

Science

In sciences, as in the arts, the Incas tended to adapt the special skills of the states they had conquered and improve upon them. Most of the Incas' accomplishments were highly practical. They were outstanding engineers. Through irrigation systems and terracing (making large horizontal ridges, like stairs, on mountain slopes to create level spaces for farming), the Incas put almost all the arable land (suitable for farming) in their empire to use. The Incas inherited a road system from previous Andean societies, particularly the Wari, and built it up to traverse (run across) the entire empire—about 14,000 miles (22,526 kilometers) of roadway in all. They built excellent bridges, mainly of rope and fiber, providing access to remote areas. They also had advanced skills in medicine. Although they did not have a writing system, they did have an instrument for recording information: the quipu. Without this device, none of their other accomplishments would have been possible.

Inca Medicine

When people got sick in the Inca Empire, priests usually performed healing ceremonies over them. The Incas also had a fairly sophisticated understanding of the medicinal properties of herbs and plants. The bark of one tree, for example, produced quinine, which the Incas used to cure cramps, chills, and many other ailments. The Incas used the leaves of the coca plant to numb people who were in pain. (Cocaine, which is derived from the same plant, was later prescribed by modern doctors for the same purpose.) Inca hunters dipped their arrows in a drug called curare that they extracted from a tropical vine; the substance instantly paralyzed the muscles of their prey. With the animal paralyzed, hunters could easily get their arrows back. (Modern doctors use curare as an anesthetic (a drug that causes a patient to temporarily lose feeling in a particular part of the body or to temporarily lose consciousness). Inca surgeons apparently performed amputations for medical purposes, and their patients survived in good health.

Archaeologists have made the surprising discovery that the Incas practiced brain surgery on living patients who apparently survived the ordeal. The Inca surgeons used bronze or copper knives, hammers, tweezers, and chisels to drill into the skull. They cut out a rectangular or circular hole, lifted out the hole, and went to work on the brain. Archaeologists have found hundreds of skulls with incisions that show the remarkable precision of Inca brain surgeons. Some of the skulls were operated on more than once, and one skull appears to have undergone five different surgeries. Experts believe that the Incas performed brain surgery to repair injuries to the head and to cure ailments such as chronic headaches and even epilepsy (a disorder of the nervous system that usually includes convulsions). How successful they were in curing the ailments is not known, but it is certain that the Incas were far ahead of all other ancient civilizations in the field of brain surgery.

The Quipu

A quipu (or khipu) is a long cord with a set of about one hundred strings hanging from it. Each string is knotted at intervals along its length. The placement of the knots indicates units of ten and multiples of ten—1, 10, 100, 1,000, 10,000, and so on. There is also a knot for zero. The knot closest to the top represented the highest number on the string. Detailed information was recorded on the threads, probably by using different colors or different knots. The color of the strings defined what kind of item was being counted. For example, purple strings might represent pieces of cloth, while yellow strings might represent gold bars. The Incas used quipus (pronounced KEE-poos) to record inventory, such as how much grain was in a storehouse. They also used the device to count the number of people in a given area and to keep track of labor obligations owed by the provinces.



Storytellers also used quipus. Historians believe that storytellers who used quipus thoroughly memorized the tale, but kept certain key facts recorded on the knotted strings to jog their memory. Quipus were used only to count and record numbers; they could not be used to calculate arithmetic functions—adding, subtracting, multiplying, or dividing; the Incas had special counting boards for these functions.

Quipus were essential to the running of the empire and most historians believe they were a substitute for writing in the ancient Inca civilization. They provided records of all the goods and stock of the empire, of the population, of the amounts of labor owed to the government from every individual and province, of the justice system, and much more. Without quipus, it is unlikely that the Incas could have organized such a vast empire.

Calendar and Astronomy

Scholars have many theories about Inca calendars, but because the Incas did not keep written records, no one really knows how they recorded time. It is apparent that some form of calendar based on the movements of the stars and planets was used. The Incas' monthly ceremonies and rituals attest to their careful observance of the sun and the seasons.

Like other Inca arts and sciences, Inca astronomy (the study of the stars, planets, and other objects outside Earth's atmosphere) was highly practical; astronomical information was mainly used to time planting and harvesting. The Incas built observatories to watch the heavens. They also tracked the movement of the sun by erecting carefully oriented pillars on hilltops. By keeping track of the sun's position between the pillars when it rose and set the Incas could determine the right times to plant crops at different altitudes. To date, there are no records that suggest the Incas had any further astronomical knowledge.

Music and literature

“The most notable aspect of this religion is how they had nothing written down to learn and keep. They made up for this shortcoming by memorizing everything so exactly that it seems as if these things were carved into the Incas' bones. For this purpose alone the Incas had more than a thousand men in the city of Cuzco who did nothing but remember these things. Along with these men others were raised from youth by them, and these youngsters were trained so that these things would not be forgotten. I certainly do not believe myself that such care in preserving their religion and remembering their opinions and shrines was taken by the ancient pagans nor any other people.”

Father Bernabé Cobo in Inca Religion and Customs (c. 1653).

Music and dance were important to the Incas and were prominently featured at Inca festivals. At these celebrations groups of men chanted out songs in perfect unison. For musical instruments, they used drums, whistles, flutes, and panpipes (wind instruments with several pipes attached to a mouthpiece) made from wood, bone, and ceramics. During the large ceremonies, such as Inti Raymi, a band of musicians would march, almost like a modern marching band, playing music all day. Others would begin a ritual form of religious dancing with repetitive rhythms and almost trance-like movements. Many other aspects of Inca culture have been lost, but the music from pre-Spanish times lives on in the Andes and has been incorporated into the region's modern music.

Although the Incas had no writing system, their empire had a great deal of oral literature in the form of religious poems, drama, story songs, and tales of royal heroism and history. These were passed on by word of mouth from generation to generation. Most of the Inca myths and legends were carefully memorized by storytellers and recited to the public during ceremonies and other gatherings.

Religion

The different Andean cultures conquered by the Incas all had their own set of religious beliefs, practices, and major deities. However, rather than switching to the Inca state religion after they were conquered; most of the Andean peoples simply added the Inca gods to their own set of gods and spirits. The Incas in turn adopted the gods of the people they conquered, hoping to unify their empire through shared religious beliefs. As the Inca Empire expanded, religious practices in the Andes grew and changed.

Worshipping the Inca gods

The Inca had over 200 gods, so many in fact that the exact number is unknown. Almost all religion in the ancient Andes was deeply connected to the forces of nature and to the success of farming. The Inca religion was no exception. Inti was the source of warmth, light, and healthy crops. Inti ruled over the earth with Illapa, the thunder god who brought the necessary rains, and Mama-Quilla, the moon goddess and wife of Inti. Inti was represented as a golden disk with a face, surrounded by radiating sunbeams. Other important Inca gods include Pacha-Mama, the earth goddess, and Mama-Cocha, the goddess of the sea.

When they conquered new lands, the Incas required the conquered people to worship Inti. Temples dedicated to Inti were built in every region. Each temple had its own priests, and local people had to support the temples and the priests with their labor. Although the Incas demanded that conquered people accept the Inca gods, they also accepted the conquered people's gods into the Inca pantheon (the officially recognized set of Inca gods). They invited the defeated states to bring the idols (representations or likenesses) of their gods to Cuzco and promised to place the idols in the Temple of the Sun, or Coricancha, the highest place of honor for an Inca god. Though it was a seemingly benevolent gesture, the Incas had a sinister motive.

Appeasing the gods

The Incas and indeed most or all early Andean cultures believed that the gods of nature controlled their world and their lives. The only way they felt they could gain control of natural forces such as rain or earthquakes was by appeasing the gods—that is, making the gods happy. Hoping to please the gods, they carefully fulfilled every detail of their traditional rituals (formal acts performed the same way each time as a means of religious worship) and ceremonies. The Incas and their subjects practiced sacrifices as one way to make the gods happy. In most Inca sacrifices, the offerings were llamas (South American mammals with soft, fleecy wool), fine textiles, and even chicha. Human sacrifice was also an Inca tradition, but not on a large scale.

Certain important occasions and ceremonies called for the sacrifice of humans—the installation of a new Sapa Inca, earthquakes, or victory in battle, to name a few. Usually the victims were children between ten and fifteen years old. Only children of particular beauty were chosen, and it was considered an honor to be selected. When children were selected from conquered territories, they were often brought to Cuzco to participate in ceremonies before they were sacrificed. Then they were taken home, where they were often given a feast and chicha to drink. During the sacrifice, some were buried alive. Others had their hearts cut out, and the hearts, still beating, were immediately presented to the gods.

The Incas had a concept of afterlife similar to Christian notions of heaven and hell. They believed that people who led good lives would be rewarded after death by eternal life in a place beyond the sun. People who were bad during their lives went to a dark place in the center of the earth after they died. But only common people had to worry about their destiny in the afterlife. Inca nobles went to the place beyond the sun and did not have to fear the dark underworld no matter how they lived their lives.

Priests

The most powerful person in the Inca religion and the second most powerful person in the empire was the Villac Umu, or chief priest. He was generally a brother or close relative of the Sapa Inca and was in charge of every priest in the Inca Empire. The chief priest chose ten bishops (high-ranking officials who oversaw regional priests)—one for each of the religious districts in the empire; all the bishops were Incas. Within the districts, the priests were generally family members of the local leaders, or curacas. In Cuzco the Villac Umu had a staff of about four thousand religious officials to help him run the state religion.

Ceremonies and rituals

For thousands of years, Andean peoples carefully carried out rituals and ceremonies to honor the gods, believing that this was the way to ensure abundant crops, maintain good health, and prevent disasters. By the time the Incas came to power, ceremonies had become dramatic events. There were still some simple daily sacrifices, with bits of wood or thread burned as offerings to the gods. But other ceremonies were magnificent week-long festivals attended by thousands. Some major ceremonies took place only when a particular event occurred, such as a natural disaster, a military battle, or the illness of a Sapa Inca. However, there were many ceremonies that occurred regularly. In fact, the Incas held at least one official state ceremony every month of the year (see the box on page 209).

The three main Inca ceremonies were Capac Raymi (Great Festival), Aymoray (which means both "corn harvest" and "May"), and Inti Raymi (festival of the sun). Capac Raymi was celebrated in December at the beginning of the rainy season. This festival celebrated the puberty or initiation into manhood of fourteen-year-old Inca boys. In Cuzco, the festival lasted about three weeks. First the boys climbed a tall mountain peak, where they sacrificed llamas and sought the approval of the spirit of the mountain. When they returned to Cuzco, the boys participated in a dance during which their relatives whipped the boys' legs. Then the boys went back up the mountain and began an extremely dangerous race down a steep mountainside. After twenty-one days of repeating these and other ordeals and rituals, the boys attended a ceremony and received large earplugs, which were then inserted into their split earlobes. At this ceremony the Inca boys formally became warriors, or men of the royal Inca line. Boys who were not Incas went through similar puberty rituals.

The biggest Inca festival was Inti Raymi, the festival of the sun, which is still held annually in Cuzco. It was celebrated throughout the Inca Empire, but the biggest and most elaborate ceremony was in Cuzco. The festivities went on for nine days on a hill near the city. They began at sunrise on the day of the winter solstice, which takes place in June in the Southern Hemisphere. This is the time of year when the sun is at its greatest distance from the equator, marking the beginning of the sun's New Year. The festival connected the New Year to the Inca myth of creation. It provided recognition to the sun god Inti as the source of all life and the father of the first Incas.

The Spanish Conquest

The Spanish conquistadores, or conquerors, came to what they called the New World in search of gold. Francisco Pizarro had heard rumors of a land filled with gold to the south of Mexico. They traveled by boat and landed in what was then known as Tahuantinsuyu, the “Land of the Four Quarters,” known to us as the Inca Empire.

When Pizarro and his men arrived in the Inca capital of Cuzco, they saw a splendid city with palaces, halls, and temples made of huge stones carefully fit together without mortar. Most incredible of all were the temples decorated with gold, silver and precious jewels. The most important temple was the Coricancha, or “House of the Sun,” dedicated to the Inca sun god, named Inti. Its walls and doorways were covered with gold, both inside and out. One building within the complex contained a large statue of the sun, made of solid gold and embedded with precious stones. More fantastic still was the garden.

A small Spanish force, led by Francisco Pizarro, quickly conquered the Inca Empire through a combination of superior weapons, trickery and luck. The empire had already been weakened by the introduction of European diseases, especially smallpox, and the five-year civil war. Pizarro landed on the coast in 1531 with a force of just 260 men. They traveled to Cajamarca, where Atahualpa was encamped with an army of thousands of soldiers on his way to Cuzco to be invested as the new emperor. The Spaniards hid men, horses and guns in the large halls surrounding the town’s central plaza. Atahualpa entered the plaza unarmed, along with several thousand guards. The Spaniards charged on horseback and fired their canons into the crowded square. As many as 7,000 Incas were killed, and the emperor captured. Not one Spaniard lost his life. The Spanish demanded that Inca officials hand over a huge ransom in gold and silver in order to free the emperor. Inca officials brought rooms full of gold and silver objects over several months—an estimated \$50 million in today’s dollars. But even this did not save the Inca emperor, who was executed on Pizarro’s order eight months after he was captured. The Spaniards named Thupa Wallpa, a younger brother of Huascar, as a puppet ruler.

While the supporters of Atahualpa mourned his death, allies of Huascar cheered his execution. Some ethnic groups who resented Inca rule sided with the Spanish. Fighting continued for several months, but the Spanish and their native allies soon managed to defeat Inca forces in Peru and triumphantly entered Cuzco, exactly one year after confronting Atahualpa at Cajamarca. Manco Inca was installed as Sapa Inca and at first cooperated with the Spanish conquerors. But in 1536 he led a massive attack involving between 200,000 and 400,000 troops on Cuzco, where a force of only a few hundred Spaniards withstood the Inca assault for months.

After failing to run the Spaniards out of Inca territory, Manco Inca retreated to the isolated Vilcabamba region in the lower reaches of the Urubamba River Valley, about 125 miles from Cuzco, where he maintained an independent Inca state for 36 more years. Spanish forces captured and executed Thupa Amaru, the last Inca leader, in 1572. This did the Incan Empire fall at the hands of the Spanish conquistadors, motivated by greed and religious zeal.

Administering a Vast Empire

An empire is a government that controls a huge territory and millions of people. It usually encompasses many different ethnic groups. Empires usually gain control over other areas by military force, but control can also be economic or political. The leaders of empires need to develop certain mechanisms to exert control over their vast territory, such as a road system, a common language, an administrative system and an army. One reason the Inca Empire ran smoothly is that the Inca rulers took traditions that already existed in the Andes region and altered them to serve in the administration of the Inca state. For example, a road system had already been built by previous civilizations in various parts of the Inca Empire. The Inca emperors expanded it so that it connected the entire empire. Inca emperors also used the traditional **mita system** of sharing labor as the basis for obtaining labor services from all households. The mita system was a tax system where individuals provided labor towards road and building construction projects in place of a monetary tax.

The Ayllu

The basic unit of society in the Andean highlands was the ayllu, a group of related families who traced their origins back to a common ancestor and were responsible for honoring him by providing ritual offerings. People were expected to marry someone from their own ayllu. Ayllu members shared land and exchanged labor throughout the agricultural year. For example, members of an ayllu would work together to plow and plant fields, take care of llama herds, build a house, and maintain irrigation canals. Ayllu members helped each other—if one member of an ayllu was called to serve in the army for several months, other members would perform his work. Strict accounting was involved—if someone performed a job for another ayllu member, he or she would expect an equal amount of labor in return. Payment could be the same service—for example, plowing five rows in a field—or giving a textile that took the same number of hours to make. Food was also used to repay someone for work performed. Inca administrators used the ayllu as the basic unit for determining the amount of goods and mita labor owed.

Inca hierarchy

The Inca Empire was organized in a strict **hierarchy** starting with the emperor and reaching all the way down to individual households. The Sapa Inca, or Ultimate Inca, had complete power. He was considered a descendant of the sun god. The empire was divided into four quarters, and a close relative of the emperor was lord (**apu**) of each quarter. The four apus made up the Supreme Council, which advised the Sapa Inca on important matters. Royal governors, usually but not always Incas, headed each of the **provinces**, which often encompassed a single ethnic group. The empire contained over 80 provinces at its peak. Each province had a hierarchy of **curacas** who were responsible for between 100 and 10,000 households. The curacas appointed foremen, who were in charge of between 10 and 50 taxpaying households. The curacas carried out many tasks vital to the running of the empire. They determined how much land a household needed each year to support itself, based on the number of people in the family and how much the family owed in mita labor and agricultural products. The curacas were responsible for collecting what was owed and seeing that it was stored properly. Curacas were in charge of managing the ayllu's resources, resolving quarrels, and maintaining the community's well being. If a disaster occurred, the curaca was held responsible. One curaca was put to death when a devastating El Niño destroyed his ayllu's territory. Curacas were expected to be generous and provide ayllu members with food and chicha during festivals. Curacas appointed by the Inca were often former leaders of conquered groups. The position became hereditary, so that sons of curacas were sent to Cuzco to be trained, returned to the home province and became curacas. Usually curacas were men, but women could also perform the role.

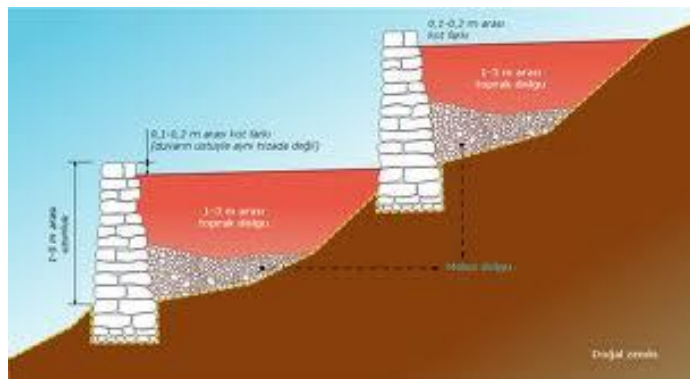
Connecting an empire

The Inca rulers realized that to govern a huge empire, they needed a common language, so they made their tongue, Quechua, the official language of the empire. But local groups could still use their own language for daily activities. The Inca rulers needed a system of communicating with all parts of the empire. So they expanded the existing roads into an elaborate system that ran throughout the empire. The road system was over 25,000 miles long. One road ran along the coast, and another lay inland along the Andes Mountains. Bridges crossed broad rivers as well as rushing streams that cut through deep mountain valleys. Shorter roads linked the two main roads. The road system was used almost entirely by people on official business—the Inca emperor and his court examining the realm, caravans of llama herders transporting goods to be housed in storehouses, soldiers marching to put down an uprising in a rebellious province, administrators on official business, and runners delivering messages. Ordinary people could use the roads only if granted official permission. Runners, called chasquis, lived in small huts that were built every four to six miles along the road. The messengers would run to the next way station, shouting the message to the next chasqui. Messages could travel about 150 miles a day in this manner. The messengers probably carried quipus to assure that their messages did not get distorted by frequent repetition. Chasquis also carried goods to the emperor, bringing fish from the coast to Cuzco in just two days.

Inca armies used the roads in time of war to move quickly into battle. Storehouses built along the way held weapons and supplies, including lances and darts, dried food, blankets and even sandals for soldiers to use in time of war. If crops failed in one area, food was distributed to area residents from the warehouses. The local community was expected to refill the storage houses when crops were plentiful.

Irrigation and terracing

The land along the Pacific coast and in the highlands is dry and requires irrigation to produce reliable crop yields. People living in the arid deserts along the coast had built elaborate irrigation systems to harness the many rivers that flowed from the mountains to the ocean. The Incas expanded this system to make it more productive. In the highlands, farmers had long built terraces to create more surface area for farming. Terracing involves building large retaining walls on a mountain slope and filling in the space between the wall and the slope above with soil. Terracing prevents soil erosion and rainfall runoff. Channels divert spring water and streams to water the tiny fields. Farmers had been terracing the slopes of the Andes for centuries, and the Incas greatly expanded the amount of agricultural land by building terraces in conquered lands throughout the Andes. At the height of the Inca Empire, about 2.47 million acres of irrigated terraces were in cultivation. Andean farmers still use some of these terraces today, but many have fallen into ruin.



Inca Architecture

The Incas share their love for building with another much earlier civilization, that of Mycenaean Greece, a habit of building with massive blocks of masonry. But the precision of the Peruvian masons puts all others to shame. In their capital at Cuzco, or in subject cities where they wish to emphasize their presence, the Incas leave their trade mark in great slabs of stone, often of eccentric shape, fitting together with an uncanny and beautiful precision. The modern-day city of Cuzco has grown upon and around its Inca origins. But Inca masonry can still be seen, underpropping churches or flanking streets, as a reminder of the great builders of the 15th century.



Even more mysterious, in the jungle at the far end of the Urubamba valley, and believed to have been a retreat for the Incan Emperor or other nobility, is the long-lost city of Machu Picchu. Its site is as dramatic as the story of its rediscovery. High on an inaccessible peak in the jungle (See below), the Inca masons somehow contrive to place their vast dressed stones, even in this remote spot, with wonderful exactitude. In modern day, this is the only location in which a person could see the wonderful intricacy of Incan Architecture that still stands, and it is due to this extreme masonry that the lost-city still stands today.

