

Chapter 6

Inca Engineering

The Royal Road It's one thing to conquer many lands. It's another thing to keep control of what you've conquered. Remember how the ancient Romans held their empire together? They built roads all across it.

The Big Question

How did the Inca use their engineering skills to manage and grow their empire?

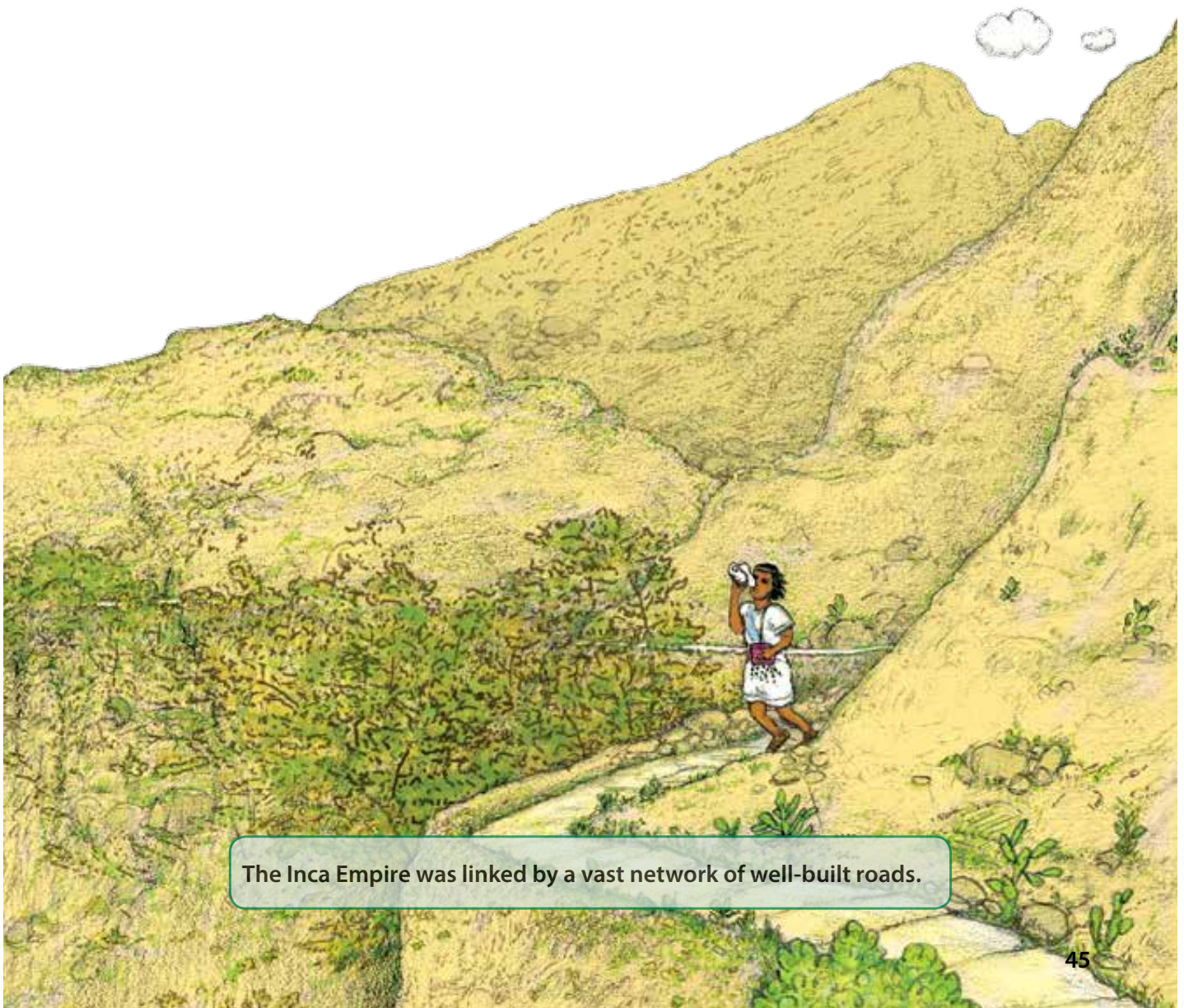


The roads made it possible for government **officials** to travel around the empire. Roads also encouraged trade. Most importantly, the roads allowed the army to travel quickly. This way, they could put down a rebellion or enforce the emperor's rule.

Vocabulary

official, n. a person who carries out a government duty

The Inca knew nothing of ancient Rome. But they too were great road builders. Their Royal Road stretched over two thousand miles. It ran from the northern end of the empire to the southern tip. It was the longest road in the world until the 1800s.



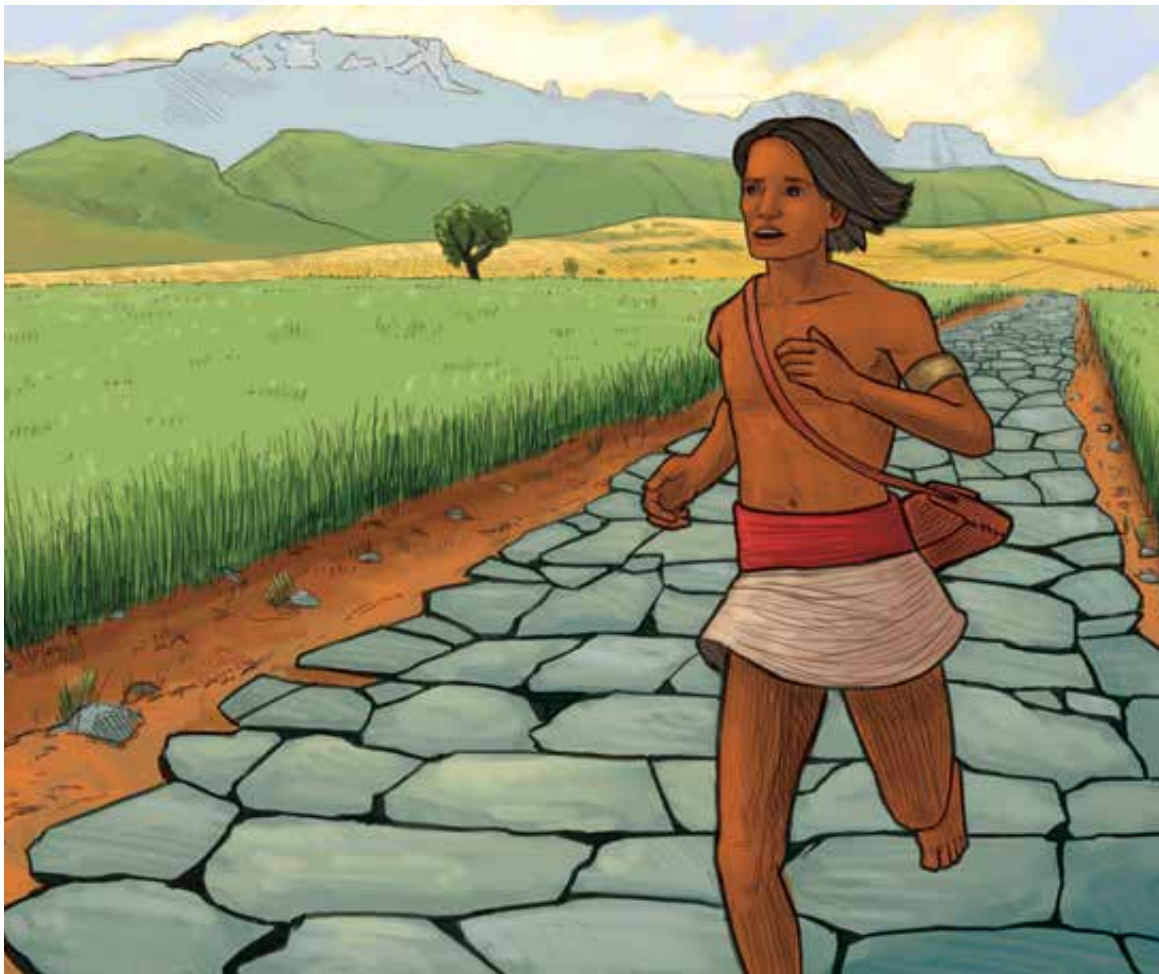
The Inca Empire was linked by a vast network of well-built roads.

The Royal Road was twenty-four feet wide in most places. Although it crossed mountains, valleys, deserts, and swamps, long stretches were straight as an arrow. Markers measured distances along the road. Trees shaded the road. A canal provided water for travelers. There were even roadside storehouses where travelers could get food at the end of the day.

Vocabulary

engineer, n.
someone who uses science and math to design useful objects or buildings

Parts of the Royal Road were made of packed dirt. Other parts were paved. Inca **engineers** fitted paving stones together like pieces of a jigsaw puzzle. Modern builders use



Inca builders cut and assembled stone with great precision to build roads and other structures.

mortar, a cement-like material, to keep stones together. The Inca did not use any mortar. Instead, they cut stones so exactly that they fit together snugly.

The Royal Road shows the great skill of Inca builders. These builders had no earth-moving machinery. They did not have horses or oxen to pull wagons. They did not even have the wheel. Everything was done by hand. Yet the Inca were able to build roads so sturdy, not even heavy rains or flash floods could destroy them.

The Royal Road was the main Inca road, but there were others. At every valley, east-west roads crossed the Royal Road. The Royal Road was like the spine. The crossroads were like nerves branching out from it. This network of roads linked all parts of the empire together.

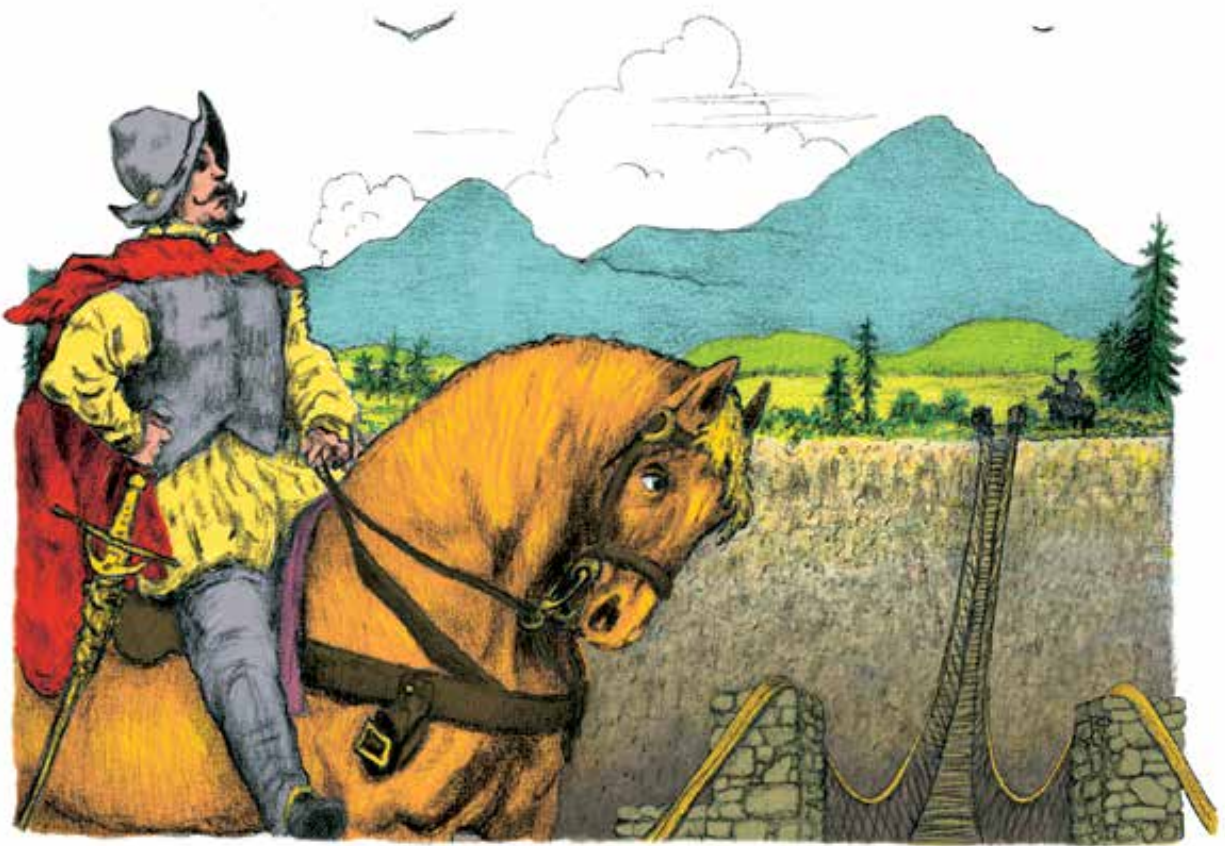
Bridges Built for the Centuries

To build roads through mountains and across streams, the Inca had to build lots of bridges. Like the roads, these bridges are marvels of engineering. A bridge built over the Apurimac (/ahp*uh*ree*mahk/) River in Peru is a fine example. It was built over a steep river gorge in 1350. It was a **suspension bridge**, held together by heavy strands of rope. The ropes were replaced every two years. This amazing bridge was in service from 1350 until 1890! For more than five hundred years, the bridge was maintained and used by the Inca.

Vocabulary

mortar, n. a material used in building that is soft at first but that then gets hard and rocklike

suspension bridge, n. a type of bridge in which the road or pathway hangs from ropes or cables that are attached to anchors or towers



The Inca were master bridge builders.

It was then used by the Spanish and finally by the people of Peru. It is one of the greatest achievements of the Inca engineers. It gained wider fame when it was featured in the classic novel *The Bridge of San Luis Rey*, by American writer Thornton Wilder.

Mountain Staircases

The Inca also used their engineering know-how to help them farm in the Andes. Farming on a mountainside is challenging. The incline makes every task—plowing, planting, and harvesting—very difficult. In heavy downpours, water runs downhill and washes out crops.

The Inca had to find a way to grow crops on the slopes of the Andes. Their solution was to cut **terraces** into the sides of the mountains. The terraces created level fields that could be planted and harvested just like valley fields. The Inca also built irrigation systems. This allowed them to bring water to the terraced fields.

Vocabulary

terrace, n. a flat piece of land carved out of the side of a mountain or hill

Keeping It All Together

The Inca had an advanced road system, but they had no written language. How could they possibly run an empire of twelve million people that spanned the length of a continent without writing?

The Inca came up with some clever strategies. For instance, they invented a means for counting and record-keeping using a *quipu* (/kee*poo/). A quipu was a piece of string that had shorter strings of various colors dangling



The quipu allowed the Inca to carefully track and keep records of amounts of troops, food, and other goods moving through their vast empire.

from it. By tying knots in a certain pattern on a quipu, an official could record how many warriors were headed for a village or how much corn was in a storehouse.

The Inca also used messengers trained to run short distances to carry news. Since the Inca had no written language, these messengers did not carry a written note. Instead, a runner memorized his message and sprinted to a station, a mile or so away. There, the next runner would be waiting. Without slowing the pace, the second messenger ran alongside the first messenger to hear the message. Then the second messenger continued on.



Fast Inca runners were able to move messages quickly over the full length of the empire.

The system was fast! A message could travel 150 miles in a day. This meant news could travel all the way from Quito (/kee*toh/) to Cuzco in a little over a week. In the 1860s, the famous pony express riders of the American West were only able to cover about two hundred miles a day—and they rode on horseback!

City in the Clouds

Another marvel of Inca engineering is the famous city of Machu Picchu (/mah*choo/peek*choo/). Machu Picchu is a mountain fortress seven thousand feet above sea level, located about fifty miles northwest of Cuzco. It sits in a high valley, between two peaks of the Andes.

Today, visitors can stand in the center of Machu Picchu. From there, they can see the ruins of an open plaza, a temple, and a place where archaeologists discovered Inca skeletons. The surrounding hillside is terraced for farming.

Archaeologists estimate that Machu Picchu was built in the mid-1400s. For years it was a vacation spot for Inca emperors. Today it is the leading tourist attraction in Peru.

Machu Picchu is not an easy place to visit. Tourists now take a railroad partway up the mountain. Then they follow a steep, twisting road to the top. Energetic hikers can walk on an old Inca trail that climbs up the steep slopes of the Andes.



The ruins of Machu Picchu rest high in the Andes Mountains.

Expanding the Empire

Like the Aztec, the Inca built their empire by conquering other people. They also sacrificed human beings for religious purposes. However, human sacrifice seems to have been less widespread in the Inca Empire. The Inca focused more on turning conquered people into loyal subjects.

When conquered people were cooperative, the Sapa Inca made few changes. Inca architects and managers went to new regions. Their job was to oversee the building of roads and temples. The Inca taught their language to the local people. They also asked

them to worship the sun god Inti. The worship of local gods was allowed. Sometimes those gods were even made a part of the Inca religion.

If conquered people were uncooperative, the Sapa Inca moved swiftly. He shipped troublemakers from their homes to villages. There, they were surrounded by local Inca citizens. He also shipped loyal Inca citizens to live among the conquered people. In this way, the Sapa Inca was able to quickly build a large and unified empire. This empire would endure until the Spanish conquistadors made their fateful appearance.