Amazing Technologies Weapons & Gadgets of the Ancient World

Explore the clever ancient technologies, cunning weapons, and curious gadgets which shaped our modern world and still reflect the brilliance of ancient minds.

Incredible ancient technologies leave us awe-struck at the knowledge and wisdom held by people of our past. They were the result of incredible advances in engineering and innovation as new, powerful civilizations emerged and came to dominate the ancient world. Many ancient inventions were forgotten, lost to the pages of history…

Travel with Ancient Origins now to experience the surprising and clever "Amazing Technologies of the Ancient World".

Did ancient Egyptians harness electricity to power lights? This enigmatic relief in a crypt in the Temple of Hathor shows people holding what is known as the Dendera Light. Roland Unger/(CC BY 3.0)

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1,600-Year-Old Goblet Shows that the Romans Used Nanotechnology

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Ancient technology transforms chalice from jade green to blood red

ANCIENT-ORIGINS | April Holloway

The unique and amazing Roman chalice spills secrets about ancient nanoparticles. Lucas/(CC BY-SA 2.0)

The Lycurgus Cup, as it is known due to its depiction of a scene involving King Lycurgus of Thrace, is a 1,600-year-old jade green Roman chalice that changes color depending on the direction of the light shining upon it. It has baffled scientists ever since the glass chalice was acquired by the British Museum in the 1950s. They could not work out why the cup appeared jade green when lit from the front but blood red when lit from behind.

The mystery was solved in 1990, when researchers in England scrutinized broken fragments under a microscope and discovered that the Roman artisans were nanotechnology pioneers: They had impregnated the glass with particles of silver and gold, ground down until they were as small as 50 nanometers in diameter, less than one-thousandth the size of a grain of table salt.

The incredible ***Lycurgus Cup appears jade green when lit from the front but blood red when lit from behind****. Lucas/(CC BY-SA 2.0)*

When hit with light, electrons belonging to the metal flecks vibrate in ways that alter the color depending on the observer's position.

Now it seems that this technology, once used by the Romans to produce beautiful art, may have many more applications - the super-sensitive technology used by the Romans might help diagnose human disease or pinpoint biohazards at security checkpoints. An engineer at the University of Illinois at Urbana-Champaign, Gang Logan Liu, and his colleagues, have long focused on using nanotechnology to diagnose disease and realized that this effect offered untapped potential.

They conducted a study in 2012 in which they created a plastic plate filled with gold or silver nanoparticles, essentially creating an array that was equivalent to the Lycurgus Cup. When they applied different solutions to the plate, such as water, oil, sugar and salt, the colors changed. The prototype was 100 times more sensitive to altered levels of salt in solution than current commercial sensors using similar techniques. It may one day make its way into handheld devices for detecting pathogens in samples of saliva or urine, or for thwarting terrorists trying to carry dangerous liquids onto airplanes.

According to a more recent study published in the Proceedings of the National Academy of Sciences of the United States of America, this same interference produced by the interaction of light with nanoparticles allows holograms to go beyond the normal limits of diffraction, or the way in which waves spread or bend when they encounter an opening or obstacle. When metallic particles have dimensions on the nanoscale they display iridescent colors, much like as seen in the Lycurgus cup.

Scientists say the Roman artisans created the dichromic effect in the magnificent Lycurgus chalice by accident, however, others have argued that their work was so precise that it is ridiculous to assert that the outcome was accidental. In fact, the exact mixture of the previous metals suggests that the Romans had perfected the use of nanoparticles – "an amazing feat," according to archaeologist Ian Freestone of University College London.

The painstakingly carved cup shows a man preparing to hurl a rock. Both the jade green and blood red colors are visible. Lucas/(CC BY 2.0)

This is not the first time that Roman technology has exceeded that of our modern day. Scientists studying the composition of Roman concrete, submerged under the Mediterranean Sea for the last 2,000 years, discovered that it was superior to modern-day concrete in terms of durability and being less environmentally damaging. The knowledge gained is now being used to improve the concrete we use today. Isn't it ironic that scientists now turn to the works of our so-called 'primitive' ancestors for help in developing new technologies?

A female figure raises a hand on the ancient chalice. Lucas/(CC BY 2.0)

References

Gartia, M. R., Hsiao, A., Pokhriyal, A., Seo, S., Kulsharova, G., Cunningham, B. T., Bond, T. C. and Liu, G. L. (2013), Colorimetric Plasmon Resonance Imaging Using Nano Lycurgus Cup Arrays. Advanced Optical Materials, 1: 68–76. doi: 10.1002/adom.201200040

DOE/Lawrence Berkeley National Laboratory. (2013, June 4). Roman seawater concrete holds the secret to cutting carbon emissions. ScienceDaily. Retrieved July 3, 2015 from www.sciencedaily.com/releases/2013/06/130604135409.htm

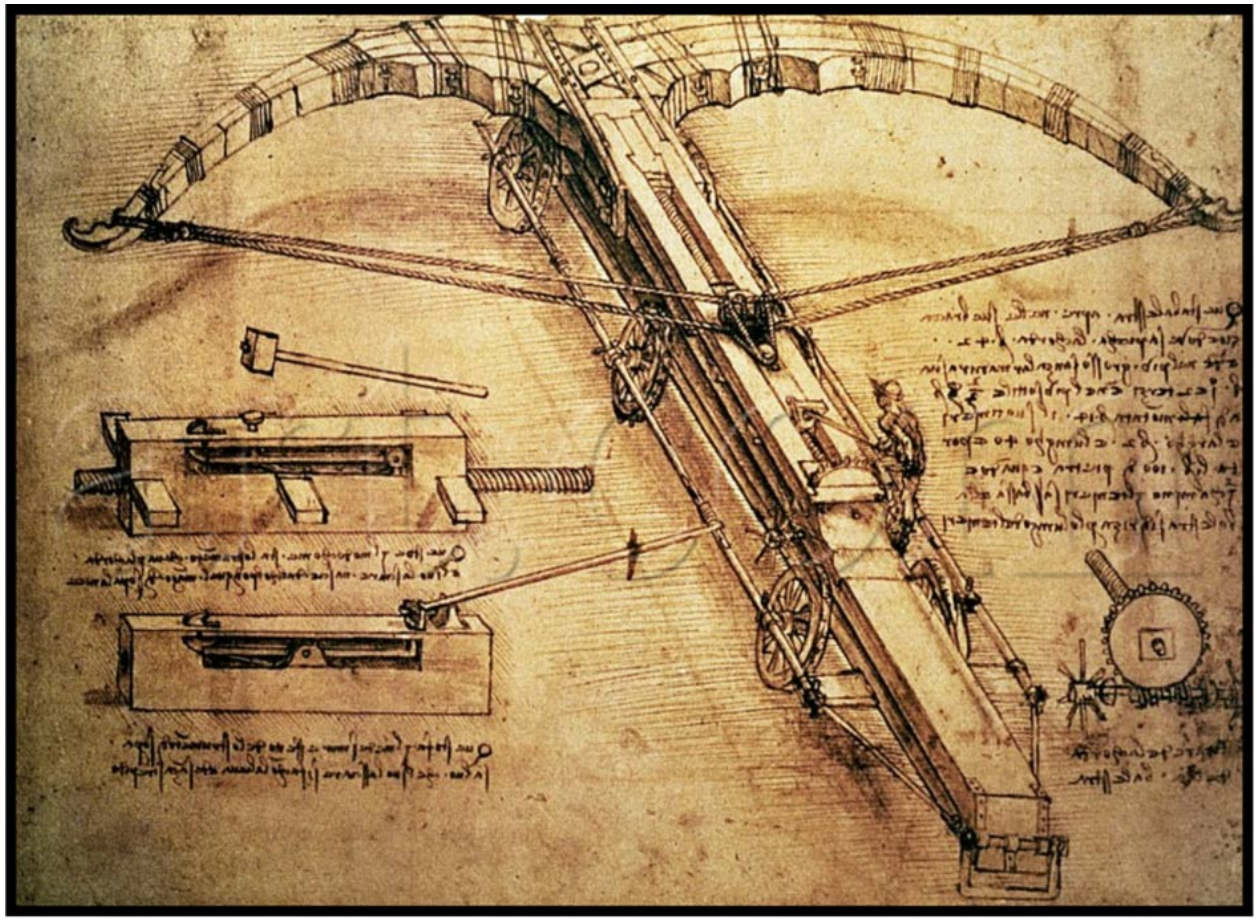
PNAS, August 13, 2014. "Plasmonic nanoparticle scattering for color holograms". doi: 10.1073/pnas.1405262111 PNAS September 2, 2014 vol. 111 no. 35 12679-12683

Five da Vinci inventions that could have revolutionized the history of technology

GADGET: Leonardo Da Vinci Inventions

Da Vinci's amazing inventions show he was ahead of his time

ANCIENT-ORIGINS | April Holloway



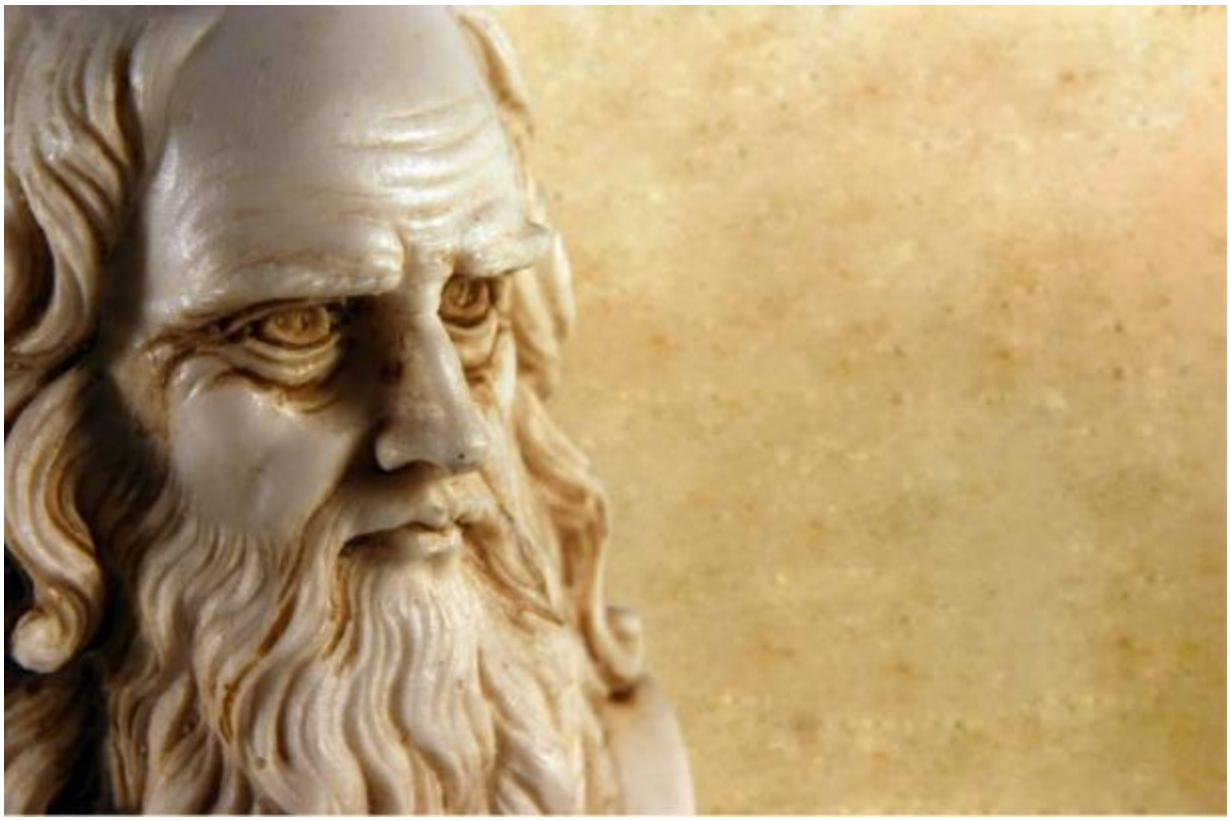
Leonardo da Vinci is one of the most famous artists in history. His genius, however, was not just in his art; Leonardo was also a brilliant inventor in the fields of civil engineering, chemistry, hydrodynamics, optics, mechanical engineering, pyrotechnics, anatomy, and physics.

He envisioned many ideas long before the technology to build them actually existed, meaning that many of his designs, from helicopters to armored vehicles, calculators, diving suits, and robots, never came to fruition.

If they had been built, they may have revolutionized the history of technology,

but it is clear the world was not ready for da Vinci.

Leonardo da Vinci was born on 15 April 1452 to a notary, Piero da Vinci, and a peasant woman, Caterina, in Vinci in the region of Florence, Italy. Leonardo was educated in the studio of the renowned Florentine painter Verrocchio. Much of his early working life was spent in the service of Ludovico il Moro in Milan. He later worked in Rome, Bologna and Venice, and he spent his last years in France at the home awarded him by Francis I. During his lifetime, he was a renowned painter. Among his works, the *Mona Lisa* is the most famous portrait, and *The Last Supper* the most reproduced religious painting of all time. However, throughout his life, Leonardo spent many more hours on his inventions, recorded in over 13,000 pages of notes and sketches, many of which were not discovered until after his death on 2 May 1519.



The iconic polymath, Leonardo Da Vinci was ahead of his time. (BigStockPhoto)

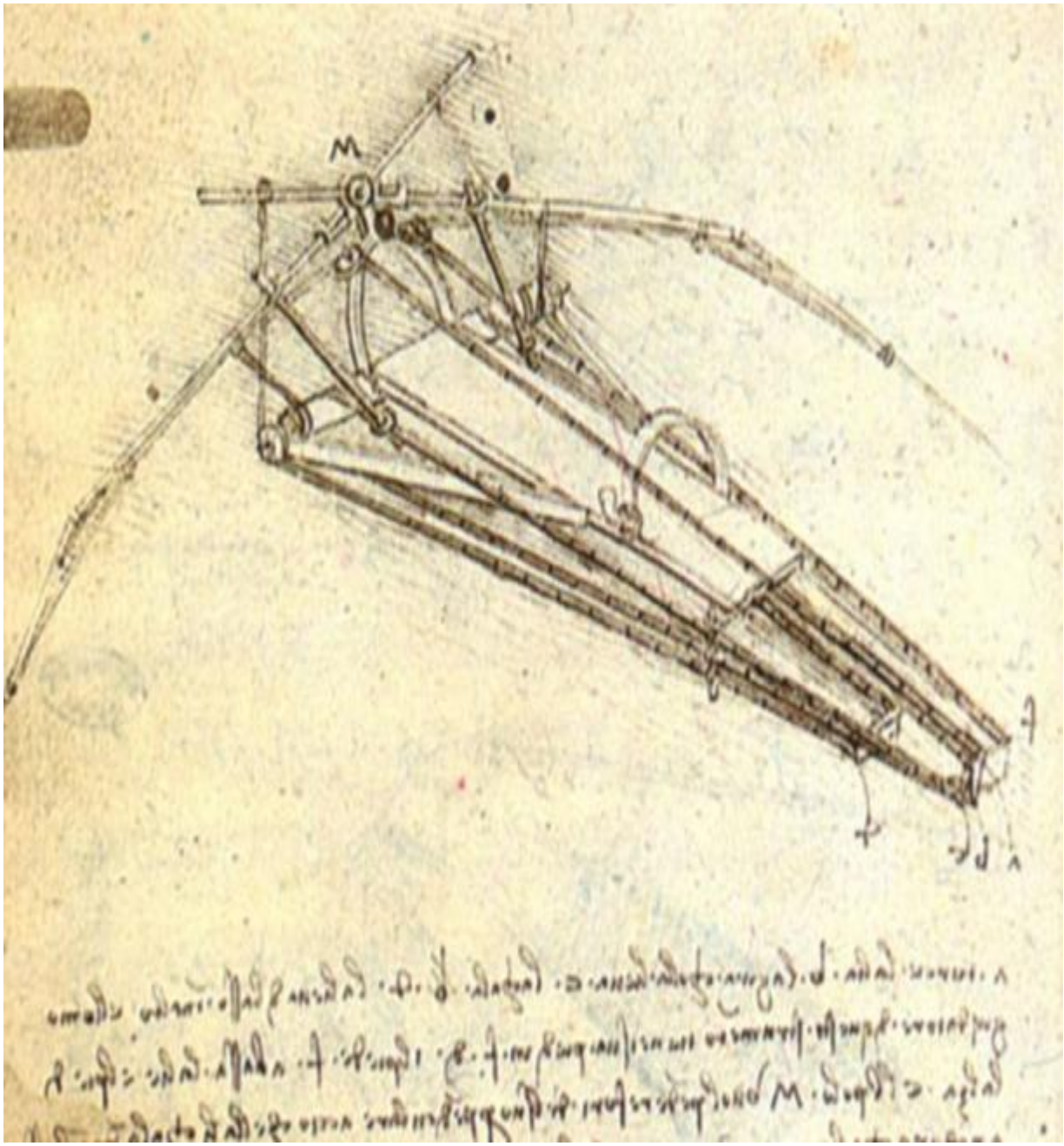
An article on LiveScience, reports on five of da Vinci's key inventions that were before his time – a flying machine, armored vehicle, diving suit, machine gun, and humanoid robot.

Flying machine

One of da Vinci's most famous inventions is the flying machine, although there were in fact many different models, mostly based on the flight of bats, kites, and birds. His designs reflect his powers of observation and imagination, as well as his keen desire to experience soaring like a bird.

One of da Vinci's models consisted of a wooden frame with a wingspan exceeding 33 feet (10 meters). The 'wings' were to be covered in fine silk to create a light but sturdy membrane, like the wings of a bat. The pilot would lie face down on a board in the center. To power the wings,

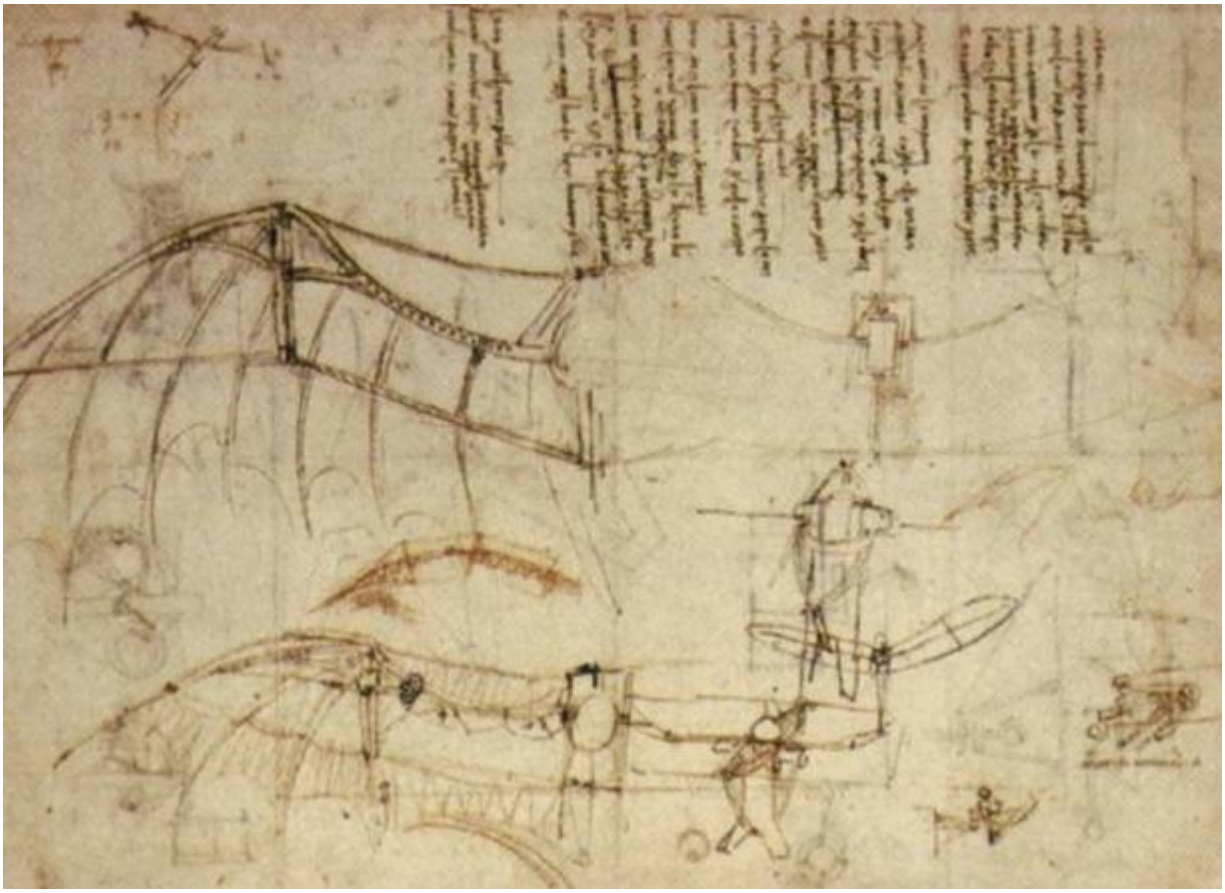
the pilot would pedal a crank that moved a series of rods and pulleys, causing the wings to flap. The fact that the wings were also designed to twist as they flapped demonstrates da Vinci's inspiration from nature.



A sketch by Leonardo da Vinci showing one of his envisioned flying machines. (Public Domain)

There is a legend that Leonardo tested the flying machine with one of his apprentices, and that the apprentice fell and broke his leg. However, there is no real evidence of such a test, and experts have indicated that while the flying machine may have flown once it was in the air, a person could never have created enough power to get the device off the ground.

“The world would have to wait another 400 years or so for a machine that could really fly,” writes LiveScience. “It wasn't until 1903 that brothers Wilbur and Orville Wright made their first successful flight in a powered aircraft.”



One of da Vinci’s sketches of a flying machine shows close resemblance to the wings of a bat. (Public Domain)

Armored vehicle

Many of da Vinci’s inventions centered around weaponry and war machines, most likely because he was receiving funding from the Duke of Milan, who was responsible for Milan’s defense against the French.

One of da Vinci’s designs was an armored vehicle equipped with weapons and capable of moving in any direction, which many have called a precursor to the modern tank.

“Da Vinci’s vehicle has a number of light cannons arranged on a circular platform with wheels that allow for 360-degree range,” writes ‘Da Vinci Inventions’.

“The platform is covered by a large protective cover (much like a turtle’s shell), reinforced with metal plates, which was to be slanted to better deflect enemy fire. There is a sighting turret on top to coordinate the firing of the canons and the steering of the vehicle. The motion of the machine was to be powered by eight men inside of the tank who would constantly turn cranks to spin the wheels.”

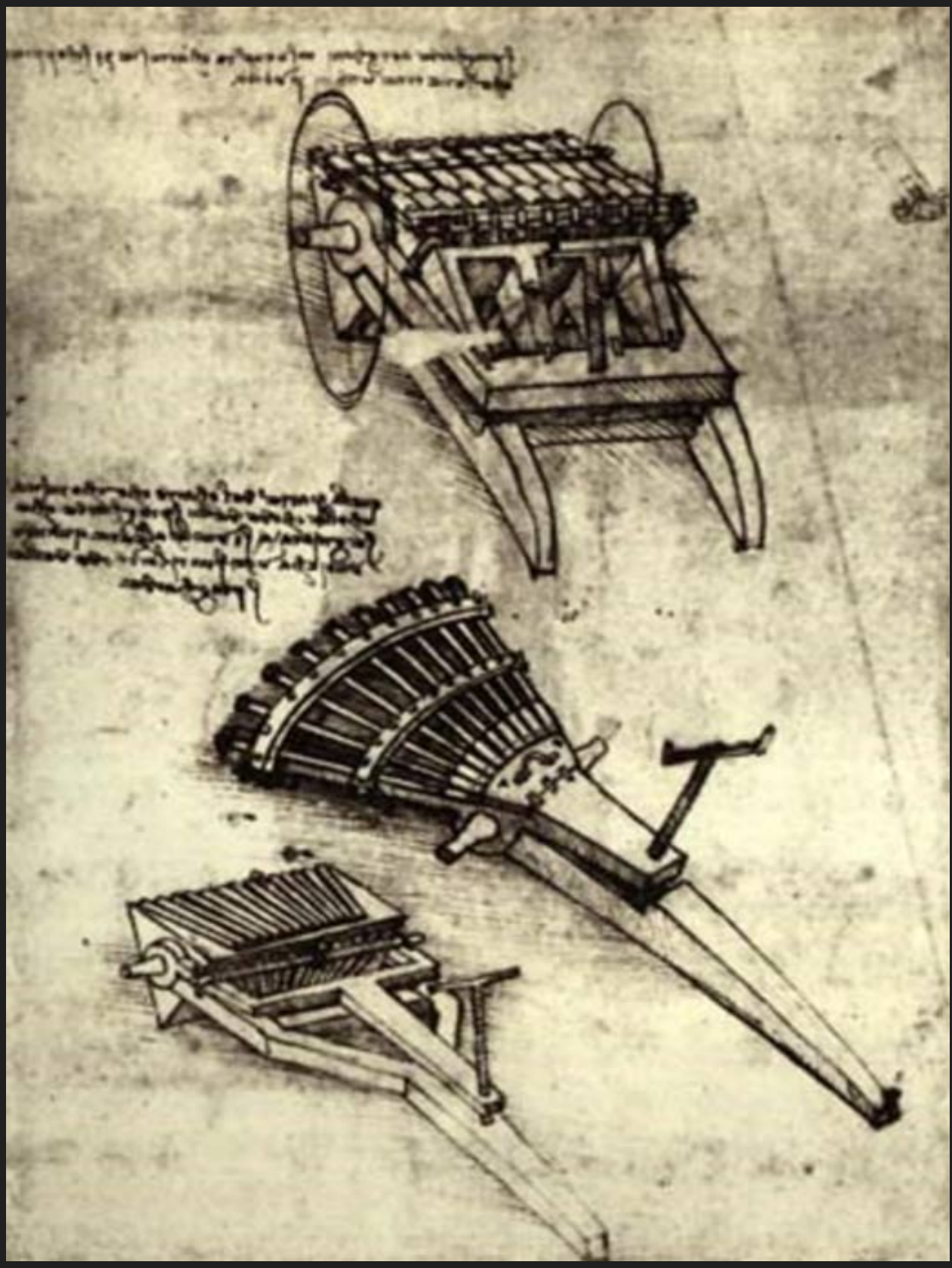
Model of da Vinci’s armored vehicle based on his sketches. Traveling exhibition "Leonardo da Vinci il genio e le INVENZIONI" at the Palazzo della Cancelleria. (CC BY 3.0)

“Like his flying machine, da Vinci's armored car was never built. And it wasn't until 400 years later, during World War I, that armored tanks became a fixture of European battlefields,” LiveScience reports.

Machine gun

Another of da Vinci’s war weapons was the 33-barrelled gun, which was designed to overcome the problem with the canons of the time, in that they took too long to load. His concept was that by creating three rows of 11 guns in each, all connected to a single revolving platform, the guns could be loaded at the same time and then fired on rotation, eliminating delay.

“Leonardo da Vinci’s design for the 33-barrelled organ is generally regarded as the basis for the modern day machine gun,” writes Da Vinci’s Inventions, “a weapon that didn’t really develop for commercial use until the 19th century.”



Sketch by Leonardo da Vinci of his concept of a multi-barrel gun (Public Domain)

Diving suit

While Leonardo was working in Venice, he produced a design for an early diving suit, to be used in the destruction of enemy ships entering Venetian waters. The suit was to be constructed using pigskin treated with fish oil to repel water. The helmet had inlaid glass goggles, and a breathing tube of bamboo with pigskin joints was attached to the back, and connected to a float of cork and wood. As well as receiving air from the surface, the suit was designed to store air in a pocket in the jacket.

A replica was constructed for a BBC documentary based on da Vinci's drawings and notes. When the scuba divers tested the suit, they found it to be a workable precursor to a modern diving suit, the cork float acting as a compressed air chamber when submerged.

It was some 500 years later before famous inventor Jacques Cousteau and engineer Emile Gagnan invented the modern scuba suit.

Sketch of a lifebelt by Leonardo da Vinci. (Public Domain)

Humanoid robot

Leonardo's study of human anatomy led to the design of one of the first known humanoid robots in recorded history. The robot, clad in in German-Italian medieval armor, is believed to have been made around the year 1495 and presented at a celebration hosted by The Duke of Milan, but was only rediscovered in the form of sketches in the 1950s.

The robotic knight could stand, sit, raise its visor, open and close its mouth, and independently manoeuver its arms. The entire robotic system was operated by a series of pulleys, cables, internal gears and hand cranks.

In 2002, Mark Rosheim, a specialist in robotics, built a working model of da Vinci's robotic knight. It was proved to be fully functional, as Leonardo had planned.

Model of a robot based on drawings by Leonardo da Vinci. (Public Domain)

Leonardo had no formal education in Latin, mathematics and science, and never attended a university. This meant that many of his inventions were largely ignored by scholars and wealthy patrons, and his genius remained locked away in mere sketches of a notepad. When his diaries were discovered, analyses revealed that Leonardo's approach to science was one of intense observation and detailed recording, his tools of investigation being almost exclusively his eyes. Da Vinci was a fundamentally different kind of scientist for his time, as he integrated the arts into his theorizing and hypothesizing, bringing about a unique integrated and holistic approach to science.

References

Palermo, Elizabeth. "Flying Machines? 5 Da Vinci Designs That Were Ahead of Their TimeThe Truth. 2014. LiveScience [Online] http://www.livescience.com/49210-leonardo-da-vinci-futuristic-inventions.html

"Armoured Car". 2008. Da Vinci Inventions [Online] http://www.da-vinci-inventions.com/armoured-car.aspx

The Devastating and Diabolical Ancient Origins of Biological Warfare

WEAPON: Biological Warfare

Ancient humanity harnessed deadly natural weapons to lethal effect

ANCIENT-ORIGINS | Liz Leafloor

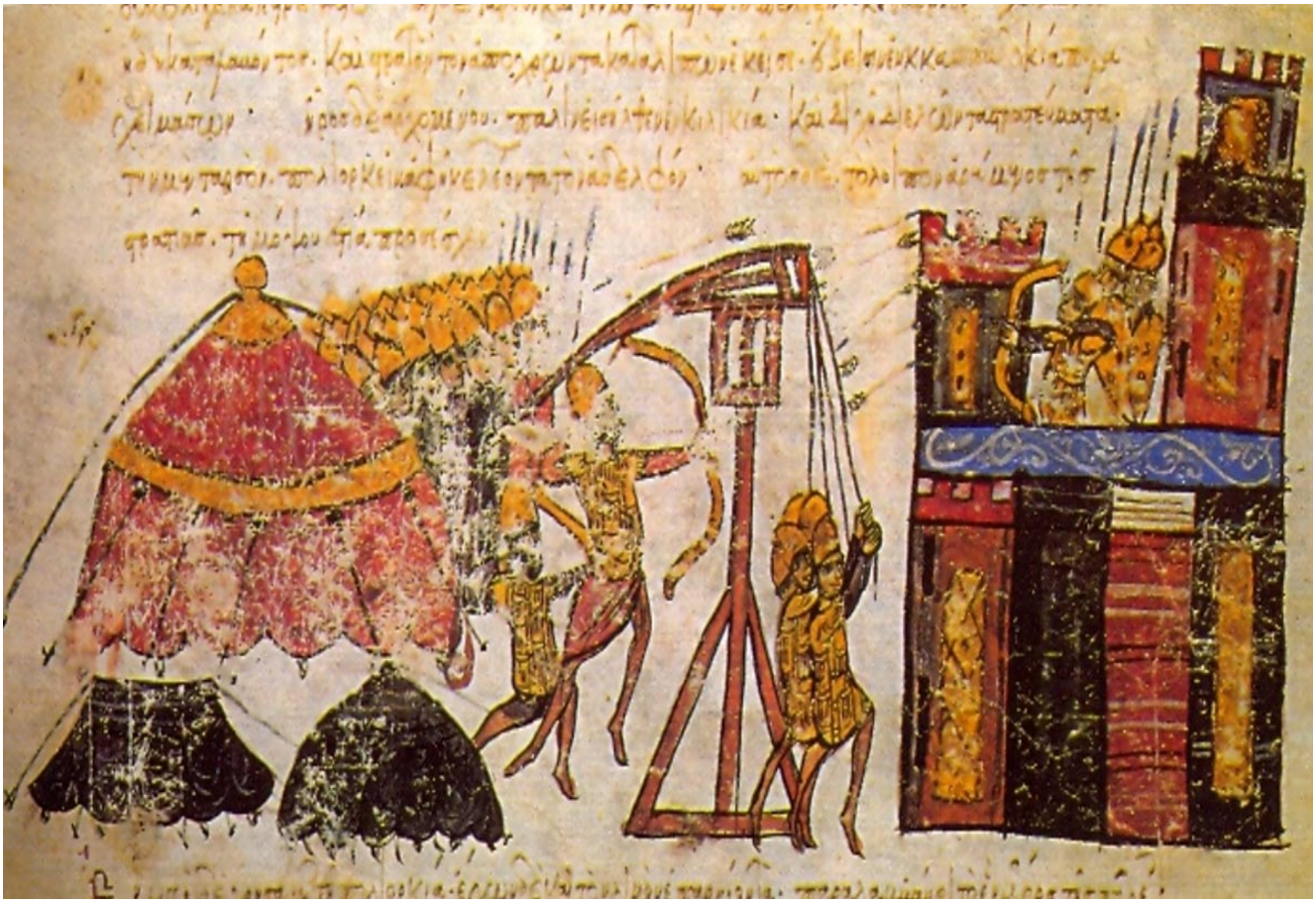


Image from an illuminated manuscript depicting a Byzantine siege of a citadel. A tactic of ancient biological warfare was to hurl infected dead bodies over city walls. (Public Domain)

History paints a bleak picture of the devastating effects that disease, contamination, or poison can have on humans. But with those hard lessons came experience and knowledge, and mankind has effectively harnessed that knowledge to create biological weapons, using them against enemies since prehistoric times.

The deliberate use of biological agents against enemies has been practiced time and time again throughout history to lethal effect.

Acts of ancient biological warfare generally fall into three categories: deliberate contamination of water sources and food supplies with poisons or contagions; the use of toxins and microbes from plants and animals on a weapon; and the purposeful infection of goods and people with disease.

Aboriginals have long coated arrowheads and spear points with plant and animal toxins, from frog or snake. In prehistoric times toxins were used on hunting weapons to quicken the death of enemies or prey. As the advantages of poison became clear, tools and weapons were specifically constructed for poisons. In fact, the word “toxin” itself comes from the ancient Greek term for arrow poison.

The black-legged dart frog is a species whose secretions are used in the preparation of poison darts. Luis Miguel Bugallo Sánchez, (CC BY-SA 3.0)

The ways in which tribes, nations, and civilizations plotted with biological agents against foes are beyond numerous, and include an ancient Hindu treatise advising poisoning the food of enemies, second century BC writings in China advocating the use of a “soul-hunting fog” through the burning of toxic vegetables, and tactics in ancient Greece encouraging the tainting of vital aqueducts with the harmful hellebore flower.

Tools of Infection, Illness, Disease and Terror

In antiquity there was an incomplete understanding of the spread of disease, but it was believed the rotting corpses of animal or man were sources of illness. Scythian archers dipped their arrows in rotting bodies and in feces-tainted blood as far back as 400 BC. Later, English Longbowmen would stab their arrows in the ground in front of them, arrowheads in the dirt, so not only could they be drawn and fired quickly, but the points would be unclean, increasing the likelihood of infection in the unfortunate target.

From 300 BC, Greek, Roman, and Persian warriors were said to contaminate water wells with feces and animal carcasses.

In the 14th century The Black Death, or the plague, swept through Europe, the Near East, and North Africa, resulting in the widest-spread health disaster in history, killing 75 to 200 million people. It is harrowing to realize that a part of the terrible pandemic was due to the deliberate infection of populations during warfare.

Dead bodies were flung over the walls of besieged cities in attempts to terrify, and to introduce intolerable stench (the smell itself was thought to carry disease), rot, and infection to the enemy.

Citizens of Tournai, Belgium bury plague victims. (Public Domain)

Based on a 14th century account by the Genoese Gabriele de' Mussi, it is said that in 1343 a war erupted between the Genoese and Mongols over control of caravan trade routes between the Black Sea and the Orient. The Mongols attacked Caffa, a Genoese colony in Crimea, but the sieging armies also had to contend with the Black Plague which had ravaged their numbers. In the end, the Mongols could not sustain the years-long attack, but as a parting shot they hurled "mountains" of plague-ridden dead across the walls with the intent of infecting the whole of the city with stench alone. It is said plague devoured the population inside the city walls. This nasty tactic has been repeated many times since then, even as late as 1710 when Russians besieging Swedish forces in Estonia allegedly catapulted dead plague victims into the city of Reval.

Beasts of Biological Warfare

Animals also played a large role in biological warfare.

They were not only used as a weapon of killing and war due to their natural venoms, but they also served as vessels for disease and plague.

In the region that is now Turkey, the ruling Hittites purposefully left infected sheep outside enemy cities in 1325 BC. The sheep carried tularemia, known as rabbit fever – a dangerous disease which remains incurable today. When the locals ate the sheep, or bred them with their own stock, the infection spread like wildfire, killing many. A weakened population cannot defend a city.

Much like the legendary tale of the Trojan Horse, in which a large, wooden, horse-shaped construction allowed the infiltration of Greek soldiers into the city of Troy to the Trojans' ultimate loss, real, disease-carrying horses were flung by catapult in the attack on the castle of Thun L'Eveque in northern France in 1340.

The venomous snake appears in myth and history around the world, and the Carthaginian leader, Hannibal, used the deadly serpent as a weapon of bio-terror. In 184 BC Hannibal won the battle of Eurymedon against King Eumenes II of Pergamon. The cunning commander placed poisonous snakes into clay pots and hurled them onto the decks of enemy ships. When the pots shattered, the snakes both terrified and struck at enemy sailors.

Roman mosaic depicting young man with snakes. 5th century AD. (GFreihalter/CC BY-SA 3.0)

From Ancient to Modern War

Biological warfare was allegedly used deliberately by the British forces in their dealings with the Native Americans in 1763. According to correspondence between British officers, blankets tainted with smallpox were purposefully given to Native Americans at diplomatic talks during the French and Indian War. The British knew the Native Americans were uniquely vulnerable to the deadly virus, and the British commanding general Sir Jeffrey Amherst ordered the use of smallpox in order to prevent sieges on British forts by the Native Americans. The disease did notoriously ravage the indigenous populations of the New World.

Iroquois Native Americans engaging in trade with Europeans, 1722. (Public Domain)

Truly warfare, and the history of the world, has been shaped by humanity's practice of biological warfare. It is a tactic that remains in use today, with or without treaties, regulation or law, for the very reason that it is so devastatingly effective.

References

Scutti, S., 2015. Biological Weapons: Tracing Their Evolution From Ancient History To The Present. Medical Daily [Online] Available at: http://www.medicaldaily.com/biological-weapons-tracing-their-evolution-ancient-history-present-336426

Hooker, E., MD, DrPH, 2014. History of Biological Warfare. eMedicineHealth [Online] Available at: http://www.emedicinehealth.com/biological_warfare/article_em.htm

Lenhart, K., MD, PhD, Colonel, MC, US Army, et al, 2007. Medical Aspects of Biological Warfare – Textbooks of Military Medicine [PDF] Available at: http://documents.theblackvault.com/documents/biological/MedAspectsBio.pdf

Wheelis, M. 2002. Biological Warfare at the 1346 Siege of Caffa. CDC [Online] Available at: http://wwwnc.cdc.gov/eid/article/8/9/01-0536_article

Willyard, C., 2011. Ancient Forms of Biological Warfare. Last Word on Nothing [Online] Available at: http://www.lastwordonnothing.com/2011/03/07/ancient-forms-of-biological-warfare/

Tipón, Peru and the Hydro Engineering Marvel of the Inca

TECH: Hydro Engineering

"Eyes" watch as you tour ancient cave with majestic natural features

ANCIENT-ORIGINS | Bryan Hilliard

Tipón is one of the most captivating archaeological sites in Peru and reflects the awe-inspiring accomplishments of the Inca Empire. While traces of occupation at Tipón date back thousands of years, its most impressive development occurred about 500 years ago, when it became a self-contained, walled settlement that served as an estate for Inca nobility. Inside the settlement lay beautiful royal rooms, canals, plazas, aqueducts, and great water fountains, which all turned a remote mountainside into an engineering marvel.

It was also a place for ceremonial and religious purposes. Today, some of these structures still exist, and stand as a testament to the Inca's mastery of irrigation and hydraulic technology.

The spectacular engineering site of Tipón, Peru. (AgainErick/CC BY-SA 3.0)

The Inca Empire once occupied a vast region centered in and around the capital of Cusco, in modern day southern Peru, and existed for over a century. It extended across parts of Colombia, Ecuador, Peru, Bolivia, Chile, and Argentina and was the largest empire in pre-Columbia America. The Inca were skilled engineers and craftsmen who built a network of roads linking the distant provinces of the empire together, as well as sophisticated water collection systems for harvesting rainwater, groundwater, and natural springs. Nowhere is this technology more beautifully preserved than at the ancient site of Tipón.

A water spout in Tipón has withstood the test of time. Sophisticated engineering sorted the water into different paths and filling different areas. CC BY 2.0

According to legend, the origins of Tipón can be traced to one of the royal gardens that Viracocha, the supreme God of the Incas, ordered to be built. Since the language of the Incas was not a written one, it is impossible to know the exact meaning of the word. However, some believe the origin may come from the Quechua word *Timpuj* which means "to be boiling", and relates to the water flowing out of the fountains as though liquid was boiling. Others say Tipón could have been the Royal House of Yahuar Huaca, who retreated here after being defeated by the Chancas.

Tipón is located 25 kilometers (15.5 miles) from Cusco in a ravine high above the Cusco Valley, ranging in elevation from 10,700 to 13,000 feet (3261 – 3962 meters). The highest point, Cruzmoqo, once served as a military observance post and place of religious significance, and mysterious ancient petroglyphs from 2000 BC still decorate the volcanic rock there. While the Inca constructed the sophisticated settlement in Tipón in around 1400 AD, the site's prehistoric importance is well established and can be traced back to between 6000 and 4000 BC.

The many-leveled terraces of the Tipón Incan agricultural site. (CC BY 2.0)

The site of Tipón is made up of thirteen terraces flanked by polished stonewalls, enormous agricultural terraces, canals, and decorative waterfalls. Every archaeological complex features well-built canals which channeled and distributed water throughout the settlement. There are various baths and irrigation channels that still function today, providing the archaeological site with an endless stream of running water. The outer wall at Tipón, measures 15 to 20 feet (4.5 to 6 meters) high and nearly four miles (6.4 kilometers) long, encircling the entire community. This wall also indicates that a large labor force was once used, representing a major construction achievement in and of itself. However, evidence points to it being built by an earlier people who pre-dated the Incas.

Today, many of the water channels at Tipón are still as functional as they are beautiful. (CC BY 2.0)

During the earlier period of the Incas, palaces, temples and fortresses were built. The people designed buildings, waterworks, and large structures to be visually and functionally in touch with the natural environment around them. In planning a place that would integrate water, soil, agriculture, and topography together, the Inca created a water garden at Tipón.

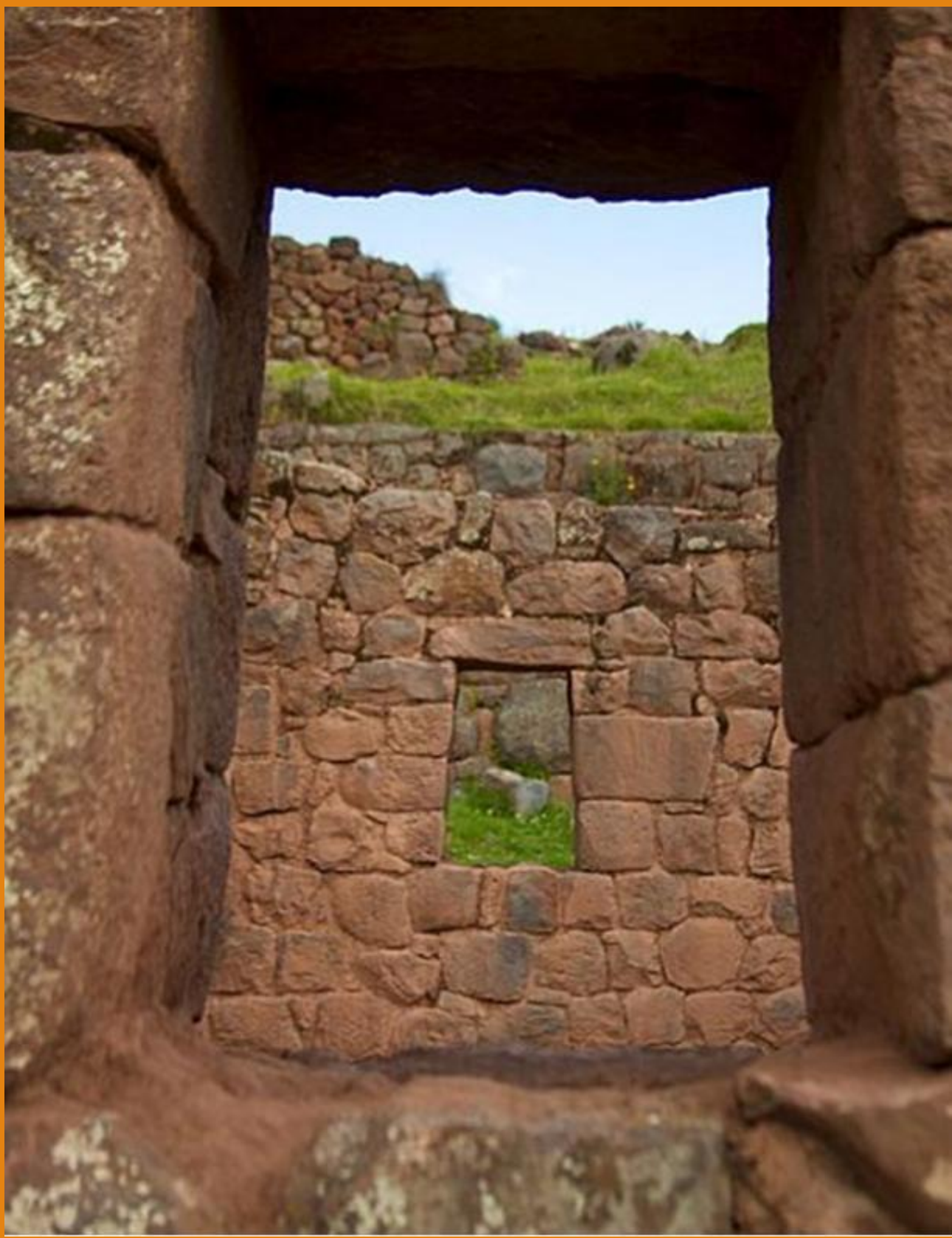
One of the best examples of their advanced hydraulic engineering constructions is at the Tipón Inca Palace. It has been built in the imperial Inca style and has trapezoidal doors which are serviced by finely cut stone fountains similar to those found at Machu Picchu. These large structures were created from massive, tight fitting stones.

The lower sector of the Tipón ruins is comprised of a series of agricultural terraces, watered by stone-lined channels, all of which are preserved today. At the back of the lower ruins, water flows from a stone-faced “mouth” around a spring which is probably an aqueduct diverted underground from above. The entire complex is designed around this spring and reached by a path from the last terrace.

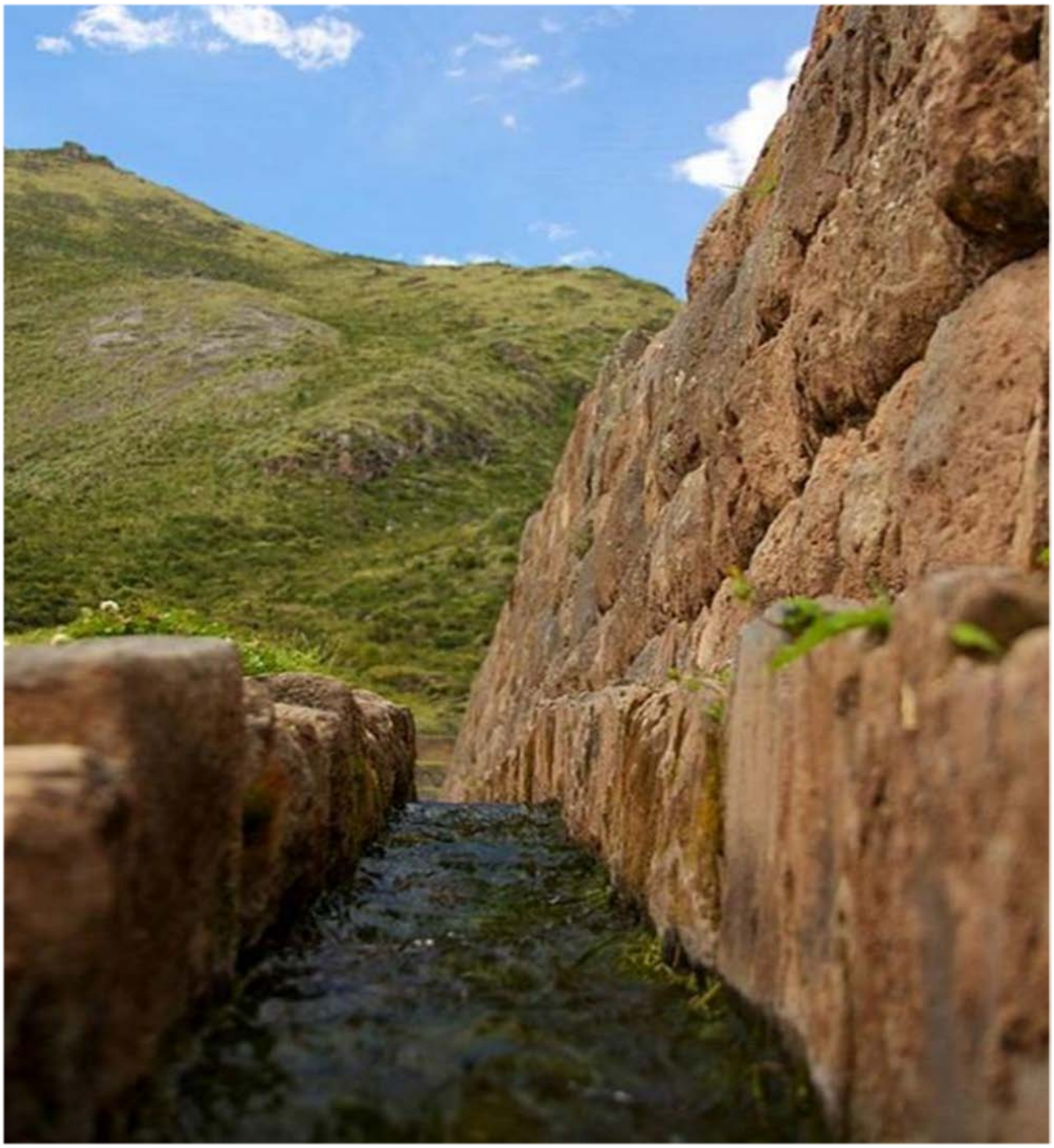
Another sector of the ruins contains a reservoir and temple block centered on a large, exposed volcanic rock which is thought to be some kind of huaca (temple) or burial place. Off the back of the reservoir, a large stone aqueduct crosses a small crevasse before continuing uphill to an area of unexcavated terraces and dwellings.

Beyond these exists another level of the upper valley covered in Inca terracing, dwellings and stone storehouses. Similar in size to the lower ruins, they are used by locals today who have built their own houses among the ruins.

Tipón was a settlement which was not built overnight, but whose technology and culture was drawn from much earlier Andean civilizations and can be traced back many millennia. Millions of people once lived within the Inca empire and of these, a few settled at Tipón during the reign of the Inca. With the arrival of the Spanish and the collapse of the empire, Tipón was not entirely abandoned and was used by the Quechua Indians, the direct descendants of the Inca. Today, it lies in the heart of what is known as the Sacred Valley. This area was considered sacred in Inca Times because of the astronomical relation with the Milky Way which, at certain times of the year, arcs high above the picturesque valley.



The well-constructed remains of an old Inca house at Tipón (CC BY 2.0)



Bubbling freshwater flows through an ancient water channel at Tipón (CC BY 2.0)

References

Wright, Kenneth R., and Gordon Francis McEwan. "Tipón: Water Engineering Masterpiece of the Inca Empire". Reston, Va.: American Society of Civil Engineers, 2006.

"The Tipón Temples and Aqueducts | Cusco and around Guide." The TipÃ³n Temples and Aqueducts. Accessed May 8, 2015.

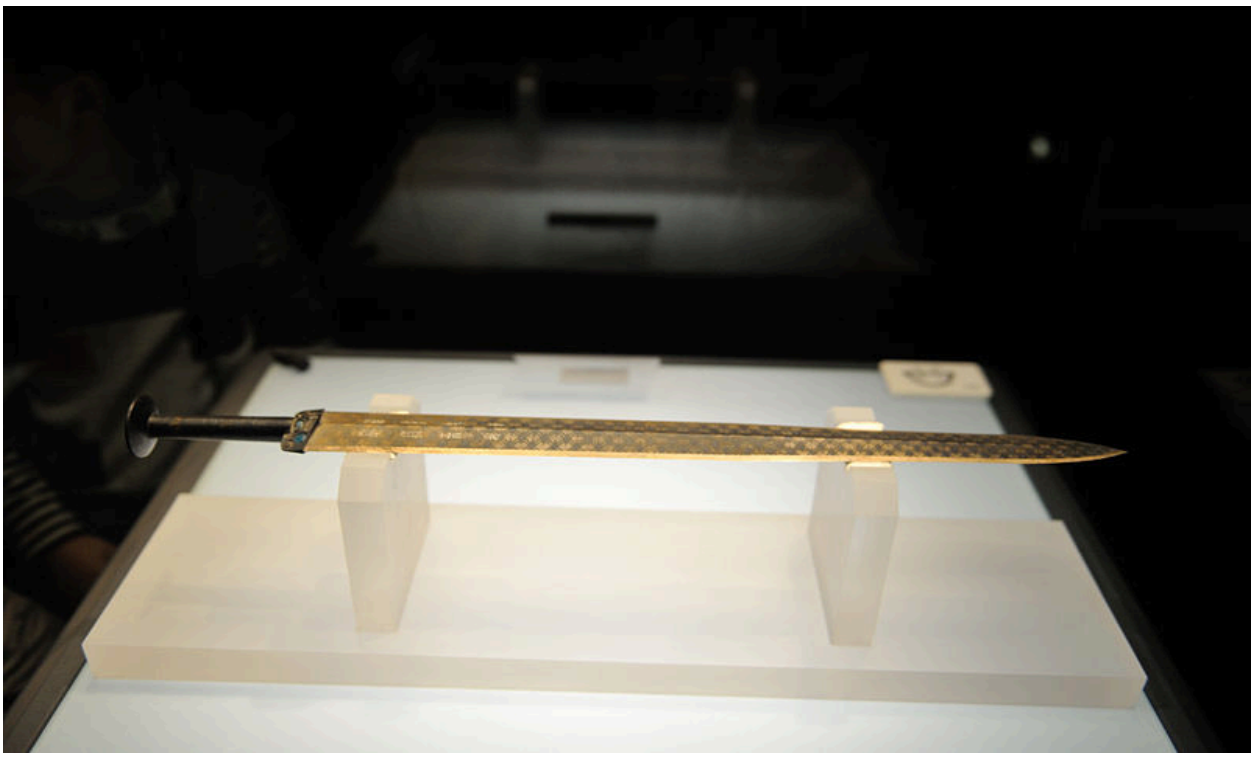
"Tipón, Cusco Peru, Machu Picchu, Machupichu Cusco, Cuzco Peru, Cusco Travel Information." Tipón, Cusco Peru, Machu Picchu, Machupichu Cusco, Cuzco Peru, Cusco Travel Information. Accessed May 8, 2015.

Goujian: The Ancient Chinese Sword that Defied Time

WEAPON: Legendary Sword of Goujian

Ancient craftsmanship kept sword razor sharp after millennia

ANCIENT-ORIGINS | Bryan Hilliard



Sword of Goujian, Hubei Provincial Museum (CC BY-SA 4.0)

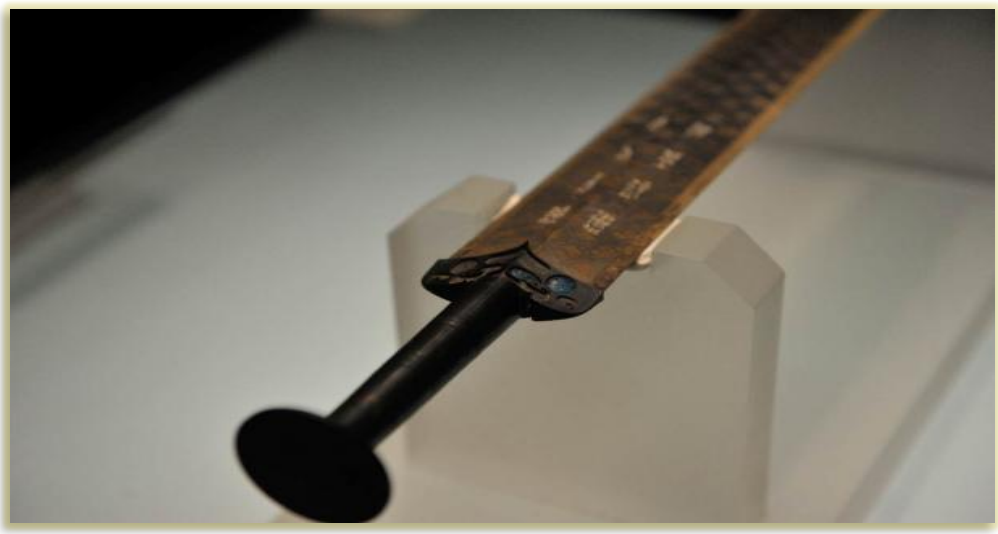
Fifty year ago, a rare and unusual sword was found in a tomb in China. Despite being well over 2,000 years old, the sword, known as the Goujian, did not have a single trace of rust. The blade drew blood when an archeologist tested his finger on its edge, seemingly unaffected by the passage of time. Besides this strange quality, the craftsmanship was highly detailed for a sword made such a long time ago. Regarded as a state treasure in China today, the sword is as legendary to the Chinese people as King Arthur's Excalibur in the West.

In 1965, archaeologists were carrying out a survey in Hubei province, just 7 kilometers (4 miles) from the ruins of Jinan, capital of the ancient Chu state, when they discovered 50 ancient tombs. During the excavations of the tombs, researchers unearthed the sword of Goujian alongside 2,000 other artifacts.

Discovery of the Goujian

According to the leader of the archeological team responsible for the excavation, it was discovered in a tomb, in a near air-tight wooden box next to a skeleton. The team was stunned when the perfectly preserved bronze sword with scabbard was removed from the box. When it was unsheathed, the blade was revealed to be untarnished despite being buried in damp

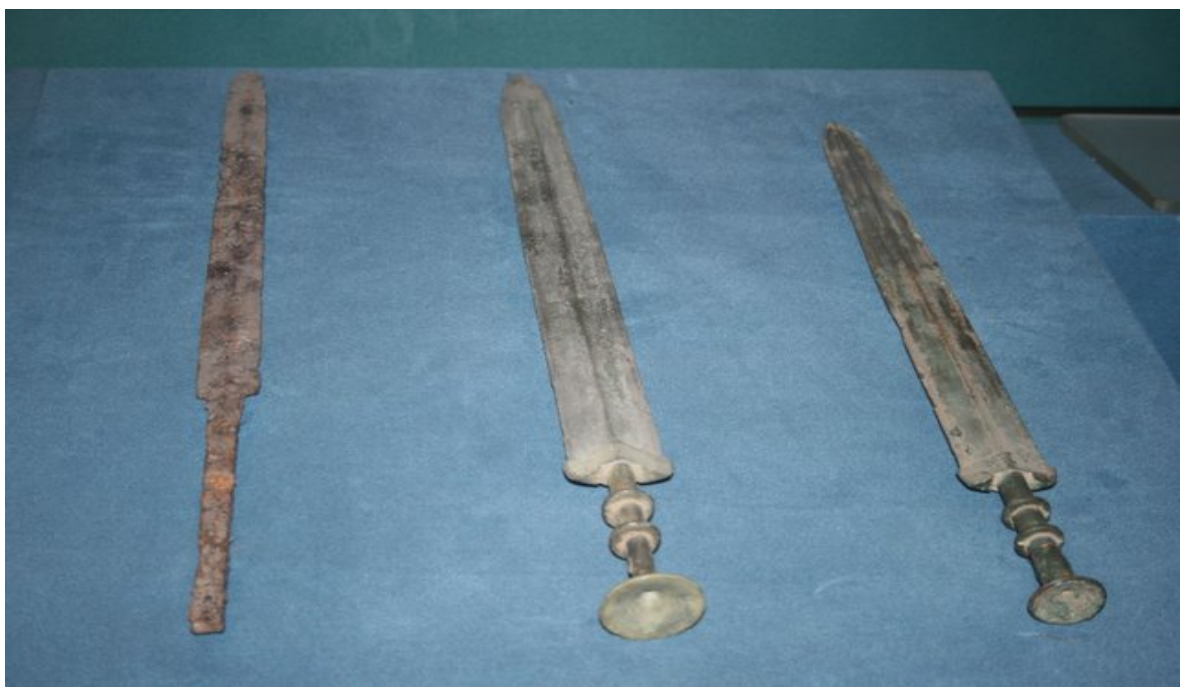
conditions for two millennia. A test conducted by the archaeologists showed that the blade could easily cut a stack of twenty pieces of paper.



Amazing weapon of the ancient world. (CC BY-SA 4.0)

Jian swords

The Sword of Goujian is one of the earliest known Jian swords, a double-edged straight sword used during the last 2,500 years in China. Jian swords are among the earliest sword types in China and are closely associated with Chinese mythology. In Chinese folklore, it is known as "The Gentleman of Weapons" and is considered one of the four major weapons, along with the staff, spear, and the sabre.

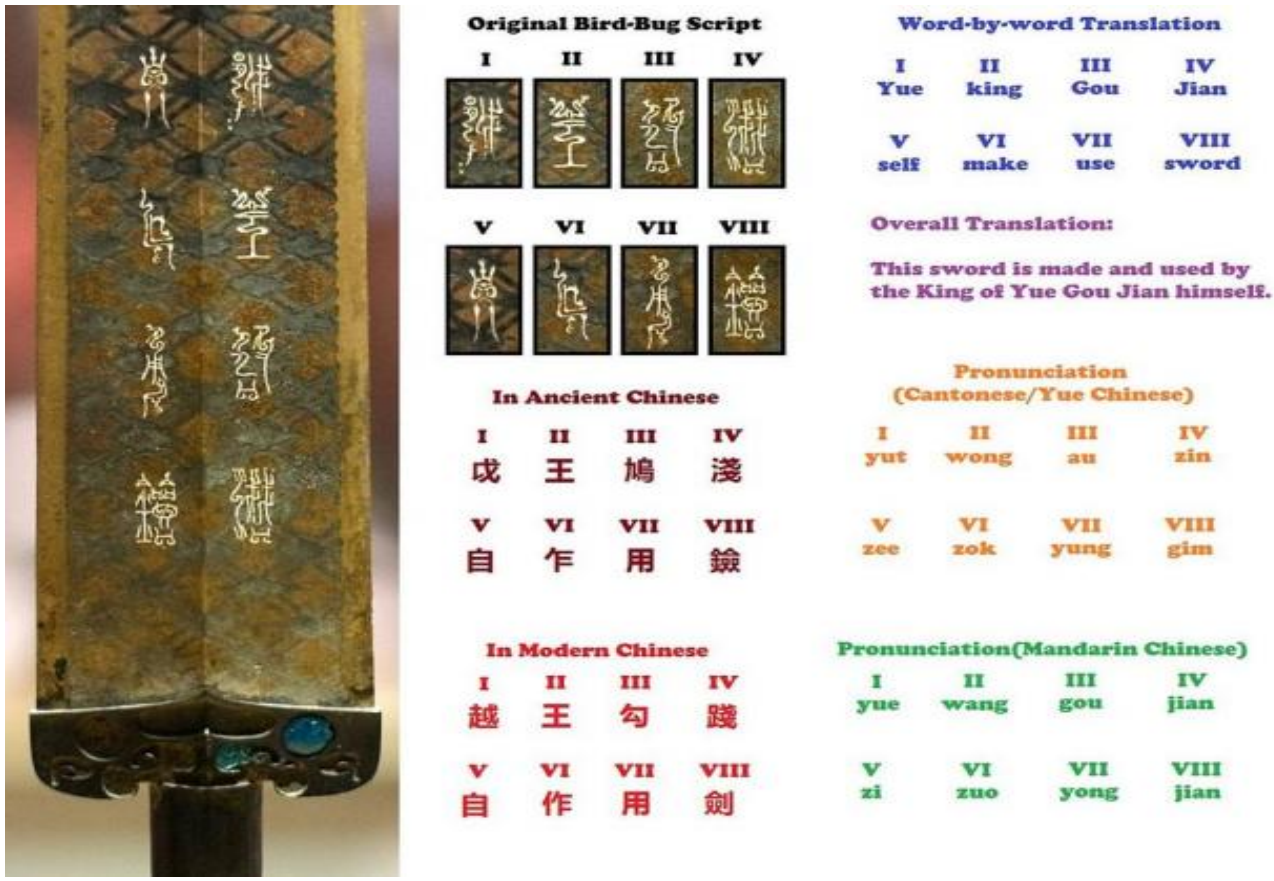


An iron sword and two bronze swords from the Chinese Warring States Period. (Professor Gary Lee Todd/CC BY-ALL)

Relatively short compared to similar historical pieces, the Gouijan sword is a bronze sword with a high concentration of copper, making it more pliant and less likely to shatter. The edges are made of tin, making them harder and capable of retaining a sharper edge. There are also small amounts of iron, lead and sulfur in the sword, and research has revealed a high proportion of sulfur and sulfide cuprum, which gives the sword its rustproof quality. Black rhombic etchings cover both sides of the blade and blue glaze and turquoise is imbedded on the sword handle. The grip of the sword is bound by silk while the pommel is composed of 11 concentric circles. The sword measures 55.7 centimeters long (21.9 inches), including an 8.4 centimeter (3.3 inch) handle hilt, and has a 4.6 centimeter (1.8 inch) wide blade. It weighs 875 grams (30.9 ounces).

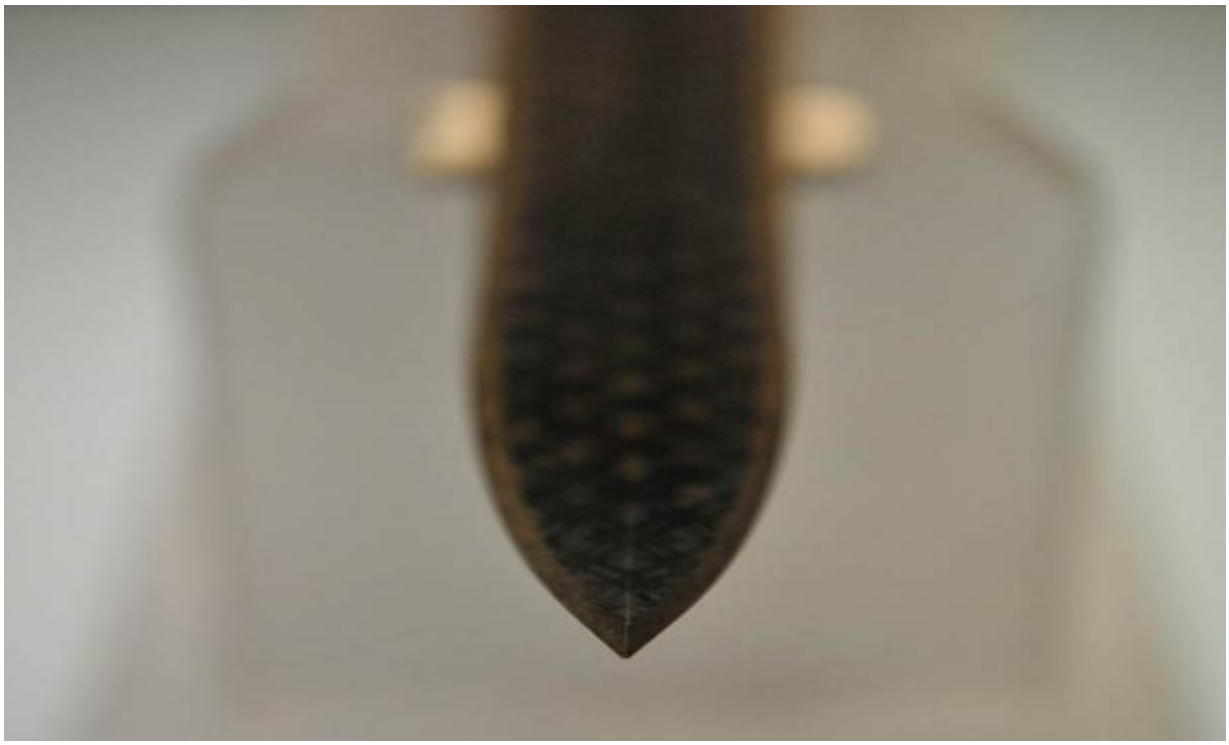
Deciphering the inscription

On one side of the blade, two columns of text are visible with eight characters, near the hilt, that are in ancient Chinese script. The script, known as "鸟虫文" (literally "'birds and worms' characters") is characterized by intricate decorations to the defining strokes, and is a variant of zhuan that is very difficult to read. Initial analyses deciphered six of these eight characters. They read, "越王" (King of Yue) and "自作用剑" ("made this sword for (his) personal use"). The remaining two characters are likely the name of the king.



Deciphering the scripts on the Sword of Goujian. Turquoise can be seen embedded in the sword's handle. (Yutwong/CC BY-SA 3.0)

From its birth in 510 BC to its demise at the hands of Chu in 334 BC, nine kings ruled Yue, including Goujian, Lu Cheng, Bu Shou, and Zhu Gou, among others. The identity of the king that owned the sword sparked debate among archaeologists and Chinese language scholar. After more than two months, the experts formed a consensus that the original owner of the sword was Goujian (496 – 465 BC), making the sword around 2,500 years old.



The Goujian sword is as sharp today as it was over two millennia ago (CC BY-SA 4.0)

Goujian was a famous emperor in Chinese history who reigned over the Yue State during the Spring and Autumn Period (771 - 476 BC). This was a time marked by chaos within the Zhou Dynasty and takes its name from the *Spring and Autumn Annals,* which chronicled this period. The Spring and Autumn Period was renowned for military expeditions; these conflicts led to the perfecting of weapons to the point that they were incredibly resistant and deadly, taking years to forge and lasting for centuries. The story of Goujian and Fuchai, King of the Wu state, contending for hegemony is famous throughout China. Although Goujian's kingdom was initially defeated by the State of Wu, Goujian would lead his army to victory 10 years later.

Unique properties

Besides its historic value, many scholars have wondered how this sword could have remained rust-free in a humid environment, for more than 2,000 years, and how the delicate decorations were carved into the sword. The sword of Goujian is still as sharp today as when it was originally crafted, and not a single spot of rust can be found on the body today.

Researchers analyzed ancient bronze shards in the hope of finding a way to replicate the technology used to create the sword. They found that the sword is resistant to oxidation as a result of sulphation on the surface of the sword. This, combined with an air-tight scabbard, allowed the legendary sword to be found in such pristine condition.

Tests also show that the sword-smiths of the Wu and Yue regions in Southern China during the Spring and Autumn Period reached such a high level of metallurgy that they were able to incorporate rust-proof alloys into their blades, helping them survive the ages relatively unblemished.

The sword was lent to the National Palace Museum in Taipei where it was on display until 2011, along with various other bronze pieces from the excavation. It is currently in the possession of the Hubei Provincial Museum.

References

"Sword of Goujian." HistoriaRex.com. [Online] Available at: http://historiarex.com/e/en/89-sword-of-goujian

"Sword of Swords: The Sword of Goujian." China Culture. [Online] Available at: http://www.chinaculture.org/gb/en_curiosity/2004-06/23/content_47488.htm

Andrei, Mihai. "The Sword of Goujian - Untarnished after 2700 Years." ZME Science. October 21, 2011. [Online] Available at: http://www.zmescience.com/science/archaeology/sword-goujian-21102011/

Kalamidas, Thanos. "The Blade That Defeated Millennia." Gbtimes.com. April 17, 2013.[Online] Available at: http://gbtimes.com/life/blade-defeated-millennia

The enigma of the Roman Dodecahedra

GADGET: Roman Dodecahedra
What was the purpose of the mysterious, oddly-shaped Roman artifact?

ANCIENT-ORIGINS | Federico Cataldo

The strange and puzzling Roman dodecahedron. (BigStockPhoto)

The Roman dodecahedron is a small, hollow object made of bronze or (more rarely) stone, with a geometrical shape that has twelve flat faces. Each face is a pentagon, a five-sided shape. The Roman dodecahedra are also embellished with a series of knobs on each corner point of the pentagons, and the pentagon faces in most cases contain circular holes in them. More than 200 years after they were first discovered, researchers are no closer to understanding the origin and function of this mysterious object.

The Roman dodecahedra date from the second or third centuries AD, and typically range from 4 centimeters to 11 centimeters (1.5 – 4 inches) in size. To date, more than one hundred of these artifacts have been found across Great Britain, Belgium, Germany, France, Luxembourg, Netherlands, Austria, Switzerland, and Hungary.

An incomplete cast copper alloy dodecahedron (1 – 400 AD), discovered by a metal detectorist in Yorkshire, England (Portable Antiquities Scheme / CC BY 2.0)

The great mystery is: how do they work and what do they do? Unfortunately, there is no documentation or notes about them from the time of their creation, so the function of these dodecahedra has not been determined. Nevertheless, many theories and speculations have been put forward over the centuries: candlestick holders (wax was found inside one example), dice, survey instruments, devices for determining the optimal sowing date for winter grain, gauges to calibrate water pipes or standard army measurements, staff or scepter decorations, a toy to throw and catch on a stick, or simply a geometric sculpture. Among these speculations, some deserve attention.

One of the most accepted theories is that the Roman dodecahedron was used as a measuring device, more precisely as a range measuring object on the battlefield. The hypothesis is that the dodecahedron was used for calculating the trajectories of projectiles. This could explain the different sized holes in the pentagrams. A similar theory involves dodecahedra as a surveying

and leveling device. However, neither of these theories has been supported by any proof and exactly how the dodecahedron could be used for these purposes has not been fully explained.

One of the more interesting theories is the proposal that dodecahedra were astronomic measuring instruments for determining the optimal sowing date for winter grain. According to G.M.C. Wagemans:

> *"the dodecahedron was an astronomic measuring instrument with which the angle of the sunlight can be measured and thereby one specific date in springtime, and one date in the autumn can be determined with accuracy. The dates that can be measured were probably of importance for the agriculture".*

Nevertheless, opponents of this theory have pointed out that use as a measuring instrument of any kind seems to be prohibited by the fact that the dodacahedra were not standardized and come in many sizes and arrangements.

An enigmatic Roman dodecahedron found in Bonn, Germany. (Hadley Paul Garland / CC BY-SA 2.0)

Another unproven theory claims that the dodecahedra are religious relics, once used as sacred tools for the druids of Britannia and Caledonia. However, there is no written account or archaeological evidence to support this view. Could it be that this strange item was simply a toy or a recreational game for legionnaires, during the war campaigns? Some sources suggest they were the central objects in a bowl game similar to ours of modern times, with these artifacts used as markers and the players throwing stones to land them in the holes within the dodecahedra.

Some believe the purpose of the enigmatic artifact has been solved, as a video published in 2014 demonstrated a fabricated copy of a Roman dodecahedron being used as a type of base upon which a five-fingered glove was knit successfully. However, some skeptical knitters suggest that although a the fingers of the glove were produced, the proportions of the glove would probably not fit anyone but the tiniest of children, and the item also only created knitted fingers, and provided no way to finish the palm of a glove. Was this the solution to the mystery? Or was this ancient item repurposed but not the original intent?

Another discovery deepens the mystery about the function of these objects. Some time ago, Benno Artmann discovered a Roman icosahedron (a polyhedron with twenty faces), misclassified as a dodecahedron on just a superficial glance, and put away in a museum's basement storage. The discovery raises the question about whether there are many other geometric artifacts of different types – such as, icosahedra, hexagons, and octagons – yet to be found in what was once the great Roman Empire.

Despite the many unanswered questions, one thing is certain, the Roman dodecahedra were highly valued by their owners. This is evidenced by the fact that a number of them were found among treasure hoards, among coins and other valuable items. We may never know the true purpose of the Roman dodecahedra, but we can only hope that advances in archaeology will unearth more clues that will help solve this ancient enigma.

References

"The Roman dodecahedron – Legends and Chronicles". Available from: http://www.legendsandchronicles.com/ancient-artifacts/the-roman-dodecahedrons/

"Roman dodecahedra."George Hart. Virtual Polyhedra: The Encyclopedia of Polyhedra. Available from: http://www.georgehart.com/virtual-polyhedra/roman_dodecahedra.html

Has The Roman Dodecahedron Mystery Been Solved? – Gralien Report. Available from: http://www.gralienreport.com/ancient-mysteries-2/man-solved-roman-dodecahedron-mystery/

"The Roman Pentagon Dodecahedron: An Astronomic Measuring Instrument for Determining the Optimal Sowing Date for Winter Grain." By G.M.C. Wagemans. Available from: http://www.romandodecahedron.com/the-hypothesis

Superweapon of the Ancient World: A History of Chariots

WEAPON: Chariots
The incredible ancient superweapon that changed warfare and history

ANCIENT-ORIGINS | Dhwty

The chariot is often associated with the ancient Egyptian civilization. It became a prominent weapon of war during the New Kingdom. In fact, it is often considered a superweapon of the ancient world.

Some have speculated that the chariot was introduced by the invading Hyksos (although there is no factual evidence to support this claim). The history of the chariot, however, stretches back more than a millennium prior to its introduction into ancient Egypt. Additionally, one has to travel to the west of Egypt's borders to discover its ancient origins.

In 1927/8, the British archaeologist, Sir Leonard Woolley was excavating the Royal Cemetery of Ur in modern day Iraq, when he discovered an artifact known today as the Royal Standard of Ur (dated to the third millennium BC). Portrayed on one side of this artifact is the Mesopotamian war machine, which included four-wheeled, cart-like structures being pulled by four donkeys. The artist even demonstrates the use of this weapon by depicting it in different states of motion. Thus, the donkeys, first shown walking, begin to trot, and then break into a gallop. To clarify that this was a weapon of war, the artist adds a trampled enemy or two under it for good measure. This is one of the earliest known depictions of the chariot, though it is far different from the ones used by the Egyptians. Apart from the fact there were four instead of two wheels, another big difference was that the wheels of these Mesopotamian chariots were solid rather than spoked. In a way, these may be regarded as 'proto-chariots'.

E Lawrence with Leonard Woolley, the archaeological director, with a Hittite slab on the excavation site at Carchemish near Aleppo before the First World War. An archer riding a chariot can be seen on the slab. (Public Domain)

Standard of Ur, 26th century BC. Bottom panel depicts chariots in action. (Public Domain)

It has been commonly assumed that the wheel was further improved in the Near East, and contributed to the development of the chariot into the type we are more familiar with today.

Representations of chariots, for instance, can be found on Anatolian seal impressions from the second millennium BC. Unlike their Mesopotamian predecessors, these chariots have wheels with four spokes. Archaeological investigation, however, has suggested that this stage of chariot development occurred at an earlier time in the Eurasian steppes. The excavation of *kurgans* (elite graves covered by earth mounds) of the Sintasha-Petrovka culture have yielded objects believed to be chariots. While the chariots themselves have decayed into dust, the lower part of their wheels left an imprint of their shape and design into slots cut for them in the dirt floor of the burial chamber. Some parts of the chariot structure were also preserved in this way. It has also been pointed out that they might not have been used in military campaigns, but in ritual races to settle disputes or win prizes, which was an Aryan practice.

Cybele drawn in her chariot by lions towards a votive sacrifice (right). Above are the Sun God and heavenly objects. Plaque from Ai Khanoum, Bactria (Afghanistan), 2nd century BCE. (Public Domain)

Indeed, the chariot was more than just an effective killing machine. During the ninth century BC for instance, chariots were being used as shock troops by the Assyrians. By the following centuries, however, the chariot's role on the battlefield was superseded by more efficient cavalry units. Nevertheless, chariots were still retained by the Assyrians. Instead of using them on military campaigns, chariots were used as prestige or ceremonial vehicles.

Scene from Ashurbanipal (668-627 BC) campaign against the Elamite city Hamaru, shows an Assyrian chariot with charioteer and archer protected from enemy attack by shield bearers. Assyrian relief from Nineveh. Alabaster relief, made about 650 BC. (CC BY-SA 3.0)

For example, a relief decorating a room in the palace of Ashurbanipal at Nineveh shows the king in his ceremonial chariot (topped with a parasol) presiding over the deportation of the conquered Elamites. Another relief from the palace shows that chariots were also used by the Assyrians during their lion hunts. It was not only the Assyrians who viewed chariots as luxury goods. About half a millennium before the reign of Ashurbanipal, Egyptian tombs at Amarna contain reliefs depict the pharaoh Akhenaten (who was not known as a warrior king) and his wife, Nefertiti, riding on chariots.

Ramses II at the Battle of Kadesh rides a chariot (relief at Abu Simbel). (Public Domain)

Other pharaohs, however, used chariots in warfare, the most famous perhaps being Ramesses II at the Battle of Kadesh, where both the Egyptians and their enemies, the Hittites, had chariots in their armies. The chariots of the Egyptians, however, were much different than those of the Hittites. Unlike the Hittite chariots, the Egyptian carriages were lighter and faster.

Orthostat relief in basalt; battle chariot, Carchemish, 9th century BC; Late Hittite style with Assyrian influence. (CC BY 2.0)

Among the reasons for these modifications is that the Egyptian chariots were used primarily used to protect the infantry, and that the terrain of Egypt and Canaan was not suitable for the deployment of heavy chariots. Instead of using them to charge into the enemies, the Egyptian chariots were used as mobile firing platforms. The warrior in the chariot was armed with a bow and arrows as well as several short spears. In addition to effectively raining a hail of arrows on the enemy before quickly moving away, the Egyptian chariot was also perfectly suited to chasing down fleeing enemies.

While most people are aware of the use of chariots in the ancient Near East, it is perhaps relatively less well-known that chariots were also used by other ancient societies.

PART II

Power and Prestige across Asia: A History of Chariots

According to written sources from ancient China, the chariot is reported to have been first used during the Xia dynasty. A Xia minister by the name of Xi Chong is credited with its invention, and the chariot is also said to have been deployed during the Battle of Gan in the 21st century BC. Much of the Xia dynasty is still a mystery, and some scholars have even expressed skepticism regarding the existence of this dynasty. The notion that the chariot was invented during this period of Chinese history is no exception.

A section of a Chinese Eastern Han Dynasty (25–220 AD) fresco of 9 chariots, 50 horses, and over 70 men, from a tomb in Luoyang, China, which was once the capital of the Eastern Han. (Professor Gary Lee Todd/CC BY-SA ALL)

With regards to archaeology, it has been suggested that, at earliest, the chariot was introduced around 1200 BC, which corresponds with the reign of King Wu Ding of the Shang dynasty. This dating is based on a curious artifact known as a “bow-shaped implement” discovered in several chariot pits. These artifacts have also been found in more readily datable contexts, including the Tomb of Fu Hao, where oracle-bone inscriptions provide a reliable date.

Archaeologists have also speculated that the chariot was not a Chinese invention, but imported from the Caucasus via Central Asia. Two important technical similarities have been pointed out between these two types of chariots. Firstly, the wheels of both types of chariots had between 18 to 28 spokes. Secondly, the position of the axle in these chariots was under the middle of the chariot box. By comparison, chariots from elsewhere in the Bronze Age world normally had wheels with only four to eight spokes. Additionally, their axles were located at the rear, rather than under the middle of the chariot box.

Chariots for combat

It has been suggested that the chariot performed different functions during its usage in Chinese history. Originally, the chariot was used as a symbol of prestige and a vehicle for hunting, much like the Assyrians during the eighth and seventh centuries BC. Unlike the Assyrians, however, the Chinese chariot was gradually used as a weapon in war. In its initial stages, the chariot is said to have been used as a mobile command platform, in line with its role as a status symbol. During the Zhou dynasty, however, the use of chariots in warfare became more widespread,

and may have played a decisive role in the overthrow of the Shang dynasty during the 11th century BC. By the time of the Spring and Autumn period (between the eighth and fifth centuries BC), chariot warfare, in which chariots were pitted against chariots, had spread throughout China.

Bronze driver, horses, and chariot found at the necropolis complex of Emperor Qin Shi Huang. (CC BY 1.0)

Unlike the Near East, however, chariot tactics are a little less clear in China. It is known that each chariot had a crew of three men – a driver, an archer and a warrior for close combat. To increase the effectiveness of the chariot on the battlefield, each chariot commander was usually allocated a contingent of infantry, with whom he could coordinate attacks on the enemy. By the third century BC, however, the chariot had become obsolete, and was replaced by cavalry. Yet, the role of the chariot as a prestige object remained, as evidenced by the bronze chariots discovered in the Tomb of Qin Shi Huang.

Indian chariots – the transport of gods

The use of the chariot as a status symbol can also be seen in India. In fact, the Indian chariot (known as a '*ratha*') was not used only by mortals, but was also said to have been used by the gods. Even today, the *ratha* is still used in religious processions in Hinduism. An image of a deity is placed on a *ratha*, and the vehicle is then pulled around in the streets by hundreds of deities in the company of priests and musicians. The most famous celebration involving the *ratha* is the Ratha-Yatra, which is traditionally celebrated in Puri, Odisha. During this celebration, the images of the deities Jaggannath, Balabhadra and Suhadra, are taken out in a procession to the Gundicha Temple in a massive *ratha*.

Painting depicting Ratha Yatra Festival in Puri, India. Circa 1840. (Public Domain)

*Ratha Yatra chariot at traditional Hindu festival still celebrated in modern times. (Jan Smith/**CC** BY 2.0)*

Chariots of the Vedas

In addition to the religious importance of the *ratha*, these vehicles were said to have played an important part in Indian warfare as well. Unlike the chariots from China, however, there are no known archaeological examples of Indian chariots. As a result, our knowledge of chariots in India is derived mainly from literary sources. Although it has been pointed out the chariot may be reconstructed using the scattered references in the Vedic texts, the picture is still incomplete. Nevertheless, some scholars agree with the description of the chariot found in the Vedic Index—a light vehicle with two spoked wheels, drawn by two, occasionally three or four horses. The chariot box was said to have a wooden framework, and was manned by two persons, namely a driver and a warrior.

In front of the Vittala Temple of Hampi, India is the world famous stone chariot or ratha. This is one of three impressive stone chariots in India, the other two found in Konark and Mahabalipuram. The wheels of the ratha could originally be rotated, but they were fixed in place by the government to avoid future damage by visitors. (Jon Hurd/CC BY 2.0)

The chariot was certainly used in ancient Indian warfare, one of the most famous being the Battle of Hydaspes in 326 BC between the Indian king Porus and Alexander the Great. During this battle, Porus was said to have fielded 1000 chariots, though they were rendered useless when their wheels got stuck in the mud. Unfortunately, without further information, we are forced to rely on our own imagination to envision how the Indian war chariot would have looked like when it was used in battles.

A chariot scene from Pakistan, Gandhara region, third century. (Public Domain)

Though the chariot is obsolete as a weapon of war, it remains a symbol of clever ancient engineering, and elevated status and power instantly recognizable in modern times.

References

Bart, A., 2015. The Tombs at Amarna. [Online] Available at: http://euler.slu.edu/~bart/egyptianhtml/tombs/Tombs at Amarna.htm

BBC, 2015. A History of the World in 100 Objects: Standard of Ur. [Online] Available at: http://www.bbc.co.uk/programmes/articles/3kQZrsnD5B7tzLc2P75RVP0/episode-transcript-episode-12-standard-of-ur

Dollinger, A., 2009. The Chariot. [Online] Available at: http://www.reshafim.org.il/ad/egypt/timelines/topics/chariot.htm

Dunn, J., 2015. The Chariot in Egyptian Warfare. [Online]
Available at: http://www.touregypt.net/featurestories/chariots.htm

Noble, D., 2015. Assyrian Chariotry and Cavalry. [Online]
Available at: http://www.helsinki.fi/science/saa/4.1%2006%20Noble.pdf

Plubins, R. Q., 2013. Chariot. [Online]
Available at: http://www.ancient.eu/chariot/

The British Museum, 2015. Stone panels from the North Palace of Ashurbanipal. [Online]
Available at: http://www.britishmuseum.org/explore/highlights/highlight_objects/me/s/stone_panels,_north_palace.aspx

The Louvre, 2015. King Ashurbanipal on his Chariot and Elamite Prisoners. [Online]
Available at: http://www.louvre.fr/en/oeuvre-notices/king-ashurbanipal-his-chariot-and-elamite-prisoners

Wilford, J. N., 1994. Remaking the Wheel: Evolution of the Chariot. [Online]
Available at: http://www.nytimes.com/1994/02/22/science/remaking-the-wheel-evolution-of-the-chariot.html?pagewanted=1

www.historynet.com, 2006. Battle of Kadesh. [Online]
Available at: http://www.historynet.com/battle-of-kadesh.htm

China Internet Information Center, 2015. Mausoleum of Emperor Qinshihuang (259 BC- 210 BC).[Online]
Available at: http://www.china.org.cn/english/features/atam/115132.htm

Kulkarni, A., 2013. Ratha - The Indian Chariot. [Online]
Available at: http://www.ibtl.in/blog/2117/ratha--the-indian-chariot/

Shaughnessy, E. L., 1988. Historical Perspectives on The Introduction of The Chariot Into China.Harvard Journal of Asiatic Studies, 48(1), pp. 189-237.

Sparreboom, M., 1985. Chariots in the Veda. Leiden: E. J. Brill.

The British Museum, 2015. Wooden model of a chariot (ratha). [Online] Available at: http://www.britishmuseum.org/explore/highlights/highlight_objects/asia/w/wooden_model_of_a_chariot_rat.aspx

UNESCO, 2015. Mausoleum of the First Qin Emperor. [Online] Available at: http://whc.unesco.org/en/list/441

www.ancientmilitary.com, 2012. The Military of Ancient India. [Online]
Available at: http://www.ancientmilitary.com/ancient-india-military.htm

Egyptian Blue – The Oldest Known Artificial Pigment

TECH: First Artificial Pigment
Blue was the color of life, fertility, rebirth, and the universe

ANCIENT-ORIGINS | Dhtwy

Egpytian Blue signified the color of the heavens in ancient Egyptian belief. (Public Domain).

Egyptian Blue, also known as calcium copper silicate, is one of the first artificial pigments known to have been used by man.

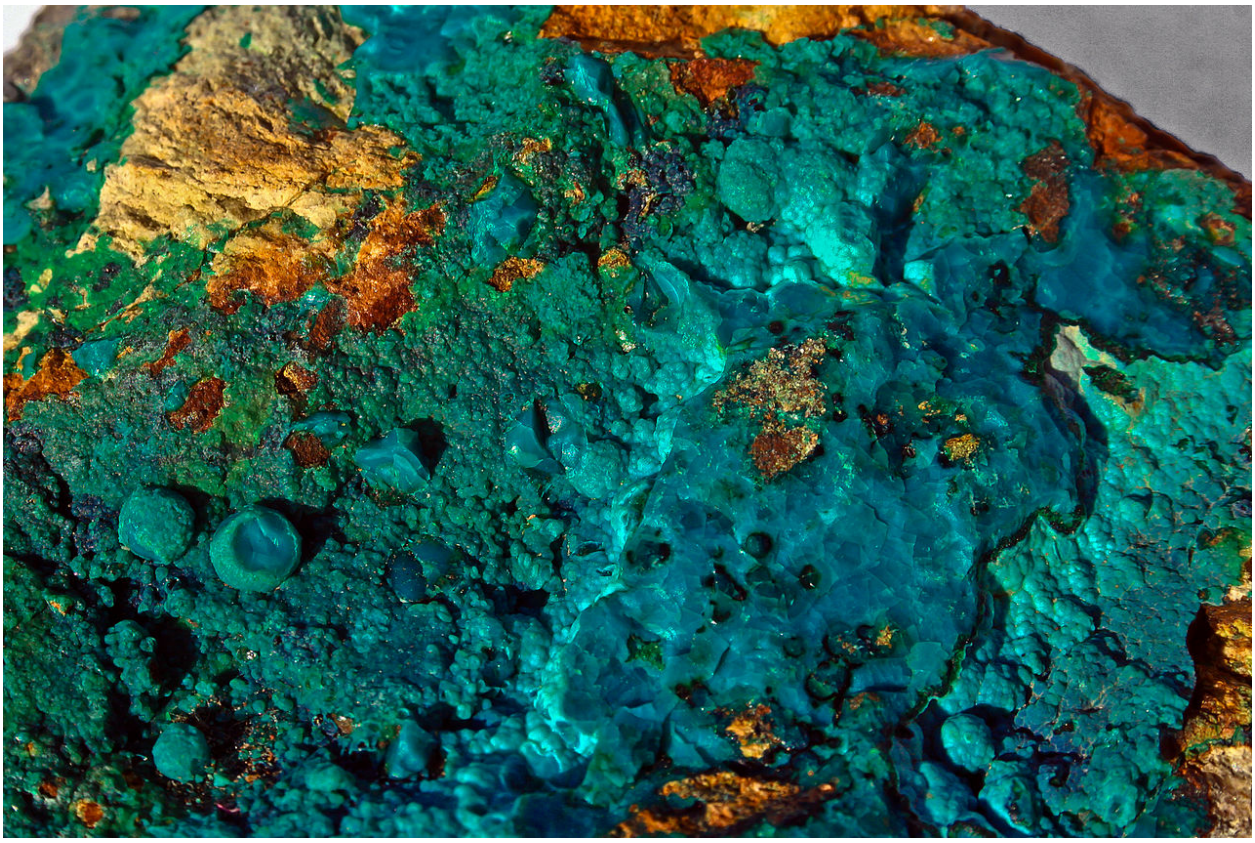
The oldest known example of the exquisite pigment is said to be about 5,000 years old, found in a tomb painting dated to the reign of Ka-Sen, the last pharaoh of the First Dynasty. Others, however, state that the earliest evidence of the use of Egyptian blue is from the Fourth Dynasty and the Middle Kingdom, around 4,500 years ago.

Nevertheless, by the New Kingdom, Egyptian Blue was used plentifully as a pigment in painting and can be found on statues, tomb paintings and sarcophagi.

In addition, Egyptian blue was used to produce a ceramic glaze known as Egyptian faience.

Blue faience hippo, Middle Kingdom (2033-1710 BC) (CC BY-SA 3.0)

Its characteristic blue colour, resulting from one of its main components — copper — ranges from a light to a dark hue, depending on differential processing and composition. If the pigment is ground coarsely, it produces a rich, dark blue, while very finely-ground pigment produces a pale, ethereal blue. It is made by heating a mixture of a calcium compound (typically calcium carbonate), a copper-containing compound (metal filings or malachite), silica sand and soda or potash as a flux, to around 850-950 celcius (1562-1742 fahrenheit).



An array of rich hues are found in copper silicate mineral. (CC BY 3.0)

In Egyptian belief, blue was considered as the color of the heavens, and hence the universe. It was also associated with water and the Nile. Thus, blue was the color of life, fertility and rebirth.

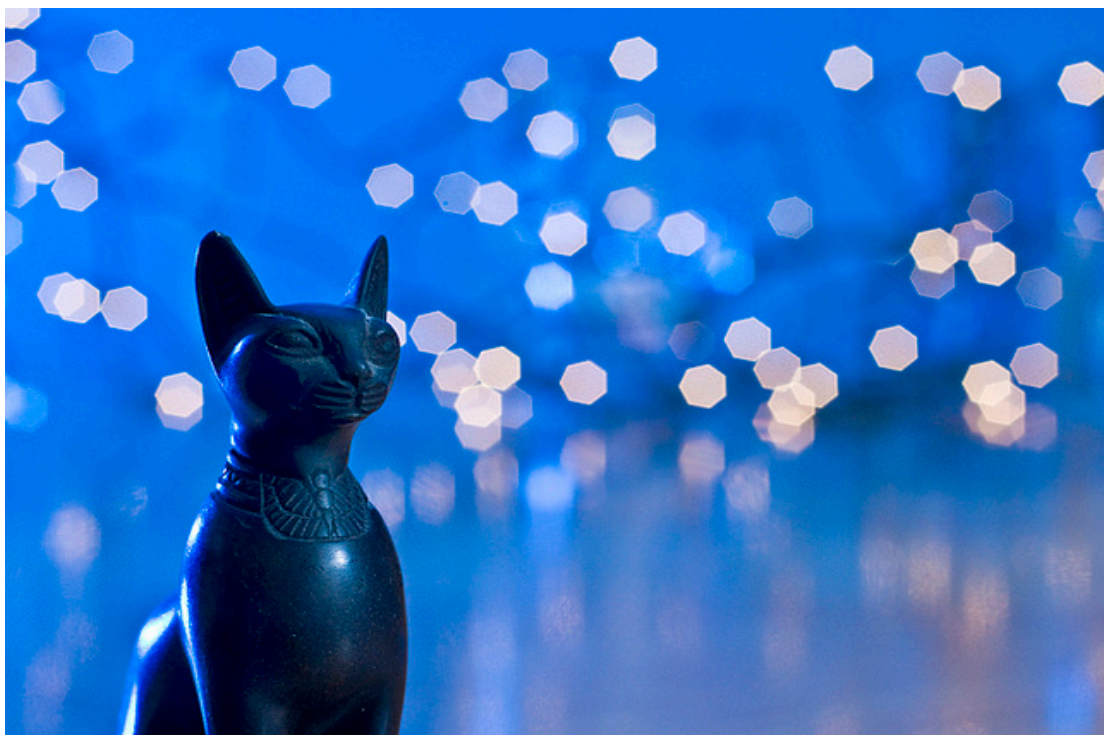
One of the naturally blue objects that the Egyptians had access to was lapis lazuli, a deep blue semi-precious stone which could be ground up into powder, although this was a luxury item and had to be imported from Afghanistan. Therefore, it is not too surprising that the Egyptians sought to produce a synthetic pigment to use as a substitute for the blue lapis lazuli.

Some parts of the iconic funereal mask of PharaohTutankhamun's mummy were made of inlaid lapis lazuli. (CC BY-SA 3.0)

The manufacture of Egyptian Blue eventually spread beyond Egypt's borders, and can be found throughout the Mediterranean. Egyptian Blue was used in numerous Greek and Roman objects, including statues from the Parthenon in Athens and wall paintings in Pompeii. Despite its extensive application in art, Egyptian Blue ceased to be used, and its method of production was forgotten when the Roman era came to an end.

In the 19th century, Egyptian Blue was rediscovered. The excavations at Pompeii revealed that many wall paintings had Egyptian Blue on them, and this prompted scientists to investigate the exact composition of this pigment. Since then, researchers have gained a much deeper understanding of its unique properties. **Experiments found that Egyptian Blue has the highly unusual quality of emitting infrared light when red light is shone onto it. This emission is extraordinarily powerful and long-lived, but cannot be seen by the naked eye, because human vision does not normally extend into the infrared range of the light spectrum. In addition, scientists unexpectedly discovered that Egyptian Blue will split into 'nanosheets' – a thousand times thinner than a human hair – if stirred in warm water for several days.** Scientists now believe that its unique properties may make Egyptian Blue suitable for a variety of modern applications.

Egyptian Blue may one day be utilized for communication purposes, as its beams are similar to those used in remote controls and telecommunication devices. Moreover, Egyptian blue could be used in advanced biomedical imaging, as its near-infrared radiation is able to penetrate through tissue better than other wavelengths. As an ink solution, Egyptian blue opens up new ways for its incorporation into modern appliances, such as the development of new types of security ink and possibly as a dye in the biomedical field. While the use of Egyptian blue in modern high-tech applications is still in its infancy at this stage, it does seem that its future is a bright one.



(Sandra/CC BY-ND 2.0)

References

Boddy-Evans, A., 2014. Blue Colors in Ancient Egypt. [Online]
Available at: http://africanhistory.about.com/od/egyptology/ss/EgyptColour_3.htm

Choi, C. Q., 2013. Ancient Egyptian Pigment's Future Now Even Brighter. [Online]
Available at: http://www.insidescience.org/content/ancient-egyptian-pigments-future-now-even-brighter/954

Gayle, D., 2013. Talk like an Egyptian: Ancient paint used to decorate Pharoahs' tombs is set to be the basis of telecommunication devices. [Online]
Available at: http://www.dailymail.co.uk/sciencetech/article-2282993/How-Ancient-Egypts-synthetic-pigment-set-enjoy-renaissance-high-tech-nanomaterial.html

Hill, J., 2010. Meaning of Blue in Ancient Egypt. [Online]
Available at: http://ancientegyptonline.co.uk/colourblue.html

McCouat, P., 2014. 'Egyptian Blue: The Colour of Technology', in Journal of Art in Society. [Online]
Available at: http://www.artinsociety.com/egyptian-blue-the-colour-of-technology.html

Pigments through the Ages, 2014. Egyptian Blue. [Online]
Available at: http://www.webexhibits.org/pigments/indiv/overview/egyptblue.html

The British Museum, 2014. Discoveries of Egyptian Blue Pigment at the British Museum. [Online] Available at: http://www.britishmuseum.org/explore/highlights/articles/e/egyptian_blue_on_objects.aspx

The Ancient Origins of Prosthetics

TECH: Prosthetics

Artificial body parts are an ancient tech, and are more than just peglegs

ANCIENT-ORIGINS | Bryan Hilliard

A 3,000-year-old prosthetic toe from ancient Egypt. The big toe is carved from wood and is attached to the foot by a sewn leather wrapping. (Jon Bodsworth)

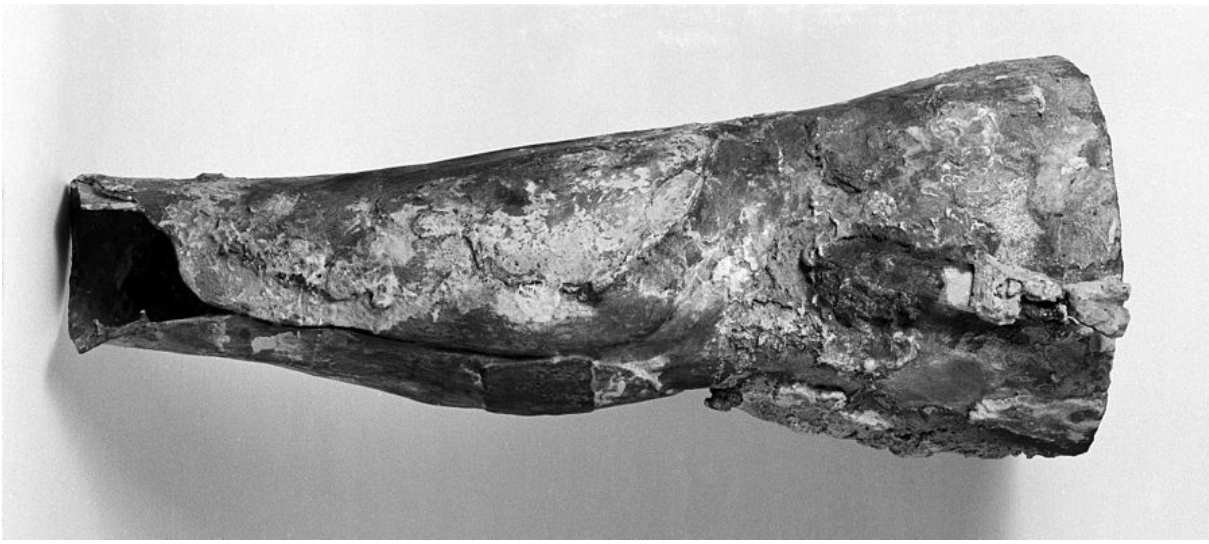
In the field of medicine, a prosthesis is a man-made device used to replace a missing body part. Although one may think that the use of prosthetic devices is a modern phenomenon, it was a technology already in use several thousand years ago.

The oldest known prosthesis that is in existence is from ancient Egypt. In 2000, researchers in Cairo unearthed a prosthetic big toe made of wood and leather which was attached to the almost 3,000-year-old mummy of an Egyptian noblewoman. As the ancient Egyptians perceived the afterlife as a perfect version of this life, it would have been important for them to go there with their body parts intact. This is evident in the fact that a variety of prosthetic devices have been found on mummies. These include feet, legs, noses, and even penises. (Yep, the ancient Egyptians believed that procreation was an activity that was possible in the afterlife).

While this ideological belief may explain the presence of such prosthetics on mummies, recent research shows that the prosthetic toe of the 3,000-year-old mummy may have had a practical function, and the device was used while the woman was still alive.

With the help of volunteers who were missing their big toes, it was shown that the use of prosthetics would have made walking around in ancient Egyptian sandals much easier.

The use of prosthetics demonstrates the resourcefulness of people in ancient times. It has been pointed out that until very recent times, prosthetic devices were made of basic materials, such as wood and metal, and were attached to the body with leather. The use of iron as a material for prosthetics, for instance, can be seen in the account of Marcus Sergius. This Roman general had lost his right hand during the second Punic War. According to historical accounts, Sergius had a prosthetic arm made of iron that allowed him to hold his shield. This meant that he could return to the battlefield and continue fighting. That's one dedicated military man.



Roman artificial leg of bronze plates fastened to a wooden core, excavated from a tomb near Capua. (Wellcome/CC BY 4.0)

Despite these early advances in 'prosthetics technology', not much changed in the use of prosthetic devices from the Roman era until the middle ages, and so it is unsurprising that many of us assume that the use of such devices is a relatively recent phenomenon.

However, iron prosthetic arms and legs were still in use during the middle ages, which was more than a thousand years after Marcus Sergius. It was the metalworkers who made armors for the knights who also crafted the prosthetic devices for their clients. Interestingly, it has been claimed that the purpose of these devices were not so much practical as aesthetic. It seems that these artificial limbs were used to disguise lost limbs, which was considered at that time to be an embarrassing deformity.

Artificial iron arm, once thought to have been owned by Gotz von Berlichingen (1480-1562), the German knight and adventurer who served with the Holy Roman Emperor Charles V against the Turks. Artificial limbs such as these were expensive items made by armorers, and they allowed wearers, who had lost a limb in combat, to continue with their fighting career. This example is believed to date from 1560-1600.

Three thousand years on, and prosthetic devices continue to be in use and are just as crucial for people with missing limbs now as they were to people thousands of years ago. Today's devices are much lighter, made of plastic, aluminum and composite materials to provide amputees with the most functional devices. In addition to lighter, patient-molded devices, the advent of implantable microprocessors, and robotics in today's devices are designed to return amputees to the lifestyle they were accustomed to, rather than to simply provide basic functionality or a more pleasing appearance. Prostheses today are more realistic, with flesh-like silicone covers, and are able to mimic the function of a natural limb more now than at any time before.

In the beginning it was the ancients who invented these clever technical and engineering solutions, and we continue to perfect their ideas to this day.

References

Choi, C. Q., 2007. World's First Prosthetic: Egyptian Mummy's Fake Toe. [Online]
Available at: http://www.livescience.com/4555-world-prosthetic-egyptian-mummy-fake-toe.html

Clements, I. P., 2014. How Prosthetic Limbs Work. [Online]
Available at: http://science.howstuffworks.com/prosthetic-limb1.htm

Coughland, S., 2012. Oldest Prosthetic Helped Egyptian Mummy to Walk. [Online]
Available at: http://www.bbc.co.uk/news/education-19802539

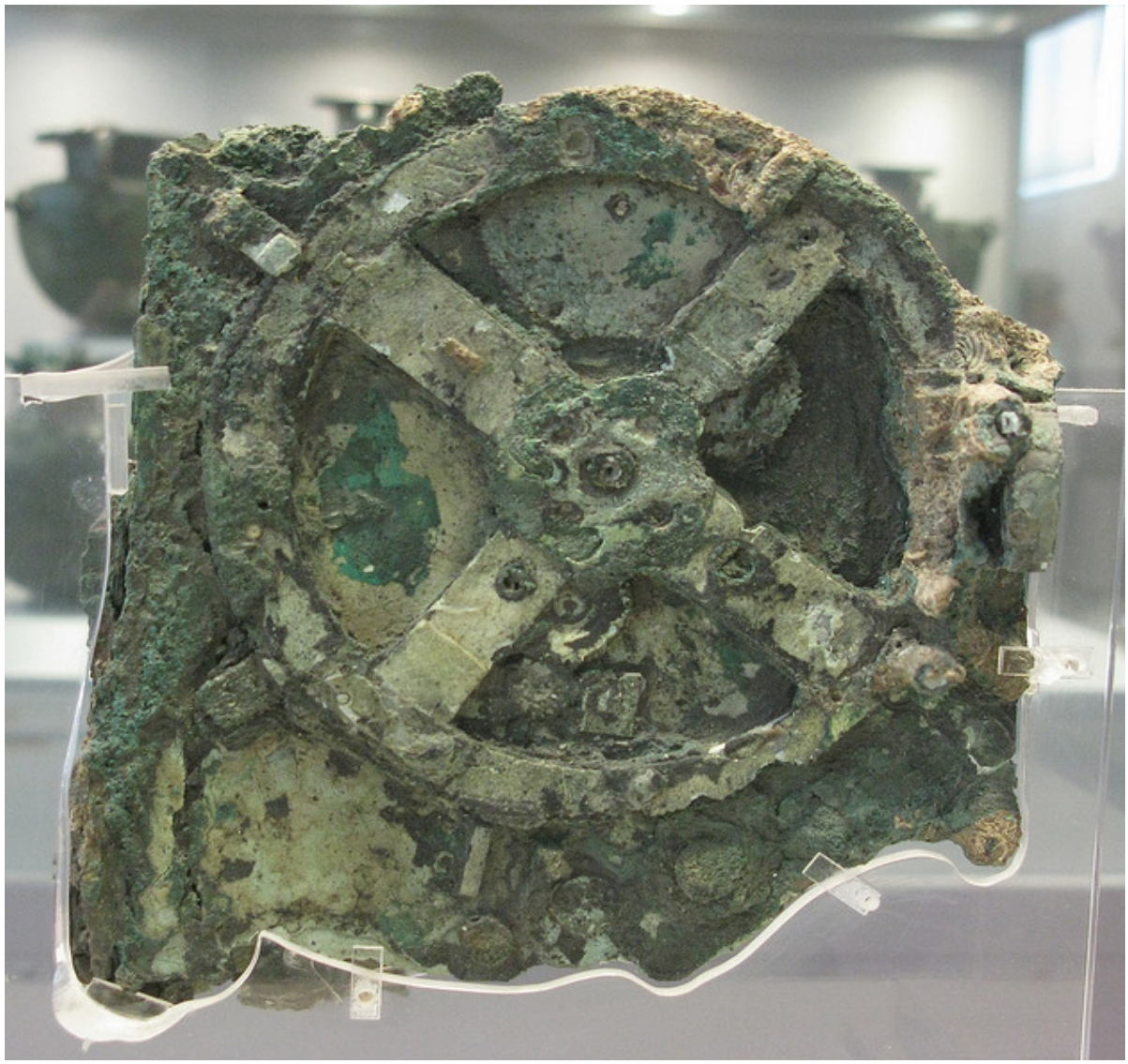
Gannon, M., 2012. Ancient Fake Toes May Be World's Oldest Prosthesis, Study Shows. [Online]
Available at: http://www.huffingtonpost.com/2012/10/03/ancient-fake-toes-oldest-prostheses-egypt_n_1936219.html

www.ingenious.org.uk, 2014. Land Mines in Cambodia. [Online]
Available at: http://www.ingenious.org.uk/read/conflict/artificiallimbs/LandminesinCambodia/

Antikythera Mechanism study reveals clues to one of history's greatest puzzles

GADGET: Antikythera Mechanism
Is the amazing ancient device older than first thought? Who made it?

ANCIENT-ORIGINS | April Holloway



The astounding and ancient Antikythera Mechanism. (Tilemahos Efthimiadis/CC BY 2.0)

The Antikythera mechanism is one of the most amazing mechanical devices discovered from the ancient world. For decades, scientists have utilized the latest technology in attempts to decipher its functionality; however, due to its complexity, its true purpose and function remained elusive. But in the last few years, a number of scientists appear to have solved the mystery as to how this incredible piece of technology once worked, and its origins.

A new study of the world famous Antikythera mechanism has revealed fascinating new information about the puzzling artifact, including that the math used for its eclipse prediction appears to be based on Babylonian arithmetic rather than Greek trigonometry. A detailed analysis of the eclipse predictor has also enabled scientists to determine that the device's astronomical calculations started in 205 BC, enabling the first accurate dating of the mechanism. If this is correct, it makes it highly unlikely that its creator was the renowned ancient Greek inventor Archimedes.

The Antikythera mechanism was discovered in 1900 during the recovery of a shipwreck off of the Greek island, Antikythera, in waters 60 meters (197 feet) deep. The metallic device consists of 37 different types of gears and is so complex that many consider it to be the first human-made analog computer. After decades of research, scientists were able to determine that it shows the positions of the sun, moon, and planets as they move through the zodiac, predicts solar and lunar eclipses, and even once marked key events such as the Pan-Hellenic games.

Scientists have claimed that the complex assemblage of bronze gears predates other similar types of technology by 1,000 years.

Archaeologists and historians have long debated when the device was built and by whom.

"Given its sophistication, some experts believe it must have been influenced, at least, by one of a small pantheon of legendary Greek scientists – perhaps Archimedes, Hipparchus, or Posidonius," writes the New York Times.

The genius of Ancient Greek scientist Archimedes may have influenced later inventions. This painting portrays Archimedes setting Roman ships on fire with a 'Burning Mirror'. (Public Domain)

Reconstruction revealing the complexity of the ancient Antikythera mechanism (Magnus Hagdorn/CC BY-SA 2.0)

References to complex astronomical mechanisms in the works of ancient writers, has led to some of the above proposals being made. For example, Roman politician and philosopher, Cicero (106 – 43 BC), refers to an instrument that reproduced the motions of the sun and the five planets. The device Cicero described, which many believe was the Antikythera mechanism, was built by Archimedes. However, the latest analysis challenges this assumption, revealing that the device may be even older than first thought.

The new study, published in the journal *Archive for History of Exact Science*, involved a detailed look at the Saros dial (eclipse predictor) of the Antikythera mechanism. Their results revealed that the prediction calendar includes a solar eclipse that occurred on May 12, 205 BC. This suggests that the device is at least this old, and may in fact be the year of its creation. Researchers had previously dated the mechanism to around 100 to 150 BC based on radiocarbon dating and an analysis of the Greek letters inscribed on the device. However, the new date pushes the origin back by 50 to 100 years, and suggests that Archimedes is unlikely to be its creator, as he was killed in 212 BC, seven years prior to the new date of 205 BC.

The study also supports the idea that the math used for eclipse prediction was based on Babylonian arithmetical models borrowed by the Greeks.

> *"We… find that a Babylonian-style arithmetical scheme employing an equation of center and daily velocities would match the inscribed times of day quite well," write the study authors. "Indeed, an arithmetic scheme for the eclipse times matches the evidence somewhat better than does a [Greek] trigonometric model."*

Last month, an expedition **returned to the Antikythera shipwreck**—with the aid of a high-tech exosuit—and recovered tableware, ship components, and a giant bronze spear that would have belonged to a life-sized warrior statue. **New investigations are hoped to reveal more about this unique piece of advanced ancient technology.**

References

Markoff, John. 2014. "On the Trail of an Ancient Mystery". The New York Times [Online] Available from: http://www.nytimes.com/2014/11/25/science/solving-the-riddles-of-an-early-astronomical-calculator.html?_r=1

Christián C. Carman, and James Evans (2014). On the epoch of the Antikythera mechanism and its eclipse predictor. Archive for History of Exact Science. Springer Berlin Heidelberg. doi: 10.1007/s00407-014-0145-5

Than, Ker. 2006. "Scientists Unravel Mystery of Ancient Greek Machine". LiveScience [Online] Available from: http://www.livescience.com/1166-scientists-unravel-mystery-ancient-greek-machine.html

Han Purple: Ink pigment from 800 BC that quantum physicists are trying to understand

TECH: Chinese 'Infrared' Pigment

Exotic, magnetic, infrared-light ink of ancient world surprises scientists

ANCIENT-ORIGINS | April Holloway

Detail of a mural from an Eastern Han tomb (25 – 220 AD) at Zhucun, Luoyang, Henan province. The painting utilizes amazing Han purple and Han blue pigment. (Public Domain)

Han purple is an artificial pigment created by the Chinese over 2,500 years ago, which was used in wall paintings and to decorate the famous terracotta warriors, as well as ceramics, metal ware, and jewelry. The pigment is a technological wonder, made through a complex process of grinding up raw materials in precise proportions and heating to incredible temperatures. So intricate was the process, that it was not reconstructed again until 1992, when chemists were finally able to identify its composition.

But that was just the beginning. According to a news report on io9.com, research since then has discovered amazing properties of Han purple, including the **ability to emit powerful rays of light in the near-infrared range, as well as being able to collapse three dimensions down to two under the right conditions.**

The production of Han purple, otherwise known as Chinese purple, dates back as far as 800 BC, however it appears that it was not used in art until the Qin and Han dynasties (221 BC – 220 AD), when it was applied to the world famous terracotta warriors, as well as ceramics and other items.

“Prior to the nineteenth century, when modern production methods made synthetic pigments common, there were only hugely expensive purple dyes, a couple of uncommon purplish minerals, and mixtures of red and blue, but no true purple pigment – except during a few hundred years in ancient China,” writes Samir S. Patel in ‘*Purple Reign: How ancient Chinese chemists added color to the Emperor’s army’.*

For an unknown reason, Han purple disappeared entirely from use after 220 AD, and was never seen again until its rediscovery by modern chemists in the 1990s.

Traces of Han purple can still be seen on many of the terracotta warriors. (Dennis Jarvis/CC BY-SA 2.0)

The Synthesis of Han Purple

Unlike natural dyes, such as Tyrian purple (from c. 1500 BC), which are organic compounds and typically made from plants or animals, like the murex snail, Han purple was a synthetic pigment made from inorganic materials.

Only two other man-made blue or purple pigments are known to have existed in the ancient world – Maya blue (from c. 800 AD), made from a heated mixture of indigo and white clay, and

Egyptian blue, which was used throughout the Mediterranean and the Near and Middle East from 3600 BC to the end of the Roman Empire.

Scientist Elisabeth FitzHugh, a conservator at the Smithsonian, was the first to identify the complex synthetic compound that makes up Han purple – barium copper silicate, a compound that differs from Egyptian blue only through its use of barium instead of calcium.

"Egyptian blue" tripodic beaker. The composition of Han purple differs from Egyptian blue only in the use of barium instead of calcium.(Public Domain)

The similarities between Han purple and Egyptian blue led some early researchers to conclude that the Chinese may have learned to make the pigment from the Egyptians. However, this theory has been largely discounted as Egyptian blue was not found further East than Persia.

“There is no clear reason why the Chinese, if they had learned the Egyptian formula, would have replaced calcium with barium, which necessitates increasing the firing temperature by 100 degrees or more,” writes Patel.

So how exactly did the Chinese stumble upon the intricate formula to make Han purple, which involved combining silica (sand) with copper and barium in precise proportions and heating to about 850-1000 °C? A team of Stanford physicists published a paper in the *Journal of Archaeological Science*, which proposes that Han purple was a by-product of the glass-making process, as both glass and the purple pigment contain silica and barium. Io9.com writes that barium makes glass shinier and cloudy, which means this pigment could be the work of early alchemists trying to synthesize white jade.

Fluorescent properties

Since its composition was first discovered, scientists have continued to investigate this unique pigment. Researchers at the British Museum discovered that, when exposed to a simple LED flashlight, Han purple emits powerful rays of light in the near-infrared range. According to their study, published in the journal *Analytical and Bioanalytical Chemistry*, the Han purple pigments show up with startling clarity under the right conditions, meaning that even faint traces of the color, which are invisible to the naked eye, can be seen with infrared sensors.

Han Purple and the collapsing of dimensions

The fluorescent properties of Han purple were not the only surprise. Quantum physicists from Stanford, Los Alamos National Laboratory and the Institute for Solid State Physics (University of Tokyo) reported that when Han purple is exposed to extreme cold and a high magnetic field, the chemical structure of the pigment enters a new state called the quantum critical point, in which three-dimension material ‘loses’ a dimension.

"We have shown, for the first time, that the collective behavior in a bulk three-dimensional material can actually occur in just two dimensions," Ian Fisher, an assistant professor of applied physics at Stanford said in the Stanford Report. "Low dimensionality is a key ingredient in many exotic theories that purport to account for various poorly understood phenomena, including high-temperature superconductivity, but until now there were no clear examples of 'dimensional reduction' in real materials."

The scientists have proposed that this effect is due to the fact that the components of barium copper silicate are arranged like layers of tiles, so they don't stack up neatly. Each layers' tiles are slightly out of sync with the layer below them. This may frustrate the wave and force it to go two dimensional.

The researchers have said the discovery may help understand the required properties of new materials, including more exotic superconductors.

Fisher said, "Han Purple was first synthesized over 2500 years ago, but we have only recently discovered how exotic its magnetic behavior is. It makes you wonder what other materials are out there that we haven't yet even begun to explore."

References

Inglis-Arkell, Esther. 2014. "This 2000-Year-Old Pigment Can Eliminate The Third Dimension". Io9 [Online] Available from: http://io9.com/this-2000-year-old-pigment-can-eliminate-the-third-dime-1661476168

Patel, Samir S. (2007). "Purple Reign: How ancient Chinese chemists added color to the Emperor's army". Archaeology Magazine. [Online, PDF] Available at: https://www.ldeo.columbia.edu/edu/eesj/gradpubs/GeneralMags/patel_chinesepurple_Archeology.pdf

Than, Ker. 2006. "Scientists Unravel Mystery of Ancient Greek Machine". LiveScience [Online] Available from: http://www.livescience.com/1166-scientists-unravel-mystery-ancient-greek-machine.html

Z. Liu, et al. (2007). "Ancient Warriors and the Origin of Chinese Purple". Journal of Archaeological Science. [Online, PDF] Available at: http://www-ssrl.slac.stanford.edu/research/highlights_archive/chinesepurple.pdf

G. Verri. (2009). "The spatially resolved characterisation of Egyptian blue, Han blue and Han purple by photo-induced luminescence digital imaging". Analytical and Bioanalytical Chemistry, 2009, Volume 394, Number 4, Page 1011. Doi: 10.1007/s00216-009-2693-0

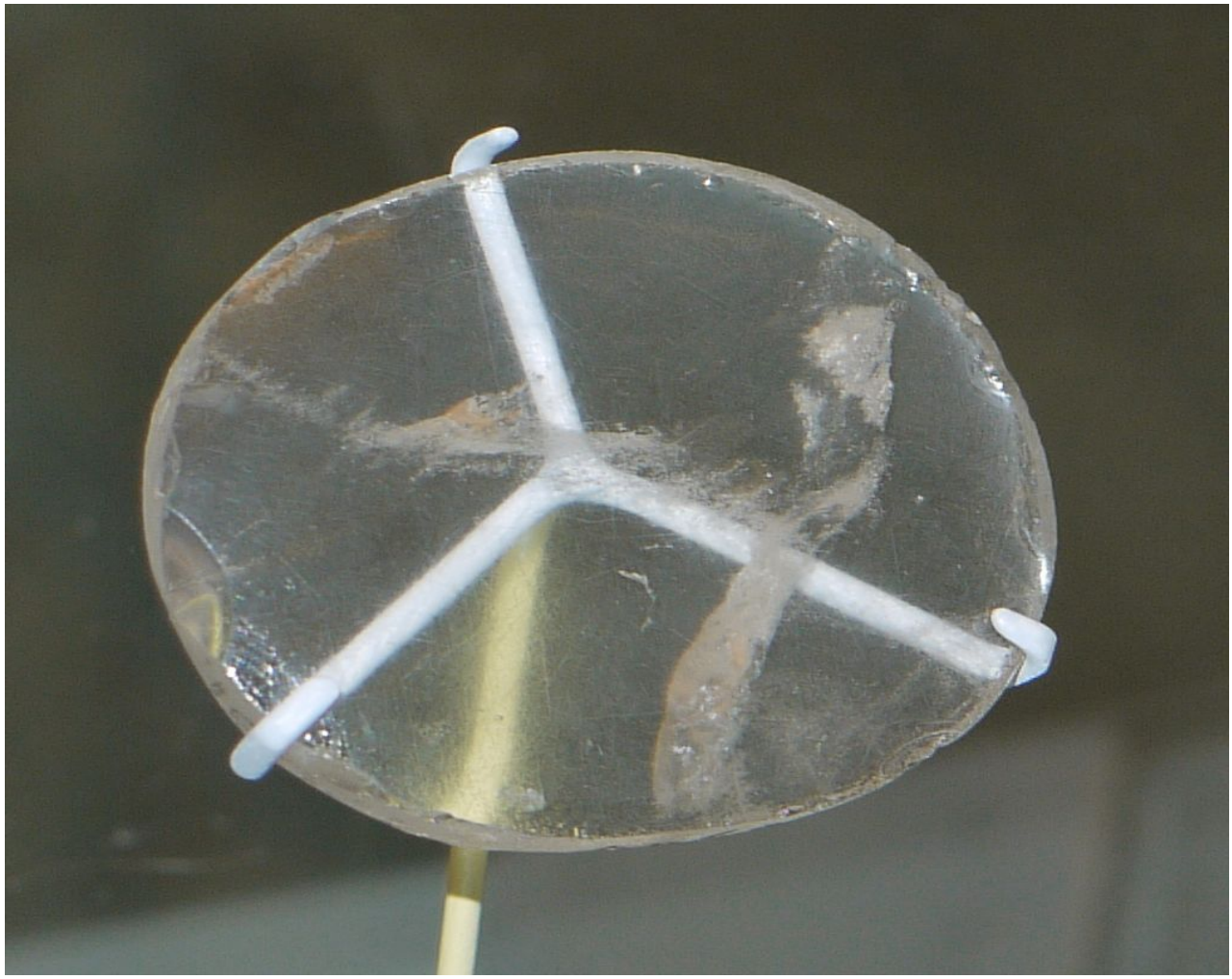
Levy, Dawn. (2006). "3-D insulator called Han Purple loses a dimension to enter magnetic 'Flatland'". Stanford News [Online] Available at: http://news.stanford.edu/news/2006/june7/flat-060706.html

Assyrian Nimrud lens the oldest telescope in the world?

GADGET: Ancient Lens

Did this shaped glass crystal allow ancients to read the stars long ago?

ANCIENT-ORIGINS | April Holloway



The Nimrud lens is a 3,000-year-old piece of rock crystal, which was unearthed by Sir John Layard in 1850 at the Assyrian palace of Nimrud, in modern-day Iraq. Since its discovery over a century ago, scientists and historians have debated its use, with one prominent Italian professor claiming the lens was used by the ancient Assyrians as part of a telescope, which would explain how the Assyrians knew so much about astronomy.

The Nimrud lens (also called the Layard lens), which has been dated to between 750 and 710 BC, is made from natural rock crystal and is a slightly oval in shape. It was roughly ground, perhaps on a lapidary wheel. It has a focal point about 11 centimeters (4.3 inches) from the flat side, and a focal length of about 12 centimeters (4.7 inches). This would make it equivalent to a 3× magnifying glass (combined with another lens, it could achieve much greater magnification).

The surface of the lens has twelve cavities that were opened during grinding, which would have contained naptha or some other fluid trapped in the raw crystal.

The lens is said to be able to focus sunlight, although the focus is far from perfect.

There has been much debate over the original use of the Nimrud lens. Some speculate that it was used as a magnifying glass, or as a burning-glass to start fires by concentrating sunlight, while others have proposed that the lens was part of a telescope.

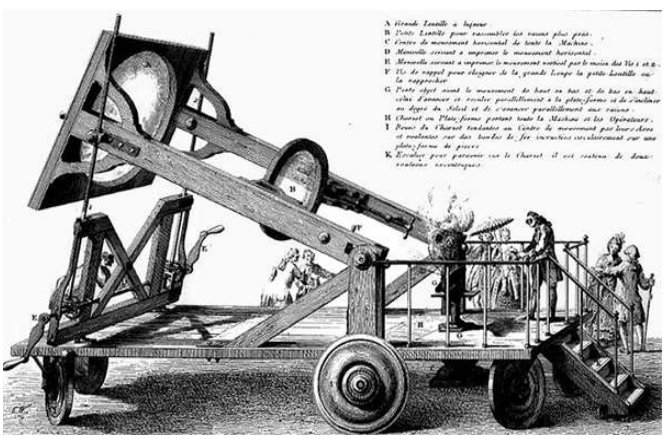
However, if we are to believe the British Museum's description, the Nimrud lens "would have been of little or no practical use", and while they acknowledge that "this piece of rock crystal has been carefully ground and polished, and undoubtedly has optical properties", they reach the unusual conclusion that the optical properties were "probably accidental".

It can be wondered if the British Museum also maintains that the hundreds of other carefully crafted and polished lenses found throughout the ancient world were also "accidental"?

The British Museum finished by saying that: "There is no evidence that the Assyrians used lenses, either for magnification or for making fire, and it is much more likely that this is a piece of inlay, perhaps for furniture." However, many disagree with this claim.

Sir John Layard suggested that Assyrian craftsmen used the lens as a magnifying glass to make intricate and miniscule engravings, such as those that have been found on seals and on clay tablets using a wedge-shaped script. But experts on Assyrian archaeology are unconvinced. They say that the lens is of such low quality that it would have been a poor aid to vision.

Another hypothesis is that the lens was used as a burning glass to start fire. Burning-glasses were known in the ancient world. Aristophanes refers to "the beautiful, transparent stone with which they light fires" in his play The Clouds (424 BC). Pliny the Elder (23-79AD) describes how glass balls filled with water could set clothes on fire when placed in line with the sun. However, there is no clear evidence to support the theory that this was the purpose for which the Nimrud lens was created.



Italian scientist Giovanni Pettinato of the University of Rome has proposed that the lens was used by the ancient Assyrians as part of a telescope. According to conventional perspectives, the telescope was invented by Dutch spectacle maker, Hans Lippershey in 1608 AD, and Galileo was the first to point it to the sky and use it to study the cosmos. But even Galileo himself noted that the 'ancients' were aware of telescopes.

While lenses were around before the Nimrud lens, Pettinato believes this was one of the first to be used in a telescope. The earliest lenses identified date back around 4,500 years ago to the fourth and fifth dynasties of Ancient Egypt (e.g., the superb `Le Scribe Accroupi' and `the Kai' in the Louvre), where it appears they were used as schematic eye structures (iris/pupil inserts) associated with funerary statues. Latter examples have been found in Knossos dated to around 3,500-years-old.

In total, there are several hundred reported lenses now on record from around the ancient world, so it appears that the ancients knew a lot more about lenses than some, like the British Museum, give them credit for.

Saturn's Serpents

One of the reasons Pettinato believed that the Assyrians used the Nimrud lens as part of a telescope is that some of their knowledge about astronomy seems impossible to have acquired without a telescope. For example, the ancient Assyrians saw the planet Saturn as a god surrounded by a ring of serpents, which Pettinato suggests was their interpretation of Saturn's rings as seen through a telescope. However, other experts say that serpents occur frequently in Assyrian mythology, and note that there is no mention of a telescope in any of the many surviving Assyrian astronomical writings.

Babylonian tablet recording Halley's Comet in 164 BC. From the British Museum: "Babylonian astronomical diaries recorded daily observations of the moon and planets from the 7th century onwards. The diaries for 164-163 BC contain observations of Halley 's Comet at its first and last visibility. This observation can be dated to about 22-28 September 164." (Public Domain)

Whatever its purpose, as an ornament, as magnifying lens, a burning glass, or part of a telescope, the Nimrud lens certainly appears to be more than an "accident". But exactly how it was used, we may never know.

References

"The Nimrud Lens / The Layard Lens". The British Museum [Online] Available from: http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=369215&partId=1

"World's oldest telescope?" (1999). BBC News [Online] Available at: http://news.bbc.co.uk/2/hi/380186.stm

"The Developmental History of the Telescope". (2006) The On-Line Museum and Encyclopedia of Vision Aids. [Online] Available from: http://www.antiquespectacles.com/telescopes/telescopes.htm

Sarah Murray (CC BY-SA 2.0)

Which of history's amazing discoveries would you like to experience next?

Ancient-Origins.net, 2016

Ancient Origins

Reconstructing the story of humanity's past ...

Front cover image, Deriv; Planispherical astrolabe (Marocco), XVI century (CC BY-SA 2.0 fr), Trebuchet, and Roman Dodecahedron (CC BY SA 2.0)

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