

JULIUS CAESAR

MILITARY GENIUS



MIGHTY MACHINES

EXHIBITION

Journey back in time, re-live history and discover the life, the culture,
the determination and the genius that carved the great
ROMAN EMPIRE 52BC – 476AD

Featuring

- Interactive Machines
- Recreated Scaled Artefacts
- Virtual Reality Animations
- Recreated Frescos and Mosaics

Exploring

- Military Genius
- Communications
- All Roads Lead to Rome
- Building Rome
- Entertainment
- Gladiators

Become a
"FREE CITIZEN OF ROME"
Audio Tour



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ARTISANS OF FLORENCE PTY LTD
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romanmachines.com





Above: Reconstructed section of Roman ship with crow bridge

Above: The Calceatorian crane, the largest and most powerful weight lifting machine of antiquity

Below: The Noria, for lifting water or transferring rotating energy derived from the flow of water



Above: Sea odometer for measuring distance by sea

Below: Detail of the water clock



JULIUS CAESAR

Military Genius & Mighty Machines
Exhibition



The Empire that shaped the world

Proudly presented by

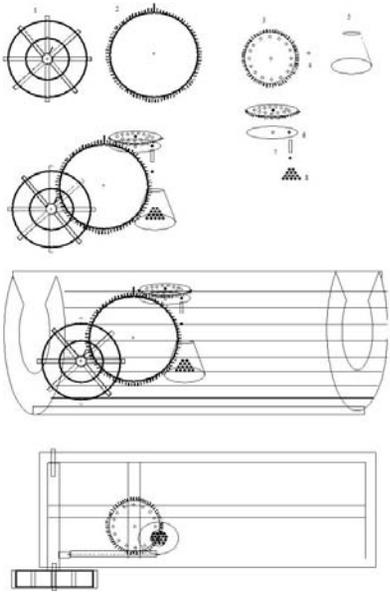
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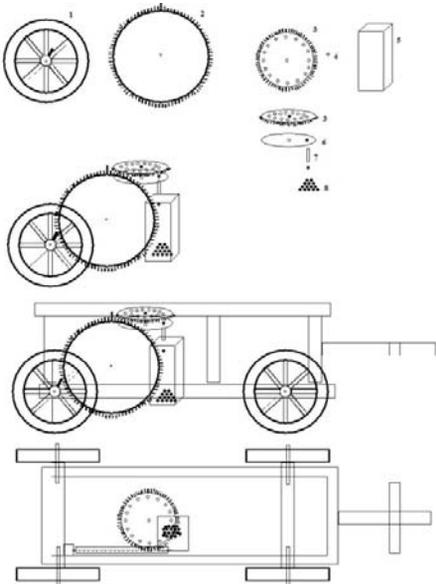






Sea Odometer

Land Odometer



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FOREWORD

It's been almost six years since we first started developing the concept for an exhibition that would, through new archaeological discoveries and re-interpretation of existing evidence, allow us to shed new light and reflect on the enormous achievements emanating from the Ancient Roman civilization.

Every item in this Exhibition is based on factual evidence, historical accounts and faithfully reconstructed artefacts inspired by a number of important exhibitions staged in Italy in the past couple of years (see the reference list at the back of this book).

What makes this exhibition 'special' is the Niccolai-Teknoart SRL© style and tradition – 'interactivity' – tried and tested in the famous 'da Vinci Machines Museum' (in Via Cavour, Florence). The mechanical wonders recreated by the Niccolai Artisans were presented to the public for the first time in early 2010 in Rome, Italy, in a somewhat didactical exhibition entitled: 'Machina – Tecnologia dell'antica Roma'. The machines caused a sensation; newspapers, magazines and even TV news reported and documented what they defined as **"a new way to experience history."** In fact, the exhibition was awarded the Italian President's Gold Medal for cultural innovation. Since we were contributors and the creators of the machines presented in this one-off display, we set about producing the ultimate 'travelling exhibition' to share the same pleasurable experience with audiences, world-wide.

Our narrative covers a monumental era in history, from the triumphant victory of Gaius Julius Caesar over the Gauls (Celtic people from

the ancient country of Gaul, today's modern France, Switzerland and Northern Italy) that sparked the transformation of Rome from a Republic to the mighty Roman Empire.

Besides the military ingenuity that we cover in detail, the Roman Imperial period was an era of massive construction and large scale technical innovation that brought unprecedented well being to the far corners of the Empire.

Material inventions such as the *book, windows, cement, ship building* and *improvements to large machineries* (cranes for lifting, energy wheels for multiple kinds of milling etc.), continued to provide benefit well past the fatal date of 476 AD, the official day the Roman Western Empire ceased to exist.

Most certainly, with its demise, we witness the end of the largest globally integrated economy the world had ever seen and will only experience again, with the time of the industrial revolution of the 19th century.

In our story of the Roman Empire, there are foundational figures that stand out. Their legacies linger on today in the fields of Architecture, Engineering, Military Leadership, Scholarship, Probity and Inspirational Vision. In learning more about them, I hope we have been able to pass on their truly inspiring nature: *Gaius Julius* – the first Caesar (and its derivatives – Czar & Kaiser), *Vitruvius* – Military Engineer and Architect, and *Octavian Augustus* – the first of many Emperors, 82 in fact – some good, some bad, who introduced advancement and enlightenment to the whole Roman World...

In what has been an amazing journey for us over the years of developing this Exhibition is the discovery that so much of Ancient Rome's technology and ingenuity is still connected to us, is present now, in our own age.

The Exhibition brings to life one of the most technologically significant times in the history of humankind. We hope your experience to the Exhibition is as rewarding as it has been for us in creating it for you.



December 2010
Luigi Rizzo MSc., Dip.Ed.
CEO, ARTISANS OF FLORENCE



Museum of Roman Civilization Museo Della Civiltà Roma, Italy

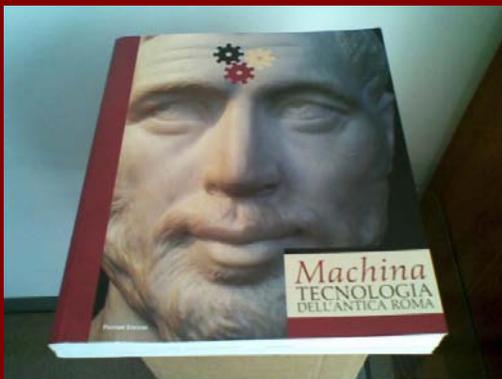
“MACHINA – TECHNOLOGY IN THE ANCIENT ROME”

From 3 December 2009 to 5 April 2010 the academic Exhibition titled, “MACHINA – TECHNOLOGY IN THE ANCIENT ROME” was launched at the Museo Della Civiltà Romana (Museum of Roman Civilization), Rome (Italy).

The 22 interactive machines which featured in the Exhibition created by the renowned Artisans of Florence Company THE NICCOLAI GROUP; have now been incorporated into this entirely new, interactive Exhibition:

“JULIUS CAESAR MILITARY GENIUS & MIGHTY MACHINES” EXHIBITION

Additional interactive machines have been created, virtual reality displays, animations, new themes and special effects have been added to ensure visitors enjoyment and the ultimate ‘Roman Empire Experience’.



Machina TECNOLOGIA DELL'ANTICA ROMA
(Machina TECHNOLOGY IN THE ANCIENT ROMAN)

ACKNOWLEDGMENTS

We acknowledge the Italian Government, Lazio Region and Roma Municipal Institutions for their support with the original exhibition in Rome in 2010. We are extremely grateful for the opportunity provided and the experience gained in working with the “Romans”. Such experience has proved invaluable in discovering ways to overcome challenges and to develop independently, the final product.

CREATORS OF THE ORIGINAL EXHIBITION

Assicuaione Piazza Duomo – Spoleto
Valore Cultura di R. Correnti
Niccolai – Teknoart SRL, The Niccolai Group.

IN COLLABORATION WITH

Comune di Roma
Sovrintendenza Beni Culturali del Commune di Roma
Ambasciate e Istituti di Cultura all’Estero

ORGANISING COMMITTEE

Rita Correnti
Gabriele Niccolai
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Raffaele Percivalli – Ingegnere Civile Edile

UNDER THE AUSPICES OF

Ministero degli Esteri
Ministero dei Beni Culturali
Commune di Roma

SUPPORTED BY

Ministero dell’Universita e della Ricerca
Scientifica

AWARDS

The Exhibition MACHINA – TECNOLOGIA DELL’ANTICA ROMA has been awarded the Gold Medal of the President of the Italian Republic.



INTRODUCTION TO THE EXHIBITION

If we could travel back in time and visit Ancient Rome, we would be very surprised to see how many aspects of our society resemble those of 2,000 years ago.

We would learn that we have inherited from this great Empire, many of the objects, concepts, technologies and machines that are part of our contemporary life.

It has been said that the Romans copied, or at least were greatly influenced by Alexandrine Science (that Greek-Hellenistic revolution sparked by Alexander the Great, circa 300 – 100 BC). However, it is thanks to the socio-economic conditions created during the Roman Empire and the Romans' shrewd and selective adaptations of that knowledge that have allowed the spread and preservation of many 'ancient technologies' to us.

This Exhibition was born from the desire to recreate this fascinating period of history as realistically as possible. Allowing visitors to explore and experience the gadgets, the clever technologies and the mighty machines of the Roman Empire, all faithfully reconstructed by the Florentine Niccolai-Teknoart© technicians.

The Exhibition comprises four thematic sections:

- MILITARY GENIUS
- ALL ROADS LEAD TO ROME
- BUILDING ROME
- LIFESTYLE & ENTERTAINMENT

The Exhibition sets the scene with display panels, videos, 3D virtual reality reconstructions and iconic objects from important historical events, myths and legends of Ancient Rome. Guided through each section the visitor is able to identify historical moments illustrated with the help of time lines.

Among the artefact replicas on display is a collection of rare copies of famous 'volumen' and 'codices' (scrolls and books) including:

- *De Architectura* by Marcus Vitruvius Pollio
- *De Bello Gallico* by Gaius Julius Caesar
- And the first known travel guide, *The Tabula of Peutinger*

And above all... the mighty machines.



The Golden Eagle – symbol of the power of Rome. One of the artefacts in the Exhibition.



RESEARCH AND DEVELOPMENT

REPRODUCTION OF ANCIENT MACHINES AND ANCIENT TECHNOLOGY

The strong passion for history and engineering together with the techniques developed in our laboratory, has led me to create models of ancient machines and tools designed by people like Da Vinci and Vitruvius. The reconstruction of these models is possible through careful studies of *De Architectura* by Vitruvius (Roman architect and engineer of the first century BC – a contemporary of Caesar and Cicero) where there are passages devoted to the building of city walls (Book I), aqueducts (Book VIII), the usefulness of science (Book IX) and finally, the discussion of *machinatio* or construction of machines for civilian or military use (Book X). My interest started in the early 1990's when I produced scale prototypes of ancient machines for research and in preparation for the reconstruction of larger models. To date these number approximately five hundred machines, all meticulously reproduced with materials of the era being wood, iron, cloth, ropes and bronze. The wood most commonly used mainly in construction and carpentry in Roman times and Middle Ages was white fir 60%, with beech and larch for those parts subject to wear and tear. These reconstructed larger models are modular and easily transportable.

In Roman times the problem of protecting wood from weather was resolved by spreading

vegetable pitch – tar, (obtained from red pine resin) and was essential for waterproofing the hulls of ships, amphorae and other more commonly used objects. The pitch however, had a problem of high adhesiveness and for this it was diluted with vegetable oil.⁵

In our endeavours to replicate the ancient techniques, we discovered that the application of vegetable pitch (produced by burning selected pine in a precise methodology) produced a characteristic reddish brown colour in the wood, different from the natural light colour of 'just cut' wood. Our reproduced models have this characteristic colour derived from the precise application of this natural protective tar. The bonding process was undertaken by using glues called *glutina* – extracted from gluten-based animal tissue or cheese. Pliny the Elder wrote that liquid pitch was commonly extracted from the fir tree.⁵

The advancement in computer and software technology in recent years has enabled us to enhance and elaborate on our original drawings, reproducing them to scale and thus creating working machines, which when compared to models of some fifty years ago, reveal previous limitations.

Our 'objective' has been to create interactivity between the visitor and the machines that have marked the history of the machines evolution whilst highlighting the mechanical principals that govern their operation.

This 'up close and personal' interaction provides enjoyment and education for adults and children alike, and allows insight to concepts and practical applications suggesting parallels with today's modern technological world.



December 2010
Gabriele Niccolai DIRECTOR
NICCOLAI TEKNOART SNC (FIRENZE)



THE BIRTH OF ROME THE FACTS

LEGENDS – OFFICIAL ROMAN PROPAGANDA

The fledgling city, populated by male farmer settlers needed women (*The Farmer Needs a Wife*), so by subterfuge and force they abducted the females of the tribe of the nearby hills, an event known as *'The Rape of the Sabines.'*



To prevent a war, the women interceded and pacified the tribes which happily integrated.

Thus began the Kingdom of Rome.

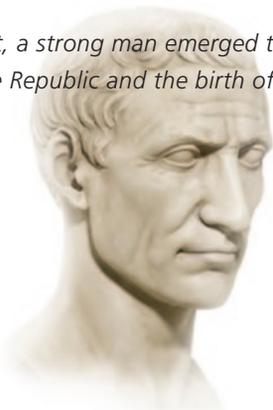
508 BC –27 AD – THE REPUBLIC

Roman historians proudly tell that the last King, the Etruscan Tarquinius Superbus *'the arrogant'*, so enraged the Roman nobles that they drove him out of town and declared a Republic. Thus the Senate, a body composed of elected members from selected Roman families, became the ruling body of Rome. Sharing responsibly the duty of government, their puritanical, virtuous family structure serving well the fortunes of Rome. Lead into victory after victory by cunning, unselfish generals and governed by just and moderate public figures, Rome had become the undisputed *'Queen of the Mediterranean Sea.'*

It is a fact that under the Republic, Rome expanded its territory outside Latium over the Etruscans and the Gauls into northern Italy and over the Greeks to the south. By the year 146 BC, with the final destruction of Carthage, Rome became the undisputed power of the Mediterranean Sea. It had acquired a huge territory to govern. However the republican institutions unable to cope with internal social pressures, entered into a deadly crisis erupting into a series of bloody civil wars.

As a result, a strong man emerged that would sanction the end of the Republic and the birth of THE ROMAN EMPIRE...

Gaius Julius Caesar



WORLD EVENTS THAT INFLUENCED ROME

c.700 BC

Etruscan, probably originating from Asia Minor (Mesopotamia), settled this area and flourished with its mineral richness and the natural ports it offered for sea trade.

330 BC

Alexander the Great annexed Persia and begins the great Hellenistic period.



A period of great scientific discoveries from which the Romans will draw much of their knowledge.





ROMAN TIME LINE REPUBLIC TO EMPIRE

750 BC

BIRTH OF ROME

From a simple village founded by Romulus and Remus, Rome becomes a Kingdom. Seven were the Kings of Rome. The first Romulus, the last Tarquinius Superbus 'the arrogant.'



509 BC

ROMAN KINGDOM

The Kings expelled, the Senate – a body composed of elected members from selected Roman families, became the ruling body of Rome.



146 BC

MARE NOSTRUM

Rome gradually expands over the whole of Italy and finally defeats its arch enemy Carthage, thus becoming the undisputed ruler of the Mediterranean Sea.



100 BC

BIRTH OF JULIUS CAESAR

The Republic is in crisis. Dictators emerge: Marius, Sulla, Pompey and finally Gaius Julius Caesar – military leader, reformer, writer, inventor and *dictator*. He will change the world forever.



58 BC

CONQUEST OF GAUL

This conquest makes Caesar the strongest of all Roman contenders.



44 BC

DEATH OF JULIUS CAESAR

Caesar becomes Dictator and is assassinated by a plot of Roman Senators lead by Brutus. A new Civil War starts.



30 BC

END OF CIVIL WAR

15 years of unprecedented disorder. The last two contenders, Mark Antony is killed in battle and Cleopatra commits suicide.



**27 BC
– 14 AD**

AUGUSTUS THE FIRST EMPEROR

27 BC Octavian becomes Emperor Augustus, historically the first Emperor and concluded what his stepfather Julius Caesar had begun. Rome was now ruled by a 'Prince', an Emperor but retained the Senate. The Empire consolidated. It is in this period that Christ is born.



80 AD

COLOSSEUM IS COMPLETED

Begun in 72 AD by Emperor Vespasian, the Colosseum is completed by Emperor Titus employing mainly slaves from the Jewish rebellion.



117 AD

EMPIRE MAXIMUM EXPANSION

Under Emperor Trajan the Empire had reached its peak controlling approximately 6.5 million km² of land surface.



235 AD

TIMES OF TROUBLE

Over the next 50 years, 31 Emperors hold power and lose it by violent death.



284 AD

EMPEROR DIOCLETIAN

Restores imperial authority and establishes the practice of dividing authority between co-emperors. During the following decades the empire was often divided along East/West lines.



313 AD

EMPEROR CONSTANTINE

Proclaims *Christianity* as the state religion. He also transformed the ancient Greek colony Byzantium into a new imperial residence, Constantinople, which would remain the capital of the Eastern Roman Empire for over 1,000 years.



476 AD

END OF WESTERN ROMAN EMPIRE

The last Western Emperor Romulus Augustus is deposed by the Germanic King Odoacer. The advancements brought by the Romans will continue to provide benefits well past the fatal date of 476 AD, the official day the Roman Western Empire ceased to exist.



THEME I

Military Genius & Mighty Machines

Our story begins in 52BC with the drama of one of the greatest battles of all times – *Julius Caesar's Siege of Alesia* - exploring the main reasons for which the Roman army became known as “unbeatable” -

- Discipline
- Tactics
- Communication (secret codes and logistics) and above all...
- The War Machines

These include mechanical devices such as –

- The Catapult
- The Battering-Ram
- The Mobile Tower
- The Pile Driver
- The Drawbridge
- The “Testudo”, the precursor of the modern tank



The machines are interactive, reconstructed to scale by the Nicolai Group Artisans, using only materials available in Roman times.

We follow the exploits of Gaius Julius Caesar, reformer (inventor), military and political leader, and who played a crucial role in the transition from a republican system of government to an imperial one.

Through the conquest of Gaul, Caesar expanded the Roman “res publica” from Egypt to the Atlantic Ocean and led the Roman armies to the first invasions in written history of Britain and Germany.



Top: Roman Centurion uniform (detail of belt, *gladius* and dagger)

Above: Roman Legionnaire uniform and kit

Left: *Testudo* formation

Below: Roman *Lorica Segmentata*





CAESAR – MILITARY GENIUS

The infantry was completely mobile, capable of marching fast over long distances between battles. It could be moved quickly whilst in battle and was extremely disciplined.

Caesar's army was endowed with a personal armament that was complete in all its components and was of superior quality to that of opponents. The concave shield offered better protection by curving around the trunk of the soldier, the *gladius* was a short but strong sword allowing to strike from the tip and their throwing lance (*pilum*) was far superior to other spears. All legionnaires were further protected by the helmet and the *Lorica Segmentata* that replaced the more common knitted metal tunics, giving them an advantage rated at 3:1.

ROMAN TESTUDO

The Roman *Testudo* (or tortoise) was a much disciplined tactical formation, requiring many drills and tests to achieve excellent collective coordination. The main component being the large rectangle shields that belonged to each legionnaire, shielding the group from arrows and darts.





THE ONAGER (WILD ASS)

The *onager*, named after an Asian draft animal known for its very powerful kick back, was a war machine used towards the end of the Roman Empire and was the most powerful instrument of war used in sieges. It worked by the storing of energy from twitching rope made of horse hair (on account of its elasticity). Inside the twisted rope was a lever pivoted at its lower end and at its top was a sling with a bolt or stone. When the lever was released the slingshot was ejected with force. From technical testimonies it is known that nine men were needed to operate just one of these machines.

The projectiles in the sling, ranged from weights of 5kg to 50kg, so the shooting range varied from 200m to 600m, according the weight of the projectile. The kick of the machine was so powerful that if it was not well anchored to the ground, it would jump backwards after each shot, risking tipping over, not to mention harming the operators.



DEFENCE TOWER-LARINGA

“Julius Caesar, being with his army near the Alps, ordered the town of Larignum, to supply him with provisions. The inhabitants, trusting in their fortifications, refused. Caesar ordered his forces to the spot immediately in front of the gate of this fortified town where there stood a tower built of timber, of considerable height, and constructed after the manner of a funeral pile with beams alternately crossing each other, so that the besieged might, from its top, annoy the besiegers with darts and stones.”

“Caesar ordered his men [to throw] torches to the tower, which was quickly executed by the soldiers. As soon as the flames began to en-compass the tower, everyone expected to see its demolition. But as soon as the fire was extinct, the tower appeared still unhurt; and Caesar, wondering at the cause of it, ordered it to be blockaded out of arrow's flight, and thus carried the town, which was delivered up to him by its trembling inhabitants. They were then asked where they obtained this sort of wood, which would not burn. They showed him the trees, which are in great abundance in those parts. Thus, as the fortress was called Larignum, so is the wood, whereof the tower was called larigna (larch).”

Vitruvius *De Architectura* Book II Chapter 9-10

THEME I – MILITARY GENIUS



THE ASSAULT TOWER

What is it?

The use of these war machines was to overcome the advantage wall defenders had over attackers. It had two functions, offensive and defensive; offensive to bring fighters above the walls – and defensive: by protecting attacking soldiers or those committed to working with other war machines.

Towers were multi-storey mobile constructions usually higher than the wall they had to overcome.

They were covered with fire retarded materials as much as possible and in a way to reduce damage from projectiles.

Inside the tower it was possible to move between floors using stairs and there were many slits in the outer



Photo Nicolai Teknoart SNC (Firenze) © 2009

walls to allow the occupants to throw darts to the enemy. Built of wood, usually *larch*, the discovery of the properties of this special wood was attributed to Caesar by Vitruvius (refer following page).

How it works:

The towers were mounted on wheels and of course they were pushed by men or by animal traction.

We also have records of mobile towers coated in iron to increase protection and to improve stability. Smaller towers could incorporate a ram, engaging defenders with a dual action: from the bottom with the ram and at the top with armed men attacking the walls.

Clearly, such a heavy construction could only move on flat ground or where appropriately smoothed. Therefore the element of surprise was not the tower's strength. Usually the defenders could counteract the danger by digging masked ditches or holes in the path of the machine or by burning it.



“The most fearsome tower of all was an enormous fortified engine called Helepolis (the “destroyer of cities”) invented by Demetrius Poliorcetes. It consisted of a square tower placed upon wheels, and run up to the height of nine stories, each of which was furnished with machines for battering and discharging projectiles of enormous size and was armed with its own banks of catapults and sling throwers. It was 50 feet square at its base, more than 100 feet tall.”

Vitruvius *De Architectura* Book X³



THEME II

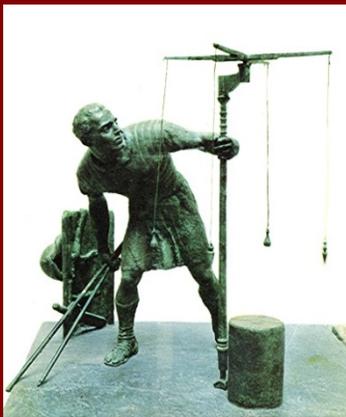
All roads lead to Rome

- Measurements
- Transportation
- Communications

This section is dedicated to the Roman Civil Genius and shows how the Romans mastered technology to control their environment and govern their citizens.

The Exhibition looks at machines used for:

- Transportation - both on land and at sea
- Machines to measure distances (the odometer)
- Machines to measure time (the water clock)
- How to build roads (that we still use today).



The Romans understood physics and excelled at controlling natural resources (the aqueduct), and used the abacus to manage their finances.



In order to communicate with and better administrate (control) their multi-ethnic populations in such a vast Empire, they adopted a sophisticated strategy of propaganda images, we now refer to as Public Relations or even "Spin".



Top: Roman roads today
Above: The water clock

Left top: The groma Below: The abacus
Below: Bust of Caesar "Spin"



ROMAN ROADS

The development of the Roman Empire depended on the roads. The Roman road system **spanned more than 400,000 km of roads, including over 80,500 km of paved roads**. When Rome reached the height of its power, no fewer than 29 great military highways radiated from Rome. Hills were cut through, deep ravines were filled in, rivers were bridged, mountains were tunnelled and they were built to last, evidenced by some still in use today.



The construction technique of a Roman road varied greatly depending on the terrain, materials available and geographical needs of the path. A mountain road for example would vary greatly from one built in wetlands, which in turn was different to one on flat or undulating fields. The first step was the design of the route: once the starting and the arrival points were selected, the most convenient and shortest possible path was chosen. To do this they used tools such as the **groma** for straight lines and the **chorobates** for the levels.

Once the path was marked on the ground they created the *statumen*, the base of the road, a trench about a metre deep that was filled into a 30 - 60cm layer of large hard stone. The second layer, the *rudus* (road derives from), was a little thinner and consisted of smaller stones pressed and kept compact with lime and *pozzolan* (cement mix). Then followed a more elastic layer made of sand and gravel (or gravel and fragments of pottery and rubble), compacted

by heavy rollers. The final cover, *pavimentum*, was formed by basalt paving stones or hard stone, which with their wedge shape were sunk in to a bed of sand. The final surface was smooth and curved, allowing for storm water runoff.

Once the roadway itself was completed, they built sidewalks on both sides, often with a layer of gravel or clay, slightly elevated above the pavement of the road and separated by edges in stone. Pedestrian crossings were erected where necessary by placing large stepping stones elevated to the level of the sidewalks and far apart to allow cart wheels to pass through.

Along the sidewalks were the mile-stones indicating distances from the nearest city. Lastly on the outer sides of the sidewalks sewer channels were dug to collect and divert storm water, thus ensuring the road structure remained dry.

THEME II – ALL ROADS LEAD TO ROME

TRANSPORT AND COMMUNICATION



THE TABULA OF PEUTINGER, THE 1ST ROAD MAP & TRAVEL GUIDE

The Tabula of Peutinger (shown below) is a road map, not to scale, not to true cardinal orientation, but a map with useful information of government run facilities, for the use of government officials. Made up of 11 original segments it is the result of successive copies and overprints carried out at various time from one or several ancient originals. The oldest information probably goes back to before 79 AD since Pompeii is indicated. It is an exceptional document without equivalent.

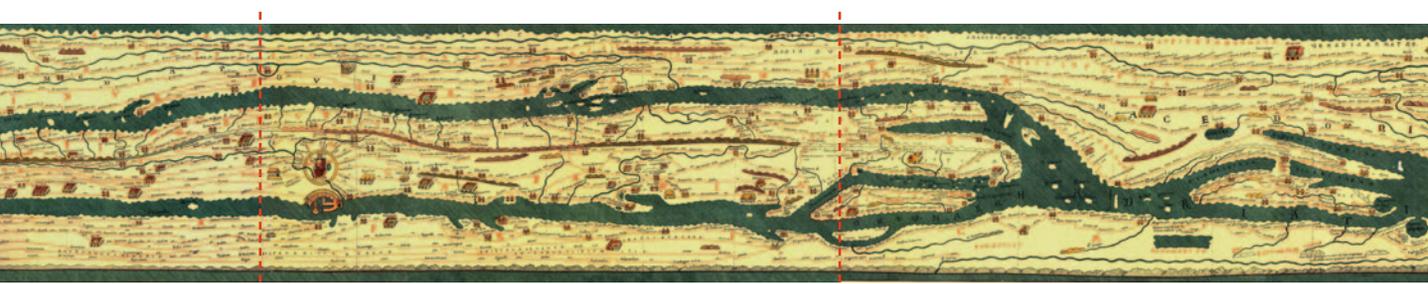
For practical reasons (i.e. to fit it all into a scroll), the Italian Peninsula seems to extend from west to east (as indeed is the rest of the world). This map is a compilation and a positioning of itineraries previously written in the form of ordinance maps for the use of officials, showing the world, as known in the late 3rd century AD, at the apex of the Roman expansion. The routes were drawn in order to be clearly readable without taking into account the scale or the exact geographical orientation, the essential being to show the distance and the cross-roads, not the land topography.^H

Map Key

- BLACK INK – Names of towns, names of roads
- RED INK – All roads, names of important cities, provinces, regions
- YELLOW – Land mass
- GREEN/BLUE INK – Seas, rivers and baths
- OTHER INKS (brown, grey, yellow, pink, red) – Mountains
- ROMAN NUMERALS – Distance between centres – Roman mile (l=1482m): west of Lyon Gallic Leagues (2220m); Persian Empire, the Parasanghe (6000m); India, the Indian Mile (3000m)
- 2 to 3 TOWERS (42) – Basic rural Roman villa equivalent to a 2 or 3 star hotel
- TEMPLES (44) – Substantial rural mansion near or part of a temple. Change of horse, food, good private rooms, equivalent to 4 star hotel
- BATH HOUSES (52) – Substantial rural mansion as above with Roman bath equivalent to 5 star hotel
- DEPOTS (10) – Bulk supply warehouses for military/commercial use
- WALLED CITIES (6) – Important roads, important road junctions (Rome has 12, Antiochia has 11)
- PORTS AND LIGHT HOUSES (4) – Major arrival and departure points for goods with good road connections. Europe (near Marseille), Italy (near Rome), Asia Minor (near Byzantium), Africa (Alexandria)

TUNNELS, BRIDGES, UNDERPASSES – are not shown even though there were many, some are occasionally mentioned in passing text as not important for travel planning. (Similarly, this type of information is not included in subway maps).

The Tabula of Peutinger SEG. IV, V, VI showing Italy and Greece



ORIGINS

All originals of the Tabula of Peutinger have been lost. The exhibit on display was copied in 1265 AD by a monk from Colmar. Consisting of 11 parchments joined into one scroll measuring approximately 35cm wide and 7m in length, it was discovered in 1494 and then given to an antiquarian of Augsburg, Konrad Peutinger in 1507. The lost piece containing parts of

UK, Ireland, Spain and Western Africa was reconstructed by Konrad Miller in 1916. At present the Tabula of Peutinger is conserved in the Austrian National Library in Vienna. The whole map looks like a modern stretched and flattened roadmap, just like a subway plan, extending past the boundaries of the Roman Empire, even as far as India, Myanmar and China.



By stretching a modern map – above, and joining the various segments, one obtains the Tabula of Peutinger projection.



Cart with *odometer*
 Vitruvius *De Architectura* Illustrated 1521 Edition



TRANSPORT – BY ROAD

The Land *Odometer*

From the testimony of Vitruvius' *De Architectura* Book VIII, the *odometer* described is a complex but ingenious method of measuring distances both on land and on water, with the appropriate modifications.

With a diameter of 4 Roman feet (1.18m), the *odometer* was applied to an axle of a wagon, adjusted to the outer rim, which according to Vitruvius, had to complete 400 revolutions to cover a mile.

The instrument consisted of a device of toothed gears. At each turn of the wheel the teeth acted on a device that enabled a pebble to drop into a container for every mile travelled. At the end of the journey, by counting the pebbles, the operator would know how many miles were covered.

TRANSPORT – BY SEA

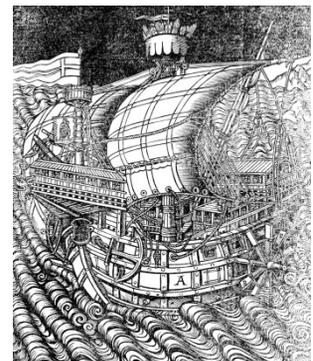
The Sea *Odometer*

From the testimony of Vitruvius' *De Architectura* Book VIII, the *odometer* described is a complex but ingenious method of measuring distances both on land and on water, with the appropriate modifications.

With a diameter of 4 feet (1.18m), the naval *odometer* was applied to a paddle wheel on one side of the boat or ship. The machine was adjusted to the circumference of the paddle wheel, which according to Vitruvius, had to make 400 revolutions to travel one nautical mile.

This device however, unlike the land odometer, did produce inaccuracies in the measurement of nautical distances. The problems derived from the motion of the sea (currents) but it still provided an estimation of the distance covered.

"... The mechanical principle is identical to that of the land odometer where a paddle wheel is included on the outside of the ship. The diameter measuring four Roman feet as the wheel of the wagon."
 Vitruvius *De Architectura* Book X 5-7



Ship with sea *odometer* - Vitruvius
De Architectura Illustrated 1521 Ed.



THEME III

Building Rome

The Roman Empire was in a state of constant expansion. Engaging in large scale construction projects, from roads and bridges to bath houses and majestic monuments such as the Roman Arch that were symbolic of the Empire's greatness.

This section of the Exhibition contains the devices that contributed to this phase of massive construction and industrialization, which may be considered the prelude to the industrial revolution.

On display visitors will discover:

- The Pulley
- *Chorobates* (construction tools)
- The *Calcatorian Crane* (the most powerful crane in antiquity, powered by slaves or animals)
- Hydraulic Mills
- Turning Platform (precursor of the ball-bearing)
- Large Water Lifting Machines
- Aqueducts.



What made these feats of engineering so remarkable and durable was the Roman sophisticated use of construction materials.

Inventions like cement, glass windows and large-scale production of an incredible variety of brick and marble products.



Top right: Model of Rome
The *Vitruvian Mill*
The *Vitruvian crane* (used in the building of the Colosseum)
The *noria* waterwheel
Left: Roman bricks



THEME III – BUILDING ROME



CRANE WITH TREADMILL – THE CALCATORIAN

What is it?

A machine intended for lifting and moving heavy loads, used in the construction of large temples, bridges and

aqueducts. An example of the machines is displayed on the bas-relief of the tomb of the *Haterii* (a family of builders), representing a crane in operation.



Bas-relief from the tomb of the Haterii

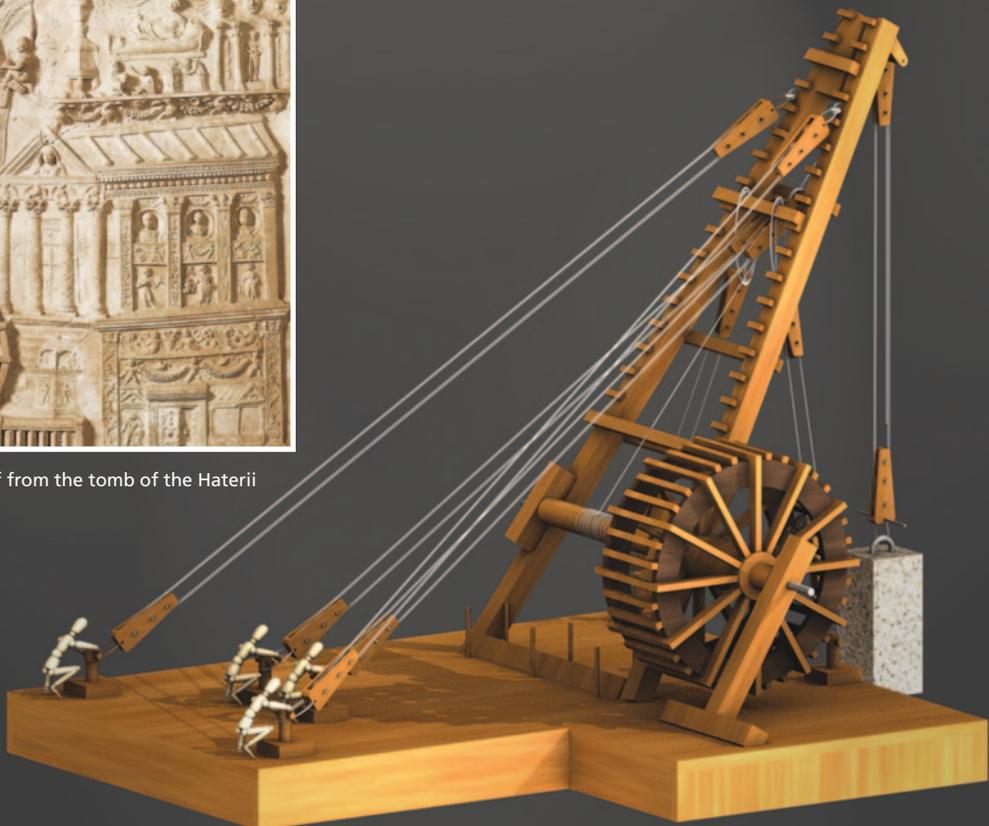


Image Mirko Marina Graphics © 2012
Model Niccolai®

How it works:

Made entirely of wood more than 10 metres in height, the machine was used by gangs specialized in lifting materials and placing objects at various heights. The machine had the function to lift heavier weights by connecting various pulleys at the top of the machine. Reaching the desired height, the safety ropes were released while keeping the pivot arm forward so as to bring the object on the vertical final position in which it was placed. The big treadmill wheel at the bottom was like a circular ladder spinning in the middle and set in motion by five men who made it work by climbing its steps. The crane was described as one of the most powerful ancient cranes capable of lifting weights of up to 21 tons.





■ ROMAN ARCHES IN THE COLOSSEUM

Building the Colosseum was only possible by the combination of two great Roman innovations – *concrete* and *vaulted arches*. Concrete was a recent invention, it was made by mixing a strong volcanic material (called *pazzolana*) with rubble, sand and a mixture of limestone.

The Colosseum had four tiers. The ceilings of the passages and corridors which circled the arena on each tier consisted of vaulted arches made of concrete that were supported by bases made of strong, heavy limestone. The vaulted arches made the ceilings much stronger than a flat ceiling would have. Vaulted arches made of concrete added strength to the building without adding excessive weight. This is why 2,000 years on they are still standing.

■ THE CHOROBATES

Described by Vitruvius in Book VIII of *de Architectura*, the *chorobates* was used to measure to horizontal plane especially important in the construction of aqueducts.



THEME III – BUILDING ROME



THE ROMAN ARCH



What is it?

Perhaps the greatest architectural invention ever, the Roman arch is a structure that spans a space to support a load.

For their various enormous monuments as well as functional constructions, the Romans required and sought a more economic building material than the large blocks of stones being used at the time.

Arches of brick first appeared in Mesopotamia around 200 BC; however their systematic use started with the Ancient Romans.

The Romans were the first to apply the technique using a wide range of building materials such as bricks, stones, volcanic rocks, masonry and the newly invented concrete which allowed the use of any sort of discarded rubble.

How it works:

First they built a frame (historically, wooden) that followed the exact form of the underside of the arch. The blocks were laid on the frame, one by one – each being different, with the keystone the last in place. Once the arch was complete and self supporting they carefully removed the scaffolding. Occasionally, if the construction process had not been followed correctly, when the frame was removed, the arch fell down.

The arch works because all the forces are resolved into compressive stresses which hold it together in a state of equilibrium. One downside however, is that an arch pushes outward at the base, requiring reinforcement.

Roman arches enabled the Ancient Romans to build multi-storey buildings. They built monuments (like triumphal arches), bridges, aqueducts, sewers, amphitheatres, temples and palaces. Its application extends to domes and cupolas, and various other parts of buildings where economy of material and labour was desired.



An Arch is made up of

- | | |
|-------------|---------------|
| 1. Keystone | 5. Intrados |
| 2. Voussoir | 6. Rise |
| 3. Extrados | 7. Clear span |
| 4. Impost | 8. Abutment |



THEME IV

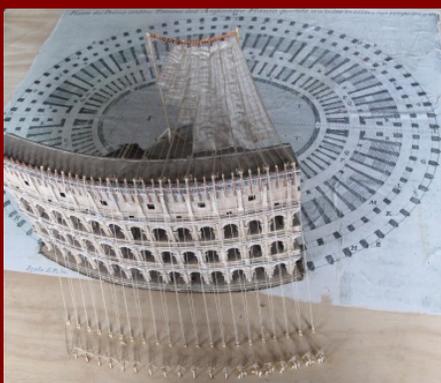
ENTERTAINMENT & LIFESTYLE Gladiators, Entertainment, Art

The Romans also used their knowledge and skills in architecture and engineering for entertainment and relaxation.

They built amphitheatres (the Oval Arena is their invention) to host gladiatorial games, their favourite sporting event.

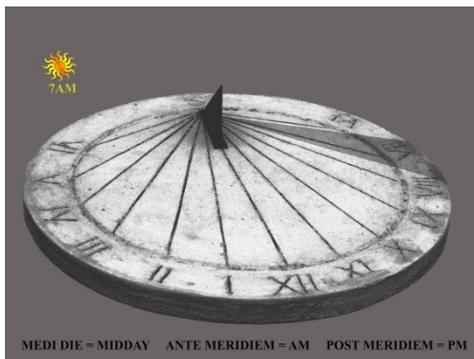


The Colosseum is one of the world's most famous monuments. This stadium, technologically advanced even by today's standards, was fitted with features such as the *velarium*, the *vomitoria*, lifts, turning platforms and turn-stiles. The skilful Niccolai Group artisans have meticulously reconstructed these features to scale, and have even recreated the gladiators in their dramatic final act.



Other forms of entertainment and lifestyle are examined (gambling with dice, playing with dolls and fast foods). In fact Roman citizens enjoyed a busy calendar of religious rites and social events aided by gadgets such as pocket sun-dials and personal "notebooks".

As a final experience visitors are invited to learn about the art of Roman Times by taking part in painting frescos and constructing mosaics.



Top right: Fresco artwork
Roman horizontal sundial
Tabula rasa "the note book"
Roman clothing

Mid left: The Great Mosaic - Gladiators fighting
Lower left: Velarium – Colosseum shade verandah

THE COLOSSEUM

For wealthy Romans life was good. They enjoyed an extravagant lifestyle with luxurious furnishings, surrounded by slaves and servants. Poorer Romans, however, could only dream of such lifestyle but could still relax in public baths and be entertained by popular sporting events in the Colosseum, events such as gladiators fighting, chariot racing or the slaughter of beasts, criminals and Christians.

All Roman citizens were admitted free of charge to the Colosseum. The Emperor and VIPs (Senators, vestal virgins and visiting dignitaries)

were given the better 'boxes' and seating depended on social standing. Men and women were seated separately, it was said to protect the man from exposure to bad language.

"The Colosseum was divided into four main 'zones.' The first was reserved for distinguished private citizens. The second was intended for the middle class while the third zone was reserved for slaves and foreigners. Finally, the fourth zone was occupied by women and the poor who sat on wooden seats beneath a separate flat-roofed colonnade."

Comfort, safety and air conditioning

Dimensions

Shape:	Oval
Capacity Maximum:	80,000
Number of Entrances:	76
Maximum Height:	50m (187')
Length:	189m (615')
Width:	156m (510')
Outer Circumference:	545m (1,788')
Centre Arena:	87m (287') long, 55m (180') wide
Marble used:	Approximately 100,000m ³

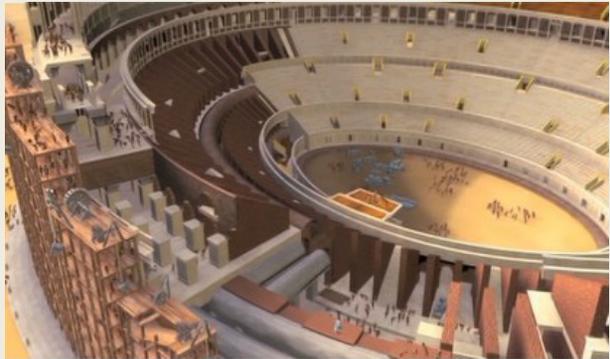


Image courtesy of History Channel

The *Amphitheatrum Flavium*, better known as the Colosseum, is the largest amphitheatre ever built in the Roman Empire and occupies a site just east of the Roman Forum. Capable of seating up to **80,000 spectators**, it was used for gladiatorial contests and public spectacles such as mock sea battles, animal hunts, executions, re-enactments of famous battles and dramas based on classical mythology.

Construction consisted of 4 levels with approximately 60-80 rows of seats, each seat 40cm wide x 70cm leg room. Turnstiles, crowd controllers and the *Vomitoria* provided easy access for entry & exiting. Drains were installed 8m (26ft) below structure. Foundations, under outer walls and

seating, were 12-13m (39-42ft) deep. Then foundations, roughly in the shape of a dough-nut, made of concrete, under the outer walls and seating, are 12-13m (39-42ft) deep, while under the inner ellipse of the arena, are only 4m (13ft) deep and designed in strips beneath each of the concentric walls. The arena was covered with 15cm of sand. Given the scale of the enterprise it was built remarkably fast and given the site, in a valley where there was previously a lake, it had to be planned carefully. Its construction started between 70 and 72 AD under Emperor Vespasian using mainly Jewish slaves and was fully completed in 80 AD under Titus, with further modifications being made during Domitian's reign (81 AD – 96 AD).

THE VELERIUM

The *Velarium* was a retractable awning that provided cover and shade. It was operated by special corps of roman sailors numbering in the hundreds.

Each retractable awning was pulled into place by a system of pulleys and ropes each attached to pillars around the perimeter the colosseum.



COLOSSEUM - HYPOGEUM LIFTS FOR BEASTS & GLADIATORS

The *Hypogeum* (under-ground) consisted of a two-level subterranean network of tunnels and 32 animal pens. There were 80 vertical shafts providing instant access to the arena for animals and scenery. Large hinged platforms provided access for large animals. Trap doors, there were 36. Inside the *Hypogeum*, was a complicated, underground mechanism operated by 300 men, used to elevate animals and gladiators into the arena at a certain time of the show. The elevators were different in size according to their use (during the time of Trajan, there were at least 60) and their mechanism of winches and counterweights were at the cutting edge for the time.



GLADIATORS

A gladiator (from *gladius* 'sword') was an armed combatant who entertained audiences in violent confrontations with other gladiators and wild animals, not only in Rome but throughout the many amphi-theatres (sporting arenas) of the Roman Empire.



Professional gladiators were free men who volunteered to participate in the games. They were trained like professional athletes, were paid each time they fought and given medical attention if needed. Most gladiators were slaves, schooled under harsh conditions or criminals who had been found guilty of murder and condemned to death and sent into combat without weapons. Other criminals who had committed lesser crimes were allowed to fight with weapons of their choice.



THEME IV – ENTERTAINMENT & LIFESTYLE



TYPES OF GLADIATORS

Samnite

(Defeated enemies 342–290 BC) Features: a shield (*scutum*), a metal or leather guard (*ocrea*) on left leg, a helmet (*galea*) with crest and plume, and a sword (*gladius*).

Thracian

(Roman Province since 46 AD, Spartacus was a Thracian, as were some Roman Emperors 3rd–5th century) Distinctive features: leather guard both legs, a small square shield, either a *galea* helmet or an open faced one with wide brim and a curved sword.

Secutor

(The Cutter) Distinctive features: naked except for a leather guard on the left leg, leather bands at the elbow and wrists (*manicae*), a helmet, carrying only a large oval or rectangular shield and a sword or dagger.

Retiarius

(Fisherman) Distinctive features: wearing only a loin cloth (*subligaculum*) and a metal shoulder-piece (*galerus*) on the left arm, and carrying a net (*iaculum*), a dagger and a trident (three-pronged spear).

Laquearii

Similar to *retiarius* but with a lasso instead of a net.



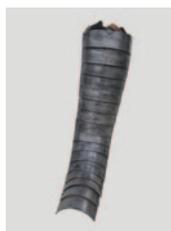
Secutor (the Cutter)

Photo Niccolai Teknoart SNC (Firenze)
© 2009 Models Niccolai®



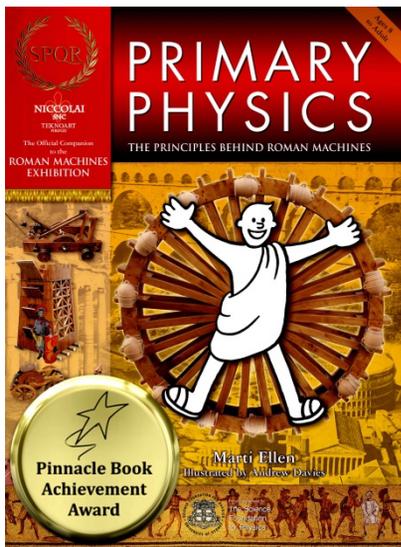
WEAPONS OF THE GLADIATOR

- Fascina*: Harpoon
- Galea*: Visored helmet crest
- Galerus*: Metal shoulder piece
- Gladius*: Sword
- Hasta*: Lance
- Iaculum*: Net
- Manicae*: Leather elbow
- Ocrea*: Metal or leather
- Greaveparma*: Round shield
- Scutum*: Large oblong shield
- Sica*: Curved scimitar
- Subligaculum*: Loin cloth



Clockwise from left: Gladiator leather arm protector, helmet, gladius & sheath, oblong shield, net & harpoon, leather leg protector and metal or leather shoulder protector.

Photos Niccolai Teknoart SNC (Firenze) © 2009 Models Niccolai®



EDUCATION PROGRAM

This new international, interactive 'JULIUS CAESAR' MILITARY GENIUS & MIGHTY MACHINES Exhibition provides Schools and Teachers with the opportunity to bring Ancient Rome's lifestyles, culture and history into the classroom.

A fascinating display of over 100 exhibits, including interactive machines, models and activities, virtual reality animations, video, scaled reconstructions, demonstrations and historical timelines provides a variety of subjects for teachers to integrate into classroom programs.

Subjects as varied as archaeology, art, ancient cultures, science, historical events, science, politics and the enormous achievements in technology that occurred during an incredible period from ancient history.

TEACHER RESOURCES

Award Winning Education Resources which include ideas and formats for integrating the Exhibition themes and content into classroom programs are available, providing a valuable teaching tool for all schools bookings excursions.

Suitable for all school levels through to University, offering the potential for students to achieve a number of outcomes in their own state's Curriculum and Assessment Framework - Primary, Secondary and Tertiary Studies.

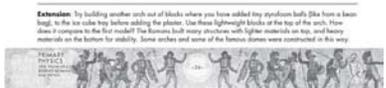
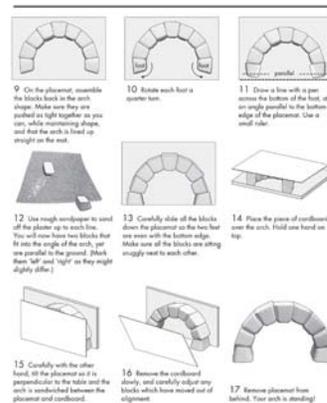
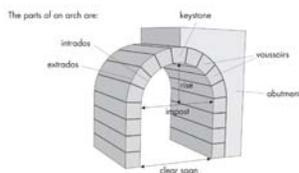
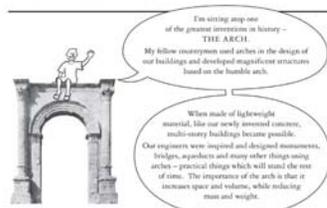
Primary Levels: Art (Exploring and responding), History (Historical knowledge and understandings, Historical reasoning and interpretation), Design, Creativity and Technology (Analysing and evaluating), LOTE (Intercultural knowledge and language awareness), Science (Science knowledge and understanding, Science at work) Thinking Processes (Inquiry, Reflection, Evaluation).

Secondary Levels: Art (Exploring and responding), History (Historical knowledge and understandings, Historical reasoning and interpretation), Design, Creativity and Technology (Analysing and evaluating), LOTE (Intercultural knowledge and language awareness), Science (Science knowledge and understanding, Science at work) Thinking Processes (Inquiry, Reflection, Evaluation), Visual Communication and Design (Exploring and responding).

Various Studies: Art (Unit 1: Art and meaning, Unit 2: Art and culture, Unit 3: Inter-pretting art, Unit 4: Discussing and debating art), Design and Technology, Roman History, Physics, Systems Engineering, Studio Arts (Unit 1: Interpretation of art ideas and use of materials and techniques, Unit 2: Ideas and styles in artworks, Unit 3: Professional art practices and styles, Unit 4: Art industry contexts), Visual Communication and Design (Unit 2: Communication in context).

Tertiary studies: Archaeology, Art, Art-History, Cultural Studies, Design, Engineering, Graphic Design, History, Science, Medicine, Psychology, Physics, Sociology, Technology, Woodcraft.

Roman arch



EXHIBITION OVERVIEW

AIM

To take advantage of new archaeological findings and new scholarly dissertations on “ancient technologies” over the past 20 years.

JULIUS CAESAR EXHIBITION – MILITARY GENIUS & MIGHTY MACHINES was born from the desire to recreate this fascinating period of history, as realistically as possible, to explore and experience the “machines” and clever technologies of the Roman Empire that have been rediscovered and better understood thanks to new interest and re-interpretation by scholars over the past 20 years.

THEMES

The Exhibition begins with historical introduction featuring timelines and primary sources of information and then presented in four themes:

THEME I	Military Genius
THEME II	All Roads Lead to Rome
THEME III	Building Rome
THEME IV	Gladiators, Entertainment, Art

KEY FEATURES – over 100 Exhibits

41	INTERACTIVE MACHINES	Built to scale with the materials of the time By: THE NICCOLAI GROUP
23	ARTEFACTS	Genuine artefacts together with recreated to identical specifications from the Roman originals
36	VIRTUAL ANIMATIONS	To demonstrate how Roman Machines, Technologies and Society worked (including 5 film clips)
18	GIANT PANELS & GRAPHICS	Presenting Time-Lines, Paintings and Maps to inform and create atmosphere
55	STANDS	Informative labels for each exhibit
3	SHOWCASE	Glass display cabinets

VISITORS HIGHLIGHTS

- Take the Audio Tour and become a “Free Citizen of Ancient Rome”
- Experience their mighty machines up close and personal
- Play with Catapults, Assault Towers and Gladiators
- Make your own Mosaics

VISITORS OUTCOMES & SUITABILITY

The exhibition is experiential, historical, technical, artistic and educational and designed to:

- Stimulate interest in scientific achievements and in particular, *Ancient Technologies*
- Provide visitors with the experience of travelling back in time, around 2000 years
- To feel and touch and in most cases operate the “mighty machines” of Ancient Rome
- Gain the knowledgeable of technologies that made *The Roman Empire* so successful.

The exhibition is suitable for the general public, people of all ages, from early primary school, university students to senior citizens.

JULIUS CAESAR ANCIENT ROME EXHIBITION

**Accessories and Official
Exhibition Companion Products**

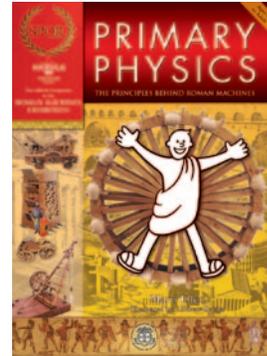
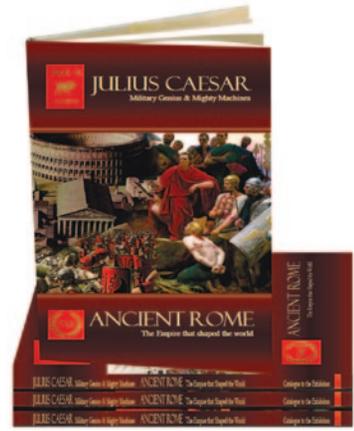
BOOKSHOP

Top:

JULIUS CAESAR – ANCIENT ROME
80 page full colour Exhibition Catalogue

Right:

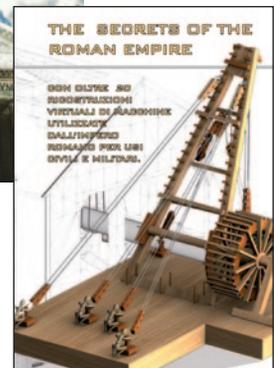
PRIMARY PHYSICS
The Principles Behind Roman Machines
64 pages



DVDS

ANCIENT ROME – INSTANT EXPERT
HISTORY CHANNEL approx. 94 minutes

THE SECRETS OF THE ROMAN EMPIRE
3D animation of
all the machines in the exhibition
with explanatory notes.
Mirko Marini Graphics
approx. 100 minutes



GIFT SHOP SOUVENIR

*Julius Caesar Exhibition
Commemorative Coin*

VENI VEDI VICI

"I came, I saw, I conquered"



1995 - Florence, Italy. The Niccolai firm of father and sons, in co-operation with noted academics and working in close collaboration with *Professor Carlo Pedretti*, enriched the study of Leonardo Da Vinci's mechanics by creating a series of interactive models.

Skilfully, using materials from the time, such as wood, cotton, brass, iron and cord, they presented each exhibit with a replica copy of the code page from the recently rediscovered Codex Madrid, from which its design was taken.

In 2001 the Italian Government recognised the high quality and skill achieved by the Niccolai family by conferring upon them the special award "Italia che Lavora" (Italy at Work).

In 2005 the Niccolai-Teknoart Group expanded with new partners, Mirko Marina (Architect) for animations, Antonio De Vito (Fresco Master/Artisan), Lisa Bouvier (Art Historian & Artisan), Sara Tagliagambara (Historian) and Luigi Rizzo (Physicist for Science/Education) and undertook new projects.

In 2009/10 the new Exhibition *Da Vinci Secrets "Anatomy to Robots"* was launched in Melbourne, then Sydney and Seoul making headlines for its 15th century 'working robots' – never seen before. The discoveries are the subject of the book titled *Leonardo da Vinci: Automations and Robotics*, CB Editions.

In 2009/10 the new Exhibition *Machina Technologia Dell'antica Roma* staged at the Museo Della Civiltà Romana, Rome, was awarded the 'Gold Medal' of the President of the Italian Republic. It has also featured in television documentaries in Italy and international magazines such as *Focus*, *Newton*, *National Geographic* and *Scientific America*.

In 2012 the Group launched the brand new exhibition based on historical and scientific data titled *-Julius Caesar Military Genius and Mighty Machines*. Launched in Melbourne, Australia it then opened at the Seoul War Museum in Korea, the South Australian Museum and the Hong Kong Science Museum before traveling to Taiwan R.O.C. in 2013.

In 2013, in collaboration with the Artisans of Florence and I Muri dell'Arte, the Niccolai Group launched the brilliant *The Divine Michelangelo* Exhibition at the Taipei National Museum of History. The Exhibition which is based on Michelangelo's life time achievements features FULL SIZE copies of his famous sculptures including the DAVID - created from the antique collections of casts derived from the original works.

To date, exhibitions created by The Niccolai Group have toured major cities all around the world entertaining in excess of 6 million visitors.

THE NICCOLAI GROUP



Father and son team, Carlo & Gabriele Niccolai in the Florentine workshop of The Niccolai Group



Luigi Rizzo and Gabriele Niccolai



Carlo Niccolai, Gabriele Niccolai with Carlo Pedretti Dr. Lt. 1928 (centre). Emeritus Professor Leonardo Studies UCLA (USA).

Advisor to the Italian Government on matters Da Vinci. In addition, adviser to Queen Elizabeth II, British Library, King of Sweden, Bill Gates and the Niccolai family on matters Da Vinci. Author of over 40 books, recipient of Italian Government Gold Medal for Services to Culture and a Congressional Citation by USA Government, both awarded 1972.

AACHINA EST CONTINENS E MATERIA CONIUNCTIO MAXIMAS AD ONERUM MOTUS HABENS VIRTUTES. EA MOVS
ST AUTEM UNUM GENUS SCANSORUM. QUOD GRAECE ACROBATICON DICITUR. ALTERUM SPIRABILE. QUOD A
UERUNT CONLOCATAE, UT AD ALTIUDINEM TIGNIS STATUTIS ET TRANSVERSARIIS CONLIGATIS SINE PERICULC



ARCINAZZO ROMANO
16 APRILE - 5 GIUGNO 2011

PRESSO LA "CASA DELLA CULTURA" PIAZZA S. LUCIA

MACCHINE DELLA TECNOLOGIA ROMANA



ORARIO VISITE: DA MERCOLEDÌ A DOMENICA DALLE 10,00 ALLE 13,00 E DALLE 15,00 ALLE 19,00
LUNEDÌ E MARTEDÌ PER GRUPPI (MIN. 20 PERS.) SOLO SU PRENOTAZIONE
CONTATTI: 0774.80.80.06 - 347.59.46.233 - 328.45.94.479 - ilbetilo@tiscali.it



JULIUS CAESAR - "Military Genius and Mighty Machines" tells the story of how a man together with a system "conquered the world".

This 'INTERACTIVE EXHIBITION' includes over 60 exhibits - machines, recreated artefacts, model animations, all created to make it seem as if you were actually there...