B.C.) in the lost part of his work “Poliorkitica” and retrieved by Polybius. This method was used as a fast and efficient way of transmitting messages across the vast empire of Alexander the Great.

Messengers stood at carefully chosen hills and used clay or metal cylindrical containers of equal size filled with water. In each container there was a cork floating a little narrower than the opening of the container. Rods, divided into equal parts, were inscribed with the same pre-agreed messages on each and attached to the centre of the floats, (e.g. Horsemen have entered the country). The operator “transmitter”, by lifting a burning torch, signalled the operator “receiver” for the sending of the message and then waited for confirmation with the rising of the torch from the “receiver”. After that, he lowered his torch, signalling for the simultaneous opening of both taps on their devices. The rods with the messages descended and when the desired message to be sent appeared at the rim of the “transmitter’s device, he raised the torch again, signalling the “receiver” for the simultaneous interruption of the outflow. Due to the similarity of the devices, the desired pre-agreed message also appeared on the “receiver’s” device.

SOURCES: Polybius, History X, 43-44 Philon of Byzandium, Syntaxi Michanikis V Polyaenos, Stratigimata IV



The pantograph of Heron

a device for copying, enlargement and diminution | 1st century A.C.

It was an impressive instrument used for copying drawings and figures (with the possibility of reduction or enlargement). It consisted of a plane base with two connected toothed wheels (with the possibility of rotation around a single axle which went through their common centre) and two parallel toothed rods (that were always in contact with the toothed wheels sliding inside two grooved racks). The latter were perpendicularly connected on one arm rotating round the centre of the toothed wheels. Two rods (soldered perpendicularly at the end of the two toothed rods) had, at their ends, the reading pointer and the copy writer (aligned with the centre of the toothed wheels). When the operator of the instrument followed the outline of the drawing with the reading pointer then the copy writer drew the copy in scale proportional to the ratio of the cogwheels.

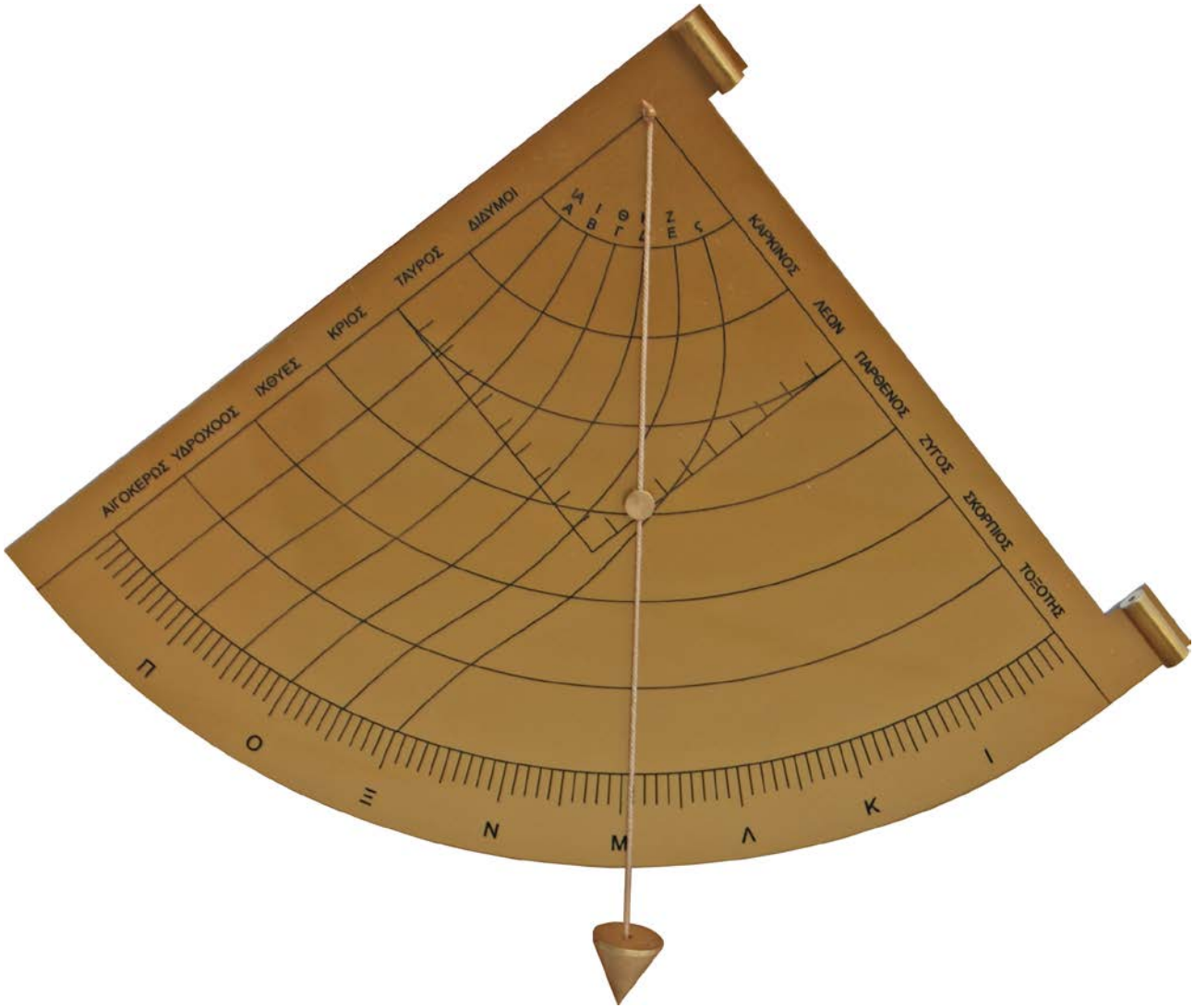
SOURCES: "Heron of Alexandria, Mechanics (Arabic manuscripts Leiden MS B and MSL)"

The “hodometre”

a taximeter | 3rd century B.C.

It was a mechanism for the accurate measurement of road distance (precursor to the taximeter). It consisted of a box with co-operating worm gears and gearwheels attached to a moving vehicle. One axial rod on one of the vehicle s wheels carried the motion to the first eight-toothed (gear) wheel in the box, while the calibrated discs on the outer top surface of the box which were incorporated on the axles indicated the distance travelled. The ratio in the proposed Heron’s construction is 1:8:30:30:30, so a full rotation of the last disc corresponded to 216000 revolutions of the vehicle s wheels. By the wheels diameter of 1.60 metres the distance is 1080 kilometres. In a variation of the device one calibrated disc had radial holes with spherules. When one of the spherules was aligned with a corresponding hole of the box, it fell into a metal vessel offering easy measurement of the distance. Archimedes is probably the inventor of this device. (Jejis Ioanis, Thousands 2, 12 th century.A.D.)

SOURCES: Vitruvius, On architecture, X 9; Heron of Alexandria, On dioptra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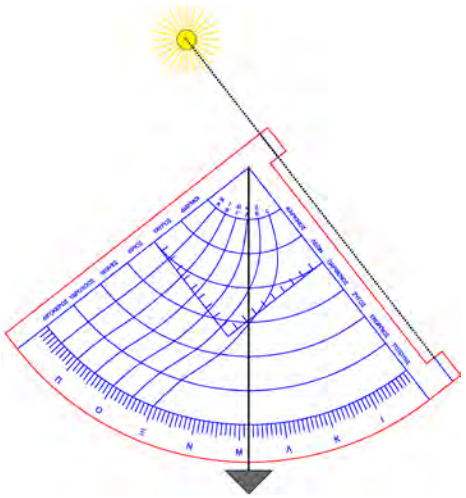
The tetrantas of Hipparhos

a latitude locator of daily use | 2nd century B.C.

It was a measuring instrument which was used (in astronomy and navigation) for the calculation of astronomical sizes and (in topography and in construction) for the measurement of terrestrial distances (e.g. the height of a building). It consisted of graduated in degrees quadrant which had an aiming device at one edge and from its centre hung a plumb bob. The latitude of each place could be found directly by aiming the Pole Star (it was equivalent to the complement angle of the angle that shaped the aiming line with the thread) and indirectly by the measurement of the zenith of some other celestial body (e.g. the Sun). Later straight lined scales were engraved on the surface of the instrument for the conversion of the (terrestrial) angles in the proportions of lengths but also monthly arcs with curved hour lines for one (or more) latitudes. A mobile button was also added which slid at length of the thread and was regulated depending on the month which was indicated by the zodiac at the edges of the instrument. The instrument at any given hour of the day could be used as a locator of place while with any given latitude as a sundial. The level astrolabes constitute its evolution.

SOURCES: "Ptolemy, The Great Syntaxis of Astronomy (Almagest)"

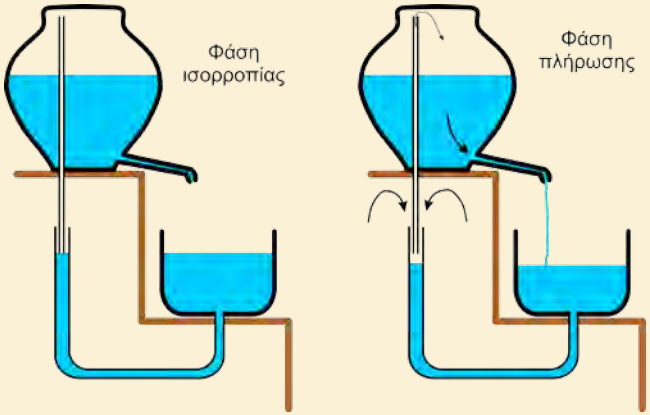


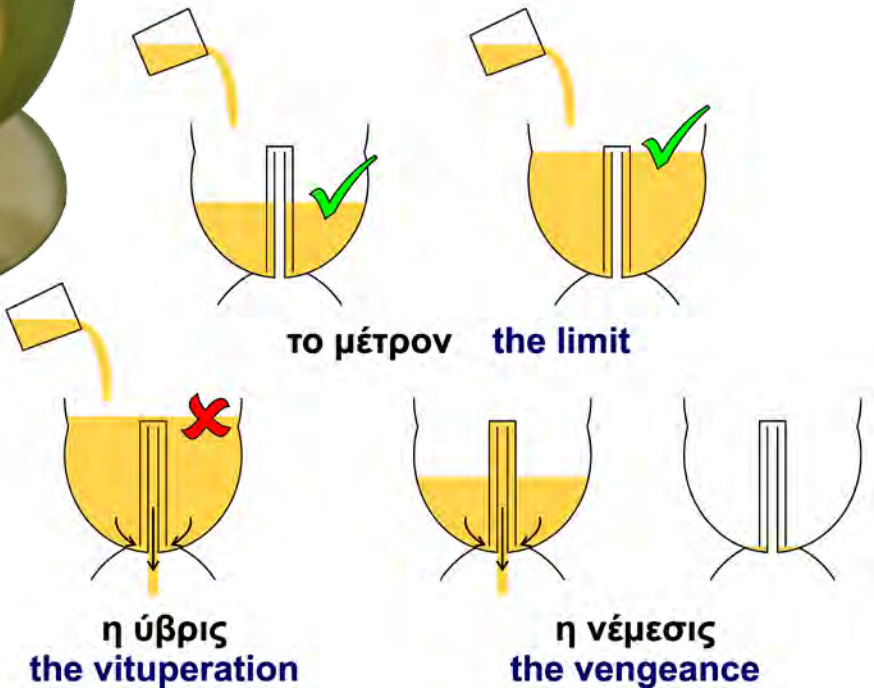
The automatic goblet of Philon

the first self-adjusting controller in human history | 3rd century B.C.

It was an invention of Philon of Byzantium which always kept a goblet of wine full, regardless of the quantity removed. It consisted of an air-tight vessel full of wine with a horizontal tube-tap that led to a goblet. The perforated bottom of the goblet led to a hollow base (horizontal piping with a vertical tube that reached the height of the goblet). A smaller tube that started from the top of the air-tight vessel penetrated its bottom and entered the vertical tube of the hollow base in a depth equivalent to the desired level of the wine in the goblet. The level of the wine in the vertical tube of the hollow base fell after the removal of a certain quantity of wine from the goblet, thus, allowing the entrance of air through the smaller tube in the air-tight vessel. This led to the flow of wine towards the goblet and to the increase of its level in the hollow base. When the level of the wine reached the mouth of the smaller tube of the vessel it created vacuum and the flow stopped.

SOURCES: Philon of Byzandium, Pneumatics; Heron, Pneumatics, A19




το μέτρον
the limit
η ύβρις
the vituperation
η νέμεσις
the vengeance

The Pythagoras cup

the first application of the axial siphon worldwide | 6th century B.C.

It was an ingenious wine cup which had an axial or curved siphon and a line that determined the limit of fulfilment. When one filled it excessively, the level of liquid covered the siphon and emptied automatically. It is considered an invention of Pythagoras (6th century BC.) who wanted to teach his students the need for compliance with moderation. It is also called the cup of justice because it reflects the basic principles of justice (vituperation and vengeance). When the limit was exceeded (vituperation), lost was not only that which exceeded the limit but also that which had been acquired up to then.

SOURCES: "Heron of Alexandria, Pneumatica"

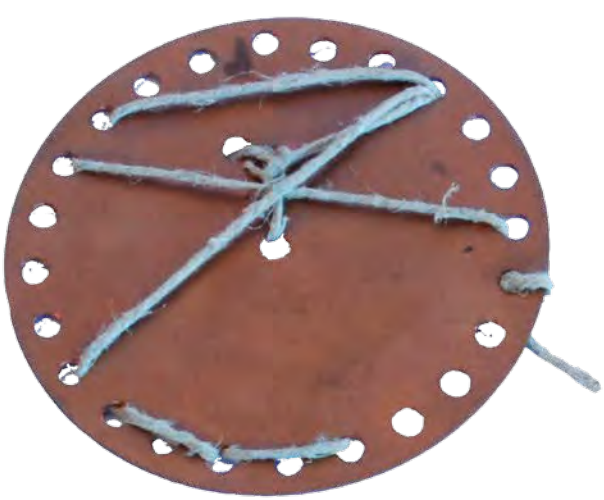
The “polis” (the city)

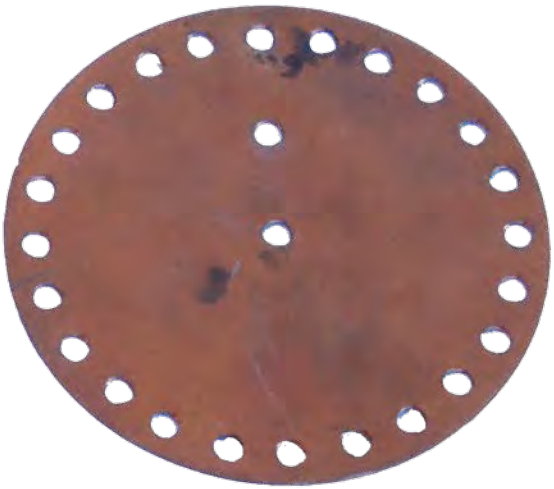
the ancestor of chess

This is an excellent strategy game, precursor of the popular modern chess.It consisted of a plate (the “city”), which was divided into small squares and of 32 to 60 whites pawns and many other black ones (the “dogs”) which were placed on both ends of the plate depending on their colour. The game was played by two players that moved alternately the pieces of each camp to various locations of the plate in order to exclude and remove an opponent’s piece. Each piece could move forward, backward, to the right and to the left. The value of victory was greater when was achieved with minimal losses. The game was very popular with the skilful players (virtuosos) at the game enjoying particular appreciation.

SOURCES: “Pollax, Onomastikon”


ΕΡΡΕΙ ΤΑ ΚΑΛΑ





The cryptic (Laconian) relay

cryptographic communication | 7th century B.C.

It was a thin band (3 mm) of finished leather which the sender wrapped around a cylindrical piece of wood and on it wrote out the message horizontally. Then, he unwrapped it and handed it to the messenger. No one but the recipient could read it, who rewound it onto a piece of wood of equal intersection. It was used from the 7th century BC to exchange messages between the ephors, the King and the Commander of the Lacedaemonians.

On this specific relay we can read the desperate message sent by the Laconians to Sparta after their defeat in the naval battle of Arginouse: 'the ships are lost, Mindaros was killed, the men are starving, we don't know what to do!'

SOURCES: "Plutarch, Lives parallel (Lysandros), 19"

Aeneas' cryptographic disc

cryptographic communication

It was a disc with 24 holes (one for each letter of the alphabet) on the periphery, one in the cent and one more defining the letter "A". The sender formed the message by passing a thin thread the holes of the relevant letters and the receiver read it by removing the thread and noting the letters from right to left.

SOURCES: "Aeneas, Poliorkitika, 31"


ΣΤΡΑΤΕΥΕΙ

The twofold waxed plates

They were wooden plates with their inner surface slightly curved and covered with black wax. A special wooden stick (with a pointed end on the one side for writing the message and a flat end on the other for erasing it) was used to engrave the message on the waxed surface with normal or cryptographic letters (i.e. with the use of dots instead of vowels, mirror writing, etc.), or in special cases under it (i.e. the message of the exiled Spartian Dimaratos in the Persian palace: "Xerxis is going to attack Greece"

SOURCES: Homer, Ilias, Z 156; Apollodoros, II 3.1; Herodotos, Histories, I; Polydeukis, Onomastikon, X57; Aristofanis, Nefelai

The (o)stomachion

the first puzzle in human history | 3rd century B.C.

It was a spiritual game, predecessor of the puzzle. It probably resulted from a mathematical problem of Archimedes, or vice versa. The game consists of a square base divided into 14 geometric pieces. The aim of the game was to reshape, in as many ways possible, using all the pieces, the square or some of the 9 particular figures (a helmet, a goose in flight, a tower, a column, an elephant, a boar, a barking dog and a stalking hunter). In the problem Archimedes demonstrates that for each of the 14 pieces, the area of the square is an integer multiple of the area of each piece.

SOURCES: "Palimpsest Archimedes, (O) Stomachion», «J. L. Heiberg, Archimedis opera omnia".

Acknowledgements

The Culture Club in the European Patent Office Munich would like to express sincere thanks to Mr Kostas Kotsanas, to the Museum of Ancient Greek Technology, to the Archimedes' Museum and to the Hellenic Industrial Property Office for the particular idea and for the initiative to present inventions from Ancient Greece here in our premises in Munich.

Furthermore, we thank members of the Greek community in the Office for supporting and transferring the thought to have an exhibition on this aforementioned topic, since deeply related with the European culture of innovation.

My acknowledgement also refers to the Department on Graphics and Design for creating the invitation card, the poster and the brochure which explains the items on display.

The department "Communication" is thanked for its continued support which enabled us to carry out also this most exciting show.

Munich, in February 2016
Dr. Hermann Schifferer
For the Culture Club in the EPO

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