

HUMANITIES INSTITUTE

LATIN AMERICAN SCIENCE

Overview Latin America's contributions to science and technology are often overlooked because they form a continuum with other countries and cultures, or have been appropriated and overshadowed by their partners. But, upon careful examination, it is clear that Latin America has contributed in many ways, and that the contributions are just beginning, particularly as we unearth more information from PreColumbian civilizations.

ANCIENT PERIOD

Maya agricultural methods: In order to provide enough food to support the large population centers in what is now southern Mexico and Guatemala, it was necessary for the Maya to develop innovative approaches for managing arable fields for the cultivation of corn, tomatoes, chili peppers, beans. Their innovations included the development of raised fields, stone-wall terraces, and crop rotation technologies.

Maya water management: The Maya lived in the Yucatan peninsula and in the part of Central America that is now Guatemala, Belize, Mexico, and Honduras. Much of the land is flat and low, with a bedrock of limestone, which has many caves and sinkholes. As a result, there are few rivers and above-ground lakes and ponds. To have enough water for life and agriculture, the Maya developed an extensive system of canals and cisterns (chultunob). They also developed a system of collecting and distributing water from limestone sinkholes (cenotes).

POSTCLASSIC PERIOD

Aztec chinampas: Known as "floating gardens," the Aztecs further developed and expanded "chinampas," a type of aquaculture which allowed them to cultivate shallow lake beds in the Valley of Mexico. The chinampas are small, rectangular artificial islands that were fabricated by weaving reeds and anchoring fences that were made of reeds. Canal waterways and drainage ditches crisscrossed the chinampas, which gave the impression that the islands were floating, when in reality they were anchored to the bottom of the lake. The chinampas were extremely fertile, and were well known for producing bountiful harvests of beans, tomatoes, squash, watermelon, chilis, cilantro, and even corn.

Aztec aqueducts: The Aztecs developed a unique system of aqueducts for transporting fresh water to the large city center of Tenochtitlan, which was located in the middle of the large lake, Texcocol. The aqueduct system consisted of twin pipes in order to have redundancy so that if one required repair or cleaning, the other would still be available for transporting fresh water.

Astronomy: The Maya, Aztecs, Inca relied on elaborate and detailed calendars for virtually all aspects of their lives. For that reason, they built observatories and developed very accurate systems of tracking, predicting, and communicating the movements and alignments of the sun, moon, stars, and planets. The Aztec (Mexico) calendar consisted of a 260-day ritual cycle, which formed a 52-year "calendar round." Both the Aztecs and the Maya believed that the sun and the entire world had gone through apocalypses (total destruction and rebirth). According to the Aztecs, the current sun is the fifth one, and it will eventually perish due to its imperfections.

Civil engineering in the Andes: The Inca were able to develop extremely complex and effective methods for transporting water, stabilizing mountain slopes, engineering terraces for agricultural purposes, and precision-cutting building stone so that it would not be necessary to use mortar.

Surgery and Inca medicine: The well-preserved Inca mummies reveal that the Incas were well-versed in surgery, and in particular, cranial surgery used to relieve intercranial pressure that could be a result of concussion or inflammation. The Inca skull surgeons were highly skilled at trepanation, and it appears that the majority of the individuals who underwent the surgery survived.

EARLY MODERN PERIOD

Chemistry and Physics: In conjunction with mining, the Seminary of Mining was established in Mexico in 1792. In addition to engineering, there were laboratories in which scientists conducted physics and chemistry experiments. Andres Manuel del Rio discovered the element vanadium at the end of the 18th century in Mexico.

Meteorology: Jose Antonio de Alzate y Ramirez, who studied in the Colegio de San Ildefonso in Mexico City, was a distinguished scientist in many fields during the 1700s. His observations about meteorological phenomena were ahead of his time in that they included mathematical modeling as well as observations about the conditions of various cloud formations. His focus was resolutely scientific, and he debunked a number of unscientific claims. For example, he proved that the psychedelic effects of the plant, pipilzintzintlis, were due to natural plant oils and chemicals, and not due to the devil.

Civil Engineering: Large earthworks were successfully implemented and came to be more advanced than in Europe. Examples include the mines of Guanajuato (Mexico) and Potosi (Bolivia). Guanajuato is honeycombed with tunnels that are so well built that they are in use today.

Metallurgy (for mining): Metallurgical processes for economically extracting gold, silver, and tin were developed in Mexico, Peru, Bolivia, and Ecuador. The processes that were developed using mercury, antimony, and sulfur were later adopted in other parts of the world, mainly North America and Africa.

Botanical experiments (Brazil): With its extensive plantation system in the northeast part of the country, Brazilian farmers and botanists developed new varieties of indigo, rice, sugar cane, and tobacco that had longer harvest periods, which meant a much higher yield. Due to the high demand by textile mills in Europe, Brazilian botanists developed indigo with many different shades of blue, violet, and purple.

19TH CENTURY

Panama Canal: After more than 50 years of surveying and planning, the Panama Canal construction began in 1881, with a workforce of more than 40,000 individuals. The project was plagued by setbacks and scandals, and was finally abandoned. The United States took over, and completed the work in 1913. A total of 75,000 people worked on the project, and almost 6,000 died of tropical diseases and accidents. The project, which was largely designed during the 19th century, was one of the wonders of the world, and was of extreme economic and strategic value.

Railroads in Mexico: The railway system in Mexico featured some of the most advanced engineering in the world, and the Veracruz – Mexico City line that was inaugurated in 1873, was renowned for its mountain bridges, engineered track beds, and systems of controls. Financed largely by British, American, and French investors, the railway system consisted of more than 15,000 miles of in-service track by 1900.

Medicinal Plants: The medicinal properties of the coca leaf, grown primarily in Bolivia and Peru, were integrated into medicines and products used in 19th century United States and Europe. An influential paper by Dr. Paolo Mantegazza discussed its stimulating effects on cognition, which in turn stimulated the production of a number of patent medicines and tonics which included the liquid extract of the coca leaf.

Shipbuilding: Italian immigrants in the 19th century settled in Buenos Aires where they continued their practice of shipbuilding. In doing so, they developed innovative ships that were able to navigate rivers as well as oceans. The innovative designs, navigation equipment, and lightweight materials were groundbreaking for their time.

Chemical Engineering Processes: The demand for rubber to make impermeable footwear created a huge boom in the Amazonas part of Brazil, especially after the development of chemical processes involving sulfur and heat, called “vulcanization.” Vulcanization was first developed in the U.S., but Brazilian chemists further perfected it, which made it possible to export even more rubber from the Amazon region, without worrying about its oxidation.

20TH CENTURY

Animal husbandry: Beef became a main export in the early 20th century with the advent of new canning and freezing technologies. Brazil, Argentina, and Mexico were leaders in developing breeds of cattle with genetic

qualities allowing them to resist heat and to gain weight quickly. Brazil quickly dominated the international beef industry, thanks to the vertical integration of the beef, from farm all the way to stockyard, slaughter, and packaging.

Canning science: Canning is a way to preserve and transport processed food in an airtight container. Canning technologies were developed in Argentina to export beef (primarily in the form of corned beef), and the double-seamed process was perfected with a double-coated liner to assure the integrity of the contents.

Cataract surgery: Cuban eye clinics are world-renowned for their state of the art technology for the diagnosis and surgical intervention for eye diseases including cataracts and glaucoma.

Lithium mining: The Uyuni Salar of Bolivia, with its lithium-rich brines that lie within layers of an ancient lake bed, has been the site of process innovation in the production and processing of minerals such as lithium. They are found dissolved in the salty brines of the lacustrine deposits.

Astronomy: The largest single-aperture telescope in the world was launched in 1963 in Arecibo, Puerto Rico. Puerto Rican scientists, collaborating with scientists from around the world, developed new workflows and processes for using the telescope for radio astronomy, atmospheric science, and radar astronomy. Major breakthroughs were accomplished in the areas of detecting perturbations in the ionosphere, which would potentially portend the deployment of nuclear warheads, which made the Arecibo telescope a vital part of military defense.

Color Television: Guillermo Gonzalez Camarena, who lived and worked in Guadalajara, Mexico, is widely recognized as the inventor of the color-wheel type of color television. As both an electrical and mechanical engineer, Gonzalez Camarena was able to integrate the transmission system and the electronic production of images. His first patent for the system was awarded in 1942.

Discussion/Questions

1. The level of technology possessed by the Maya, Aztec, Tiwanaku, and Inca civilizations was so advanced that many people have proposed that the technology came from space aliens. While we do not have any evidence for such a far-fetched hypothesis, the accomplishments of the preHispanic civilizations deserve merit for their accomplishments. Please take a look at the technology and science of the ancient Maya, Tiwanaku, Aztec, and Inca civilizations and evaluate their contributions. Which are the most surprising? What questions do their accomplishments provoke? What more would you like to know about their civilizations?

2. The scientific and technological breakthroughs after the Conquest had much to do with commercial relations with Europe, and the fundamentally mercantilist relationship between Spain, Portugal, and their colonies. Not surprisingly, the most dramatic step-changes in technology occurred in mining and also in agriculture, where plantations provided raw materials for the factories in Europe. In your opinion, which of the advances in technology had the greatest impact? Which ones may have been unethical from today's perspectives? Why?

3. The Industrial Revolution in Europe and the United States during the nineteenth century resulted in a demand for a number of raw materials and inputs that would help build machines and products. While simple agricultural inputs were often needed, there was a larger need for inputs that contributed unique attributes and represented a step-change in industrial efficiency and in the standard of living of the consumer. Rubber was one of those products. There were others as well. Select one product and analyze the reasons why scientific and technological innovation resulted in a multi-tiered economic boom associated with that product.

4. In the twentieth century, scientific and technological breakthroughs were often very futuristic and utopian, and their main justification for funding was the promise they held out of contributing to a better, potentially utopian, world. The inventions from Latin America have fit that set of parameters quite well. What are your opinions about them? How do the advancements in science and technology in Latin America in the twentieth century create solid scaffolding for a better world? When? Where?

Readings

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