



TECHNOLOGY IN ANCIENT ROME

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ROME

The Roman Empire started as a meek city state in the 8th century BCE. Initially ruled by aristocratic kings, Rome transitioned to a republic in the 6th century BCE. The city began expanding until it controlled the entirety of the Italian peninsula.

The government of the Republic, however, could easily be called an aristocracy. Power was held by old families with ties in the original Senate. These families were called patricians, while the rest of the citizenry were referred to as plebeians. There were certain positions in government reserved for each class, and there was much resentment against the upper classes by the plebs, who composed the majority of the population.

This balance of power was maintained until the rule of Julius Caesar and the consequent start of the Roman Empire. Officially called the *princeps*, the emperor wielded absolute power technically checked by the weakened Senate. Rome would remain the most powerful political entity of the world until the 5th century, when it finally succumbed to barbarians after decades of internal strife and material pressures.



ABACUS

The abacus was originally designed by the Mesopotamians in the time period between 2700 and 2300 BCE, but the Romans improved upon it during the time of their empire. The primary improvement was the Roman abacus was portable, though it was less capable than the Babylonian abacus. The abacus was effectively the first pocket calculator in history. Another feature of the Roman abacus was that it was in base-10 which



replaced the complex mathematics involved in Roman numerals. The Roman abacus was primarily used by merchants, early engineers, and tax collectors.

The Roman abacus was just one of many variations on the abacus. The word abacus itself dates to before 1387 CE, but, as previously mentioned, the device was used well before that. The abacus was used by many cultures from Egypt to China. The modern day abacus, found in Asia and Africa primarily, is used by traders, merchants, and clerks. In developed countries, the abacus has been replaced by the electronic calculator.

AMPHITHEATERS

Amphitheaters were large, open stadiums Romans used for many events, including chariot races, animal fights, and **gladiatorial combat**. Roman amphitheaters were feats of civil engineering. The largest could seat tens of thousands of spectators. The most famous amphitheater is the Coliseum, completed in 80 CE. Situated in the center of Rome, it demonstrated the immense wealth of the Roman Empire.



Amphitheaters had an important, secondary role in the Roman government. The Romans promised all citizens *bread and circus* in exchange for their obedience to the emperor, a policy which guaranteed unity among even the more distant provinces. Furthermore, the presence of amphitheaters around the Mediterranean remains an indelible mark of imperial control over the Roman lake.



ARCH

The arch was known by many early civilizations in the Near East and Mediterranean. It was one of many technologies that the Romans borrowed from the **Etruscans**; however, no other society had used the arch to its fullest advantage. The Romans made use of the arch in a diverse range of applications. From stadiums to aqueducts and triumphal arches, the arch remains a distinctive symbol of Roman imperial power, and can be seen in the many public works still standing after 2000 years.



Arc de Triomphe, celebrating his victories in the Napoleonic war.

Arches have also been used by many societies wishing to emulate the success and grandeur of the Roman Empire. For example, among the many trappings of imperial power appropriated by the Byzantines was the arch. Furthermore, Napoleon chose to copy the Roman triumphal arch in his construction of the *Arc de*

AQUEDUCTS

Aqueducts were used by the Romans to carry water all over their empire. Because the aqueducts were constructed with a slight downward slope, water could be carried for miles from natural and artificial reservoirs to cities, where it could then be used for public fountains, baths, and sewers. Aqueducts allowed the Roman cities to support larger and denser populations and were thus important in Roman **urban** life.



After the fall of the Roman empire, many aqueducts fell into disuse and therefore became damaged. Still, many well preserved aqueducts can be seen in former Roman cities, including Caesarea, Segovia, and Istanbul, giving modern visitors some glimpse into the past glory of Rome.



BATHS

Among the many social engagements frequented by the Roman populace were the baths. Referred to as *thermae*, public baths were present in nearly every Roman city throughout the empire, greatly improving public hygiene in these urban areas.

Public baths were generally fed by aqueducts although natural water sources were also used. The

water was usually heated prior to entering into the baths through complicated plumbing systems similar to those in the modern day.



Many wealthy Romans chose to also construct private baths for their own **villas** and homes. In the public baths, however, all citizens mingled outside of the class restrictions which usually fettered their lives. The baths thus took on a social and political aspect as well. Civic leaders met with the populace and brokered public deals in the baths, and going weekly became a habit for most Romans.

BOOK

The Roman *codex*, which literally translates to “trunk of a tree”, is the basis for the format of modern books. The traditional method of the ancient world was writing on scrolls. The Romans started using wooden writing tablets to replace the antiquated system of writing. The codex was spurred by the spread of Christianity throughout the world because the Bible took on the format early on. The Romans used wax-covered tablets of woods for taking notes, which evolved into bound pages under the emperor Julius Caesar. Eventually the codex traveled throughout the world from West to East.

Using the technical definition, any paperback can be considered a codex. Despite this, the term is only used to describe hand written books which were produced from the Late Antiquity era to the Middle Ages. This is a primary example of the lasting impression the Romans had on culture and society. The book was an improvement in writing because it was and is sturdy and compact. These benefits made it so that the format survived the test of time, being only flimsily challenged in the modern day by the advent of electronic books.



BRIDGE

The bridges built by the ancient Romans were the first of the large and long-lasting bridges built. The bridges themselves were a combination of stone and concrete, and they highly utilized the arch as its most basic structure. The Romans were the first to discover the true potential of arches, mostly in the semicircular shape, though



some were segmental. In a list compiled by Vittorio Galliazzo, there have been 931 Roman bridges, mostly made of stone, found all across Europe. Roman bridges can still be found today thanks to their sturdy construction.

Many characteristics were typical of the Roman bridges. The majority of the bridges were more than five meters wide, which lent to the idea that the bridges were quite large. Many of the bridges were sloped, especially those that carried water, as the slope was necessary to keep the fluid moving. The stonework was alternating; one layer would have the stones laid lengthwise while the next layer had the layers facing outwards. The stones linked with either dovetail joints or metal bars. The Roman bridge designs influence bridge designs today, though not heavily utilized in larger bridges.

CONCRETE

Concrete quite literally paved the way for many of the public works which define for many the Roman Empire. The mixture was perfected by the first century CE, allowing the construction of many monuments, some of which remain standing today, nearly two thousand years later.



The recipe for Roman concrete is known from the writings of Vitruvius. The two primary ingredients of the mixture were a special type of volcanic sands near the city of Puteoli and lime. The result was effective for both structural and underwater construction projects. For example, the harbor of Caesarea was a masterpiece of civil engineering, and the dome of the Parthenon was the largest in history until that time.

Unintentionally, Roman concrete was also stable against earthquakes. Because concrete was not a consistent mixture, there were natural variations in the density of the concrete allowing the disruption of **seismic waves**.



DAM

Though the importance of Roman dams is comparable to Roman bridges, aqueducts, and roads, they are not as widely researched. Dams started primarily in the regions of North Africa and Hispania controlled by Rome in the early imperial period. These dams were primarily made of earth or rock and acted as embankments. They could easily be utilized for irrigation, river diversion, and flood control. The four types of dam designed by the Romans are: arch-gravity dams, buttress dams, multiple-arch buttress dams, and buttress dams.

Two other inventions aided the development of Roman dams. The first was a water-proof hydraulic mortar that protected the dams from water erosion. The other development was the concrete revolution that allowed larger dam structures to be created. The Lake Homs Dam, created by the Romans, is likely the largest water barrier built in all history. Dams were an important asset to Roman architecture.



HYPOCAUST

Hypocaust was a technique of heating buildings used extensively by the Romans. Underneath the floor, furnaces burned wood and other fuels, filling the hollow chambers with smoke and thereby heating the rooms above. Hypocaust could only be used in the homes of the wealthy, however, because hypocaust both required constant attention to the fires and consumed

a lot of fuel. Hypocaust was therefore, like many luxuries in Rome, enjoyed almost exclusively by the **aristocracy**.



Although the use of hypocaust is typically associated with the Romans, other civilizations worldwide appear to have used them. In particular, evidence of hypocaust use has been found in the ruins of Mohenjo-Daro in modern Pakistan.



LIGHTHOUSES

Though they have been replaced by GPS systems and other technological advancements, lighthouses were an important part of the Roman Empire. Lighthouses were a navigational aid that warned sailors when they were approaching hazardous shorelines so that the ships could steer clear. Traditional Roman lighthouses used fire and were primitive, though they still proved helpful in guiding ships away from dangers. Romans build two lighthouses, each called the Pharos (named after the first Egyptian lighthouses), at Dover after the conquest of Britain.



While they were still in use, lighthouses evolved to become quite advanced. Each lighthouse would be looked after by a lighthouse keeper, a man who could live alone or with his family, though it is commonly considered a very lonely career. Each night the lighthouse keeper went to the lantern room to light the lens and it was his job to ensure the safety of any ships that may pass by in the night. Later versions of lighthouses would often have foghorns because if the fog were thick the light would not be visible from the sea. Lighthouses have a long, exciting history, one that stretches far beyond the reaches of this book.

PEWTER

Pewter, first used during the Bronze Age, is a **malleable** metal alloy, which is primarily composed of tin. The examples remaining from the Roman Empire are the Romano-British pieces from the third and fourth centuries CE. Roman pewter most commonly had tin proportions of 50%, 75%, and 95%. Unfortunately, ancient Roman pewter is exceedingly rare and so there is not a large amount of information known about it. Pewter was much more common in the Middle Ages until glass-making started to replace it. The earliest piece of pewter currently found is from an Egyptian tomb that dates back to 1450 BCE.

METALLURGY

The Romans also had a great knowledge of metallurgy, the forging of metals into useful tools. The Romans were one of the first civilizations to discover steel, an important advancement over iron. Equipped with iron or bronze, the barbarian tribes were consequently at a serious disadvantage. Metallurgy hence served to preserve imperial authority.



SEWER

The sanitation systems in ancient Rome were far ahead of their time and are comparable to modern day systems. The sewers found in Rome are a prime example of this, which were complex systems covered by stones. Romans flushed waste from **latrines** and connected to a central channel into a primary sewage system that then went into a nearby stream. Thanks to this innovation, Rome had early versions of toilets (They also had an early version of toilet paper, using sea sponges on sticks).

It is estimated the first sewers of ancient Rome were built between 800 and 735 BCE. The systems mainly started to be used for drainage in order to drain marshes and deal with storm runoff. The sewage system truly evolved thanks to the Cloaca Maxima, an open channel which was later covered. The largest of the sewers in Rome was built to drain the land around the **Forum**.



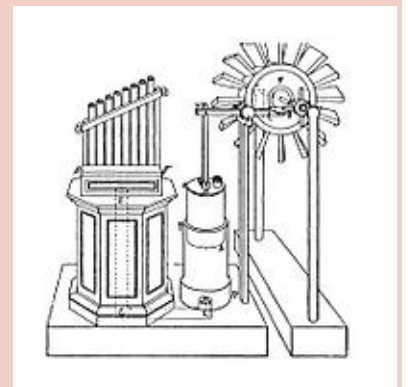
In ancient Rome, citizens would often throw their waste into the street, which led to sanitation problems. Eventually, a law had to be passed where if a person hit a bystander with their waste, they would have to pay damages if the bystander was injured.

STEAM ENGINE



Hero of Alexandria invented the first steam engine which was called an *aeolipile* after the name for the Greek god of wind. From other writings, however, it appears that the Romans knew how to manipulate steam many year prior. The steam was used to power a jet engine that then spun in circles. There is no evidence to suggest that the device had any practical application. However, the *aeolipile* had a place in temples to dazzle practitioners.

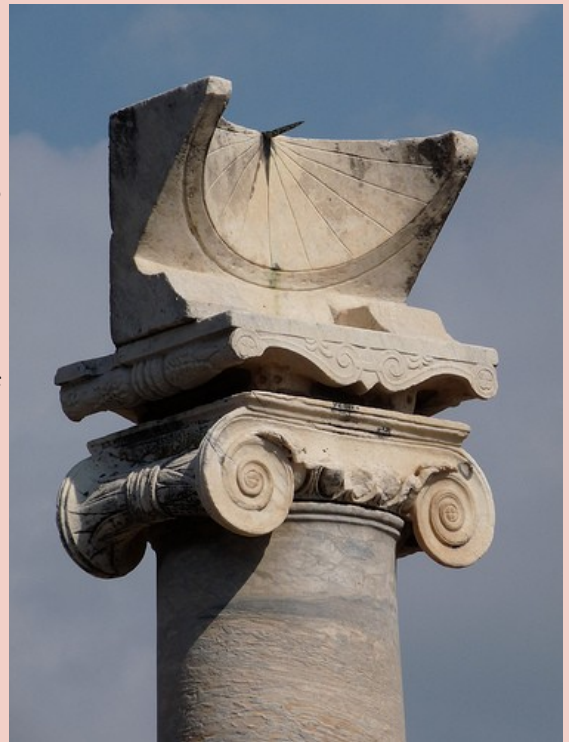
Hero of Alexandria invented many other novelties, many of which revolved around harnessing the power of the wind. For example, Hero also developed an organ powered entirely by wind.



SUNDIAL

The primary Roman contribution to the design of the sundial was making it portable, much like the way they affected the abacus. The first sundials were **obelisks** from 3500 BCE which were part of Egyptian astronomy. A famous example of obelisks used to tell time is the **druidic** Stonehenge. Throughout history, a large number of sundials have been created, including: equatorial sundials, horizontal sundials, vertical sundials, pocket sundials, and other non-planar sundials.

Portable sundials were difficult to produce because the location of a person on earth affects the location of the sun, thus making the readings different. Travelers from Sicily first brought the sundial to Rome in 263 BCE, and, as they often did, the Romans improved upon it. The introduction of the sundial also had an effect on the way the day was divided, which was into twelve equal parts, representing today's hours. To this day, people in Rome leave work at 1:00 PM and return from 4:00 PM to 7:00 PM.



TUNNEL

A number of different types of tunnel can be found in ancient Rome. The most common type was the underground aqueduct which could be found all over Rome. Another type was the tunnel found under the Coliseum used by gladiators and to escort the animals. The largest tunnel in ancient Rome was the three and a half mile long tunnel build to drain the Fucine lake. One of the characteristics of the Roman tunnel was that it was built by excavating both ends simultaneously. Tunnels were very popular in ancient Rome, though they were not often used for foot traffic.

RELIGION

Ancient Rome made leaps, not just in technology, but also in social conventions. One example of this was a newfound tolerance established by the Edict of Milan, signed by Constantine I in 313 CE. This Edict, which was written after the Diocletian Persecution (a **persecution** against the Christians in the Roman Empire), proclaimed religious freedom for all peoples in the Roman Empire.



GLOSSARY

Aristocracy refers to those in power because of their wealth

Druidic is a name for the native religion of the British Isles

The **Etruscans** were the dominant people in Italy before the rise of Rome

The **Forum** was the center of Roman political and social life and the meeting place of the city

Germ theory refers to the understanding that disease is spread by microbes called germs

Gladiatorial combat refers to fights between generally enslaved combatants used by the Romans for entertainment

Latrine is the word for an early toilet

A **Malleable** material is one easily bent into or out of shape

An **Obelisk** is a tall, triangular statue of Egyptian origin

Orators were skilled public speakers.

Persecution is the targeted mistreatment of a people because of their religion, race, gender, or sexuality.

Seismic waves are the manner in which earthquakes transfer energy

A **Villa** is a comfortable house usually situated in the country; most aristocrats had both a city residence and a villa

ABOUT THE AUTHORS



Thomas Devlin (1995-) is an American children's book author. Born July 25th in Worcester, MA, he has spent the entirety of his life living in Douglas, MA. Thomas has also written a number of online articles that have been published on a range of websites from the erudite *Scientia Review* to the more juvenile *SparkLife* (under the pen name Doctor Music). He will be attending college in

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