Museo Nacional Ferroviario - Tacna

Plan COPESCO / Ministerio de Turismo

THE TACNA – ARICA RAILROAD, TACNA – ARICA STATION

Introduction

The Tacna – Arica National Railroad Museum collection, consisting of rolling stock, equipment, tools, communication devices, scientific instruments, machinery, plans and photographs, as well as other items of historical or educational significance, offers an insight into Peru's railroad heritage and enables an interpretation of that great legacy within the social, political and technological contexts in which it played a key role.

The conservation of this monument to industrial engineering and architecture was achieved thanks to investment from the Ministry of Foreign Trade and Tourism, through the National COPESCO Plan, and in inter-institutional cooperation with the Regional Government of Tacna. The restoration and research work involved the participation of local actors and railroad experts.

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- Model Railroad Corner

THE RAILROAD - THE MOST SIGNIFICANT INVENTION OF THE INDUSTRIAL AGE

Railroads are the preeminent symbol of the Industrial Revolution and humanity's technological advances from the 19th century onward. Their development led to the growth, progress and modernization of cities and economies in countries throughout the world.

THE HISTORY OF THE RAILROAD

This timeline focuses on railroads that used locomotives to pull freight wagons or passenger cars. In earlier periods, rail systems used human and horse power to pull wagons from mines.

1515-1550
German miners discovered that they could move material in wagons carried on wooden rails. Later, in the 18th century, wooden rails were replaced with iron rails.

1770
The Scottish engineer James Watt invented and patented the first steam engine.

1804
The Englishman Richard Trevithick built a steam locomotive and tested it by pulling five wagons along a 15.5 kilometer route at a speed of 3.9 km/h.

1811
The English engineer John Blenkinsop designed and built the first successful steam locomotive, with a rack-and-pinion system that enabled it to operate on steep gradients.

1812
With his locomotive "Salamanca" the English manufacturer Matthew Murray improved upon the Blenkinsop design by employing the rack-and-pinion system and adding two cylinders.

1825
The English engineer George Stephenson built the "Locomotion", the first steam locomotive to haul a passenger-carrying train on a public railroad.

1826
Construction began on the world's first railroad between the English cities of Liverpool and Manchester. It was designed by George Stephenson.

1829
Built by George and Robert Stephenson, the locomotive they named "The Rocket" won the competition to determine the best type of locomotive for hauling passengers at speed and in safety.

1830
In England, the first intercity railroad was opened, between Liverpool and Manchester.

The United States opened its first railroad, in the city of Baltimore.

1837
Cuba opened its first railroad, ten years before Spain.
In South America, the first railroad was opened from Georgetown to Plaisance, in British Guiana.

1851
In Peru, the Lima - Callao railroad was opened, followed a few months later in Chile by the Caldera - Copiapó railroad.

A year earlier, Mexico opened its first railroad.

1854 - 1889
Railroads were opened in several countries in the Americas, including Brazil (1854), Colombia (1855), Argentina (1857), Uruguay (1869), Ecuador (1873), Venezuela (1883) and Bolivia (1889).

RICHARD TREVITHICK IMPROVED JAMES WATT'S STEAM ENGINE DESIGN

Richard Trevithick (1771-1883) was born in England. He was an inventor, engineer and builder of engines. In 1796, he exhibited steam engines that incorporated significant improvements on those built by the Scottish engineer James Watt. His principal innovation consisted of reducing their size and building powerful boilers capable of producing greater pressure, thereby improving performance.

In 1801, he successfully trialed the first steam-driven passenger-carrying vehicle. He also developed a steam locomotive for transporting ore.

GEORGE STEPHENSON - THE FATHER OF RAILROADS

The railroad pioneer George Stephenson (1781 – 1848) was a British mechanical and civil engineer who is famous for having built the world's first steam locomotive railroad, in 1825. He also designed the first passenger-carrying steam locomotive-driven railroad (Canterbury – Whitstable, 1830). It was so successful that he was entrusted with the overall design of the first modern railroad (Liverpool - Manchester, 1830).

DEVELOPMENT OF THE RAILROAD

With the technological advances of the 20th century, steam locomotives that had succeeded in reaching speeds in excess of 140 kilometers an hour were replaced by diesel (diesel cycle internal combustion engines), followed by electric (engines powered by electrical cables), diesel-electric (hybrids, with an internal combustion engine connected to an electrical generator), and by diesel-hydraulic (hydraulic turbine) locomotives, which because of their high performance are used in the latest generation of high speed trains, such as the bullet trains (some of which operate on the principle of magnetic repulsion) in service today in Europe and Asia.

However, in some mining operations and mountainous parts of the world, it is still possible to see old steam engines and hear the emblematic sound made by their smokestacks.

THE BUILDING OF RAILROADS – PERU'S IRON ROADS

Peruvian railroad expansion can be divided into two periods, from 1850 to 1879, and from 1890 to 1920. While many of these railroads have been lost, they were without doubt symbols of modernity during their heyday, and emblematic of efforts to connect the towns and cities of Peru and improve trade both domestically and internationally.

PERU, THE FIRST RAILROADS

The governments of Ramón Castilla (1845 - 1851 and 1855 - 1862) and of Rufino Echenique (1851 - 1855) launched Peru's railroad building policy.

1814
The English inventor and engineer Richard Trevithick arrived in Lima, bringing with him machinery for the Cerro de Pasco mines. This project was cut short by the war for independence from Spain. Trevithick returned to England without accomplishing his mission.

1833
The government of Luis José de Orbegoso ordered the construction of the Lima – Callao railroad, but work could only begin once the project had been approved in 1834.

1851
Opening of the first railroad in Peru; the Lima – Callao line.
Under the provisions of the December 16th 1851 bill, the government of general José Rufino Echenique (1851-1855) authorized a railroad from the port of Arica to the city of Tacna.

Congress authorized the government to commission the building of a railroad between Lima and Chorrillos.

1854
Construction began on the Arica – Tacna railroad, overseen by Joseph Hegan and Anthony W. Evans.

1856
Construction was completed of the Arica – Tacna railroad.
The final contract was signed for construction of the Lima – Chorrillos railroad.

1857
The Arica – Tacna railroad was opened, on January 1st 1857.

1858
The opening of the Lima – Chorrillos railroad.

THE RAILROADS AND MEIGGS

During the government of José Balta (1868 - 1872) and thanks to the arrival of Henry Meiggs, an American entrepreneur of English descent, in less than a decade most of Peru's railroads were built.

1868
Henry Meiggs arrived in Peru at a time when few railroads had been built in Peru: Lima – Callao, 14 kilometers; Lima – Chorrillos, 14 kilometers; Tacna – Arica, 62 kilometers; and a 10-kilometer railroad in Cañete.

Meiggs, a shrewd businessman, was commissioned to build the country's main lines, and he was responsible for the construction of over half Peru's present-day rail network. He employed Chinese, Chilean and Peruvian workers, and he was responsible for the enormous expense resulting from the importing of building materials.

Skilled in his relations with public officials, according to historians he perfected the art of institutionalized corruption. Meiggs amassed a huge fortune, which by the time of his death in Lima in 1877 had largely

disintegrated. His legacy, the great railroad network he created in Peru, has been called the most expensive project of its kind in the world.

1869
Construction of the following railroads was authorized:
Arequipa – Puno – Cusco; Chimbote – Santa – Huaraz; Trujillo – Pacasmayo – Cajamarca; and Lima - La Oroya.

1871
Opening of the Mollendo – Arequipa railroad. Construction began on the Pacasmayo - Magdalena line, which by 1908 had still only reached Chilete.

1870
Work began on the major Central Railroad project, which by 1875 had only reached Chicla, where a lack of financing and the war with Chile halted construction. Building work resumed in 1890, and by 1893 the track had reached Orolla.

1872
Construction began on the Chimbote – Santa – Huaraz railroad, which by 1876 had only reached Tablones. By 1912, the track had been extended as far as Huallanca, before the project was halted.

Work also began on the Juliaca – Cusco railroad, although the project was suspended in 1875 for financial reasons, and only restarted fifteen years later, when Peruvian Co. took over construction.

1873
Construction was completed of the Ilo – Moguegua railroad, which was completely destroyed by the Chilean army in 1880, and never rebuilt.

THE SALTPETER RAILROADS

Before southern Peru became part of northern Chile, the productive province of Tarapacá was home to the world's richest deposits of saltpeter.

In their heyday, the guano from Peru's offshore islands and the nation's saltpeter mines were the highest earning sectors of the national economy. Eventually, saltpeter became more important to Peru's economy than guano, due to the great variety of products into which it could be transformed, such as explosives, medicines, glass, sodium salts, enamel for pottery, fertilizer and many other derivatives. In its raw form, saltpeter was known as "caliche". The ore was found at ground level in Tarapacá, meaning that it could be mined using the open cast method, and then processed relatively easily into the coveted potassium nitrate. At first, saltpeter was hauled to port using wagons pulled by mules. With the introduction of the railroad, transportation could be achieved on a larger scale and at a reduced cost, making the overall enterprise even more lucrative.

During the presidency of José Balta, the railroad transport system in the province of Tarapacá was offered in concession by the government. Because of the importance of being able to transport saltpeter to port for its immediate sale, mainly to England and then to the rest of Europe, priority was given to these concessions, since the Peruvian state was not in a position to bear the construction costs of the railroads.

Three railroads were given in concession, under the condition that they would be required to serve all the existing saltpeter concerns in the area, as well as any future mining activities.

The first concession, for the track covering the route from Iquique to La Noria, and granted to the firm Montero Brothers in 1868, was known as "Yquique Railways".

The second concession, also awarded to Montero Brothers, was the Pisagua – Agua Santa – Sal de Obispo line, for which another independent company was formed: Pisagua Railways Co.

Subsequently, the same group would be awarded the concession for the Patillos – Lagunas line, for which the company Patillos Railways Co. was formed.

Following the amalgamation of the first two railroad lines, the "National Nitrate Railways of Peru Company" was established. This company was also owned by Montero Brothers, and its shares were listed on the London stock exchange. When the war with Chile began, the company became "Nitrate Railways Co.", with English shareholders, as a strategy for saving the enterprise from the chaos of war.

The wealth that saltpeter and guano generated led to this period becoming known as "the era of fallacious prosperity". In the wake of the assassination of president Balta, and following the coup that overthrew his regime, Peru found itself heavily in debt, and the war with Chile led finally to the ruin of Nitrate Railways of Peru, which had been the most lucrative railroad company in the world, with annual profits of three million six hundred thousand pounds sterling. When we remember that the combined cost of the Peruvian navy's ironclad vessel Huáscar and the frigate Independencia was one hundred and eighty thousand pounds sterling, the vast sums associated with Peru's saltpeter railroads become even more apparent.

Text and research by Elizabeth Ingunza Montero, author of the historical novel "*El tren de la codicia" Tomos I y II* ["The Train of Greed", Volumes I and II].

AND AFTER THE WAR… THE GRACE CONTRACT

During the war, Chilean forces destroyed more than 500 kilometers of railroads, from the total of 1500 kilometers that had been built in Peru by 1876.

In addition, Peru found itself forced to renegotiate its foreign debt through a deal that handed over many of the nation's resources to its creditors.

1888-1889
The Grace Contract was signed, resolving the debt owed to British creditors. Among many other concessions, the contract ceded for a period of 66 years the Paita - Piura, Pacasmayo – Yonán - Guadalupe, Salaverry – Trujillo - Ascope, Chimbote - Suchimán, Central (Callao - Chicla and Lima - Ancón), Pisco - Ica and Southern (Mollendo – Arequipa – Juliaca – Puno -Santa Rosa) railroads.

1890
Based in London, the Peruvian Corporation Ltd. was formed, as the company responsible for running the railroads that the Peruvian state no longer controlled.

1928

President Augusto B. Leguía granted the Peruvian Corporation Ltd. control in perpetuity of the railroad routes the company managed. This freed Peru from some of the payment conditions established under the terms of the Grace Contract.

THE GRACE CONTRACT

In order to finance the state construction of railroads, the Peruvian government issued a considerable quantity of bonds in London, between the years 1869 and 1872.

The loans were backed by guano and saltpeter exports, but the war with Chile led to Peru losing the saltpeter deposits of Tarapacá and the southernmost guano islands. Subsequently, Peru's creditors pushed for some kind of settlement of the country's outstanding obligations.

In order to embark upon a period of national reconstruction, Peru first had to settle its foreign debt of around 51 million pounds sterling. To that end, in 1889 the government of general Andrés A. Cáceres signed the Grace Contract with the group of British creditors headed by the entrepreneur Michael Grace.

In addition to control over its railroads, Peru granted its creditors the rights to three million tons of guano, in exchange for the canceling of the existing debt and a fresh loan. The country also ceded mining rights in Huancavelica, oil reserves in Piura, steamship navigation rights on navigable waterways and lakes, coal exports from Ancash, and the right to establish colonies in the country's jungle regions. Under the provisions of the contract, the following year the Peruvian Corporation was established, in order to oversee compliance with the terms of the agreement.

PERU, RAILROADS IN THE 20TH CENTURY

THE UNCERTAIN CONCLUSION OF THE GRACE CONTRACT

Peruvian Co. operated in Peru for 82 years, from 1890 to 1972, the year when the National Railroads of Peru Company (ENAFER) was created (during the Juan Velasco government), and all Peru's railroads were nationalized, with the exception of the Ilo – Toquepala line, owned by the Southern Peru Copper Corp (SPCC).

By this time, Peruvian Co. only operated the Central Railroad and the Southern Railroad. The other lines that had been in the company's possession were closed, abandoned or sold (including the Chimbote line). The Arica – Tacna railroad had a different fate. Because it had been managed by an English-owned company (the Arica – Tacna Railway Company) since its construction in 1933, it was protected and operations continued uninterrupted.

It is unclear whether or not the loans made to Peru by the English in 1869, 1870 and 1872 were fully repaid, but Peruvian Co. Limited was dissolved shortly after the nationalization of the country's railroads.

PERU'S RAILROADS TODAY

By early 1990, Peru was facing the worst macroeconomic crisis in its history, and in 1991 a privatization process was launched to transfer the management of several state-owned companies to the private sector.

"Under the provisions of that process, the infrastructure and assets of the National Railroads of Peru Company (ENAFER) were offered in concession to the private sector. All the assets and rights of the state company were transferred to Peru's Ministry of Transport and Communication (MTC). In this way, the MTC was granted legal ownership so that it would be in a position to award the concession for administration of the national rail system.

On September 30th 1999, the contracts were signed that awarded the Central, Southern and Southeastern railroads in concession to the consortium Peru Railroads, which divided their administration between two operators: Central Andean Railroads S.A., which would operate the Central Railroad; and Trans-Andean Railroads S.A., which would operate the other two routes."

Source: OSITRAN document "Analysis of railroad concessions in Peru, regulatory management and financial studies", June 2018.

STAMP COLLECTION - GUILLERMO UGARTE CHAMORRO

Guillermo Ugarte was born in Arequipa in 1921 and died in Lima in 1998. He was a recipient of the Amauta National Culture Prize; emeritus professor at San Marcos National University, where he founded the San Marcos University Theater; director of the National School of Performing Arts; director of the National Theater, and patron of the Tacna Theater Group. He was acknowledged as a leading authority on Peruvian theater, and an expert on Latin American theater.

He was deeply fond of Tacna, and donated to this Heroic City a valuable stamp collection containing railroad-themed stamps, so that it could be exhibited in the National Railroad Museum, housed in the Tacna – Arica Railroad Station.

The illustrious doctor and native of Tacna José Jiménez Borja wrote the following tribute: "We admire Guillermo Ugarte Chamorro's generous lifelong dedication to the theater and his fine, tenacious, innocent provincial heart, a cup always brimming with friendship and tender solidarity.

Ugarte Chamorro championed idealism, rectitude and beauty, virtues often underappreciated or forgotten today, and he chose not to pursue the wealth that his exceptional intelligence would have earned him in other fields of endeavor.

The grateful citizens of Tacna honor his memory".

(Fredy Gambetta)

JIB CRANE WITH WOODEN JIB ARM

This jib crane was used to load and unload goods or heavy cargo (ore) hauled by railroad wagons. It was installed on the flat surface of the platform and employed a hydraulic pulley system, enabling railroad workers to move loads to different locations.

NARROW GAUGE BOGIE

Device housing the wheels upon which the coachwork of a railroad car or locomotive rests. It was designed for use on a narrow gauge (1.06 meter) track (in Tacna, standard gauge 1.435 meter bogies were utilized). They were used in small industrial zones and some communities.

THE DESERT RAILROAD

The commercial hub formed by Tacna and Arica, which dated back to the viceroyalty period, did not decline with the advent of the republic. In 1851, president José Rufino Echenique signed a bill declaring the zone of national and regional interest. The transporting of goods to the port of Arica, including from neighboring Bolivia, became the focus of new investment. The arrival of engineers, technicians, workers and machinery, mostly from Chile, led to a qualitative leap into modernity for the region, and for its links with the highly-prized British market. The station at Tacna has survived as a testament to the 19th century ideal of progress that facilitated growth in trade and cultural exchange.

The Arica – Tacna railroad was opened on January 1st 1857, during the presidency of Ramón Castilla. Its name reflects the fact that Arica was part of Peru at the time, and the principal goal of the project was to link Arica's port with the city of Tacna and maximize trade with Lima, Bolivia and Chile.

The Arica – Tacna railroad is the only international railroad in Peru and the oldest line to have survived intact. It was the second route to be built within Peruvian territory and one of the two lines that remain state-owned.

Construction

The project was entrusted to the Englishman Joseph Hegan in 1851. Construction continued from 1854 to 1856, with the American engineer Anthony Walton Evans supervising the work. Upon its completion, the 99-year concession was awarded to the English-owned Arica & Tacna Railway Company. In 1942, the company suspended its operations, eight years before the concession was due to come to an end. The Peruvian state assumed control, and the route became known as the Tacna – Arica Railroad.

According to a report from 1856, the rolling stock used on the Tacna - Arica route consisted of the following:

4 Identical locomotives with tender, each weighing 140 tons
3 First class railroad cars with capacity for 40 people each
2 Mixed railroad cars, half first class and half for second class
3 Second class railroad cars
15 Wagons or closed coaches for goods transportation

The route
The Tacna to Arica railroad is a 62-kilometer long 1.435-meter standard gauge track.
The route begins at Kilometer 0, the Tacna Railroad Station. The original journey time was approximately 90 minutes.

It crosses five bridges, one in Peru (Lagartito) and four in Peruvian territory (Hospicio, Gallinazo, Chacalluta and San José). Also, between the main stations, it passes four intermediate stations, all currently inoperative: Kilometer 42 (before the Peruvian-Chilean frontier), Hospicio, Escritos and Chacalluta (the last three are on Chilean soil).

Source: "*Ferrocarriles del Perú, un viaje a través de su historia*" ["Railroads of Peru, a journey through their history"], by Elio Galesio.

THE TRAIN, WITNESS TO WAR AND CHILEAN OCCUPATION

The outbreak of war with Chile had a major impact on the railroads, with the destruction of around 500 kilometers of track. The Southern Campaign was decisive in slowing the invasion, but effective resistance ended with defeat at the Battle of Arica (June 7th 1880). During the conflict, the railroad fulfilled the mission of transporting Peruvian army personnel. Although no documentary evidence exists, it is said that the English locomotive N°03 transported the Peruvian war hero Francisco Bolognesi. The conflict caused major material damage to the railroad system, which the Chileans attempted to repair, but by express agreement under the terms of the Treaty of Ancón the English management of the railroad continued to be respected. During the Chilean occupation, the railroad station was home to the Avenue of the Flag. When Tacna was returned to Peru, the Chilean section of the railroad, on the Arica side, remained under Peruvian ownership.

Steam locomotive N°3:

Its exceptional historical and cultural value lies in its close association with the facilities from which it came and for which it was originally commissioned, those of the Tacna-Arica Railroad Station, despite the fact that it is not currently housed at the station, having been transferred to the Locomotive Park, in the center of the city of Tacna, in 1977. It served the second oldest railroad line in Peru until 1940, and during the 19th century War of the Pacific it is believed that it transported the troops of Colonel Francisco Bolognesi during the Battle of Arica, leading to its recognition in 2019 as part of Peru's national heritage.

TRAFFIC DEPARTMENT REGULATIONS

Taken from the 1947 Central Railroad manual.

The rules of the Traffic Department and strict adherence to their provisions was necessary in order to ensure the safety of employees and members of the public, and to protect the interests of the railroad company.

In these excerpts we present some of the rules to which train crews and all other railroad personnel, including station staff, were expected to adhere:

Rules for single track

Schedule:

1. – The schedule obtained from the city of Lima will be transmitted by telegraph and telephone daily at 12:00 midday, by the despatchers office to all stations.

2. - The drivers, engineers, first brakemen, stokers, yard masters, traffic and locomotive inspectors, and chief laborers will only use watches that have been examined by the inspector designated for that

task, having obtained the corresponding certification, which, in accordance with the prescribed regulation, must be registered with the Head of Traffic office every three months.

Color signals

(a) Red – Stop.
(b) White – Proceed and for other uses prescribed by the rules.
(c) Green – Proceed with caution and for other uses prescribed by the rules.
(d) Green and white – Request stop.
(e) Blue – See rule 26.
(f) Yellow – Indication that the line is safe for a speed of 6 kilometers per hour.

Hand, flag and lamp signals
Method of use

(a) Moved across the track - Stop
(b) Moved up and down, vertically - Proceed
(c) Moved vertically, in a circle, rotating the bent arm across the track, when the train is stationary - Reverse
(d) Moved vertically, in a circle, with the arm extended, across the track, while the train is in motion – The train has been divided
(e) Moved horizontally, above the head when the train is stationary – Apply the automatic air brakes
(f) Arm raised above the head when the train is stationary – Release the air brakes
(g) Raised arms crossed in the form of an X, and with the lamp describing the letter X, above or close to the track – Apply the direct air brake

*Any object moved vigorously, by any person, over or close to the track, is a signal to stop.

Locomotive whistle signals
The prescribed signals are indicated by the "o" sign for a short whistle, and "-" for a long whistle. The sound of the whistle must be clear and precise, with sufficient intensity and duration for the distance the signal is intended to reach.

Sound
(a) o
Stop, apply the brakes, answer to a signal to stop. This signal requires immediate compliance.
(b) -- ---
Release the brakes or ready to proceed.
(c) -- ooo
Signal for the signal bearer to go and protect the rear of the train.
(d) ----
For the signal bearer to return from the south.
(e) -----
For the signal bearer to return from the north.
(f) ---
Signal indicating that the train has divided while in motion.

Bell signals
Sound
(a) Two
While the train is stationary, it is a signal to start.
(b) Two
While the train is in motion, it is a signal to stop immediately.

(c) Three
While the train is stationary, it is a signal to reverse.
(d) Three
While the train is in motion, it is a signal to stop at the next station.
(e) Four
While the train is stationary, it is a signal to apply or release the air brakes.

THE TACNA – ARICA RAILROAD OFFICES

The administration of the Tacna - Arica railroad was conducted from the offices installed in the stations themselves. From the many items and pieces of machinery they would have used in those times, we have been left with some interesting examples.

“Regarding the office employees:
Art. 45 - Office employees are under the orders of the traffic agents of their respective stations, and will undertake the tasks assigned to them by those individuals.”

“Telegraph service:
Art. 103 - No extraordinary train will be dispatched without giving prior notification from one station to another and receiving the reply that the track is clear.
Art. 104 – The track and train crews will take care of checking the telegraph line, and they will assist in its repair in the event of breakdowns.”

Source: “Arica and Tacna Railroad, laws – decrees – contracts and other documents associated with this company and the extension to La Paz – Bolivia, Tacna 1914”.

AIR COMPRESSOR

Made in 1882, this device provided pressure to the engine, engaging the axles of the locomotive wheels and generating the centrifugal force required to put them in motion.

FORD MODEL T ENGINE

Known colloquially as the “tin Lizzie”, the Ford Model T was manufactured until the 1920s in the United States as an affordable automobile. This engine may have been used in a railcar or automobile at the Arica – Tacna station. It is particularly important as the type of engine used in the first railcar to run on this line.

FORD MODEL T SPARE PARTS

These items manufactured in the United States by Henry Ford in 1908 are spare parts for the Model T engine, which was used in automobiles and railcars.

LOCOMOTIVE HEADLIGHTS

Dating from 1857, these headlights were fitted to the front of steam locomotives to light the track at night.

LOCOMOTIVE LIGHTBULBS

These items, dating from 1900, served to light steam locomotives at night. A system of incandescent bulbs fitted into lamps was employed.

PERIOD FITTINGS

Wrought iron fitting with a pedal that may have formed part of a horizontal lathe.

LOCOMOTIVE CYLINDERS

Dating from 1890, this device improved the performance of steam engines by enabling more power to be generated. It was created in 1775 by the British inventor John Wilkinson, whose boring system made it possible to produce well-sealed cylinders.

WESTINGHOUSE SYSTEM

Dating from 1880, this coupling mechanism was used to link rolling stock and form a train. The system was invented by the American engineer George Westinghouse in 1869.

RAILROAD SWITCHES

Device dating from 1857 and used to change the direction of a train onto another section of track, in the event of unexpected incidents or accidents on the line. They were located at different points along the route and operated manually by personnel from stations, using a crank handle.

THE TACNA – ARICA STATION'S TRANSFORMATION INTO A MUSEUM

From when it was opened in 1857 until the 1960s, the Tacna – Arica station fulfilled its role in the transporting of goods and passengers using steam locomotives. At the beginning of the 21st century, the old locomotives were replaced by railcars. In 2012, financial difficulties led to the closure of the station. But that was not the end of the story: the creation of a railroad museum has brought new life to this historic building. Peru's second oldest railroad and one of the first in South America has been given a new role as a space for conservation and contemplation of the past.

1857
Opening of the Arica – Tacna Railroad, run by the English-owned company, "The Arica Tacna Railway Company".

1933
The Arica Tacna Railway Company's involvement in the running of the railroad came to an end.

1933-1942
The Peruvian state took over the running of the railroad, following a legal dispute with the English-owned company.

1942-1961
Following resolution of the dispute, the Ministry for Development and Public Works, through the National Railroads Office, took over the running of the line.

1972-1999
The running of the railroad was taken over by ENAFER (the NATIONAL RAILROAD COMPANY).

1978
Opening of the TACNA NATIONAL RAILROAD MUSEUM.

1980
The TACNA NATIONAL RAILROAD MUSEUM was declared part of the nation's cultural heritage and a historic monument.

1999-2004
ENAPU (the National Ports Company) took over the running of the museum.

2004
The Regional Government of Tacna took over the running of the museum.

MACHINERY: CULTURAL HERITAGE?

In addition to archaeological remains, artworks or historic houses, different types of machinery and all the work associated with them are also cultural assets. They are testimonies to a bygone era and transmit to us the legacy of technological advances developed by our forebears. This train station honors the memory of our industrial heritage.

THE WORK BROUGHT BY THE RAILROAD

One of the social impacts that the railroad brought about was the emergence of a variety of highly specific trades to meet its needs. These included the roles of stationmasters, switch operators, shunters, overseers, gatekeepers, announcers, telephone operators, engineers, stokers, guards, inspectors, night watchmen, etc.

The Tacna – Arica railroad station had two departments: Administration (the issuing of tickets, as well as operational and management activities); and Track and Works (responsible for track maintenance). In the latter department, workers were employed to produce and repair parts.

THE FOUNDRY

Maintenance of the Tacna – Arica railroad station involved tasks conducted in the foundry, workshop and disassembly shop. This group was known collectively as the General Workshop. This space was complemented by rolling stock stores and parking areas for locomotives. Such logistical organization was required in order to provide the four daily return journeys made by the route's locomotives or railcars.

The foundry contains machinery and other equipment once used by the smiths, foundry workers and casters, who performed expertly in what could be a hazardous process, producing parts that included bolts, wheels, gears, fastening nails, rails, and other items, all in an effort to ensure the continued smooth functioning of the train service when maintenance was required.

This workshop prided itself on being a supplier of parts to other railroads, saving them time and money. It also met the demand from the city for other metal items, such as the railings of Tacna's main cemetery, the metal fountains and other ornamentation found in streets and squares, and many other products.

THE ARDUOUS WORK OF THE FOUNDRY

The foundry employees worked with ferrous and non-ferrous metals, wood, natural rubber, glass, cement, certain synthetic products, fuels, lubricants, paints, enamels, de-scalers and countless other materials, according to researchers in the fields of chemistry and metallurgy, and they possessed considerable knowledge regarding the properties and characteristics of the materials they employed.

The earliest rails were made from more or less pure iron, but in Tacna they were soon produced using the Bessemer steel process, the key principle of which is the removal of impurities. The deoxidizing properties of this process resulted in high tensile strength, and these workshops became famous for the springs they produced.

The procedures used to shape the metal produced via a complex smelting process involved forging, rolling, drawing, pressing, stamping and turning.

Hot metal was shaped using a hammer and anvil, particularly during the processes for manufacturing axles, small turbines, crankshafts, or other components that would be subjected to stresses.

HOW WERE METAL ITEMS PRODUCED?

- The raw metal, either iron or bronze, was introduced into the foundry furnaces.
- Once it had melted, it flowed from the furnace along a channel that emptied into crucibles resistant to hot metal.
- Using tongs, the molten metal contained in the crucibles was emptied into molds to produce the items required.
- Once the metal had cooled, it was removed from the mold and finished using the machinery in the machine shop.

THE MACHINE SHOP

In the machine shop, different types and sizes of machinery and tools were concentrated. These were used to add the finishing touches to the pieces that emerged from the foundry, and which were destined to be used in the repair or rebuilding of engine mechanisms and wheels. Such maintenance work was conducted on the approximately twenty steam and diesel locomotives that were based at the station during its working life.

Initially, both the foundry and the machine shop were installed at the Arica station, but following the earthquakes and tsunamis that devastated Arica in 1868 and 1877, they were transferred to Tacna.

The machinery employed the most advanced technology and was the best available at the time. At the same time, the railroad workers were highly specialized in their respective fields, and possessed the knowledge required to design and build the projects for which they were responsible. As mechanical engineers, they sought to perfect their designs and develop innovative solutions.

From 1851 and during the 99-year duration of the concession granted to the English-owned "The Arica Tacna Railway Co.", an actual school had to be set up in the railroad's workshops, so that technicians could be trained in the practical knowledge acquired exclusively in the workshops, and be ready to replace previous generations of workers.

PRODIGIOUS PRODUCTIVITY

In his research, the historian José Giglio mentions that the railroad's workshops were in high demand for the fulfillment of the city of Tacna's many needs. He also mentions that Bolivia kept the workshops busy manufacturing items that were taken in mule trains as far afield as La Paz, Cochabamba, Potosí and even Santa Cruz.

The metal fountains and other ornamentation used to adorn streets and squares during the 19th and even the 20th century were produced by the railroad's workshops, where its skilled personnel always found ways to resolve the problems related to form, function and style presented by the designs they were given.

The railings that encircled the entire perimeter of the city's main cemetery were made at the railroad's facilities, as was the decoration for the niches and headstones, with their metal figures and lettering, often made from nickel or bronze.

Eventually, the workshops even began to produce complete iron window grilles, with intricate decoration, lettering, and commemorative plaques, as well as stoves, fireplaces, sinks, metal basins, charcoal grills, specially designed kitchens for restaurants or houses, beams, columns, and tempered rods for walls (during the 1868 earthquake, the mostly adobe and rush walls collapsed easily, and this led to the use of long metal rods to provide walls with added support). The workshops also produced colonial-style balconies, coverings for doors, rain gutters, etc.

THE ARICA WORKSHOPS

Both the Tacna and the Arica stations were equipped with a foundry and machine shop. The 1868 earthquake and tsunami left the Arica facilities inoperative, and despite the fact that in the port city there was a much greater demand for the workshop's services, it was decided that the Arica facilities should be moved to the Tacna station.

The earthquake led to the workshops placing themselves at the service of the community more than ever, both in Tacna and Arica.

When war was declared between Chile and Peru (April 4th 1879), the nation's railroad system was Peru was threatened. Because the company that ran the railroad was English-owned (and as is well-known, the British were involved in the underlying causes of the conflict), the Chilean government respected the terms of the contract between Joseph Hegan of the "The Arica Tacna Railway Co." and the Peruvian government.

José Giglio describes how the English company took advantage of all the exemptions contained in the contract and brought in its own machinery in order to produce *in situ* everything required for the railroad's operations and maintenance, as well as for offering services to third parties. These included the provision of services to the docks at Arica, Iquique and Ilo, the saltpeter mines to the south, and wine and spirits

manufacturers, as well as the supplying of steam-powered tractors, farming tools and mining equipment to neighboring areas, municipal works, and the supplying of any company or individual requiring foundry or machine shop services.

FOUNDRY

THE FOUNDRY WORKSHOP CISTERN TANKS

Work on the floors in the foundry area revealed the structure of the original underground cistern system. Given the importance of conserving this system as evidence of Peru's industrial heritage, the remains were studied and the technology employed in the treatment of water taken from irrigation channels in the area was documented. Upon its discovery, the system was found to be in a good state of repair, with its main components virtually intact.

OLD INSPECTION HATCHES
TREATED WATER STORAGE CHAMBER
IRRIGATION WATER STORAGE CHAMBER

Photographs of the cistern before and during restoration work.

LOCOMOTIVES YARD:

ROLLING STOCK
Tractive or towed vehicles that circulate on the railroad are known as rolling stock. On a railroad, towed vehicles are those requiring the power provided by other vehicles in order to move, while tractive railroad vehicles move under their own propulsion. Therefore, trains, locomotives and railcars are tractive vehicles, while cars, carriages and wagons are towed vehicles.

PASSENGER CAR
Towed railroad vehicle used for transporting passengers.

WAGON
Towed railroad vehicle used for transporting goods of all kinds (cargo, livestock, fuels, etc.).

RAILCAR
Railroad vehicle powered by its own small engine, with a capacity for no more than 14 people, used to transport railroad company personnel.

PASSENGER RAILCAR
Self-propelled railroad vehicle, with a capacity for more than 14 people, used as public transport for passengers. May be petrol, diesel or electric.

TRAIN
One or more hitched locomotives, or any self-traction railroad vehicle, with or without towed rolling stock, that circulates on a railroad.

LOCOMOTIVE
Self-propelled railroad vehicle used for pulling rolling stock.

THE ROLLING STOCK DISPLAYED AT THE TACNA STATION

ROGERS WORKS LOCOMOTIVE Nº 9, YEAR 1908. It was built at the Rogers Works factory, a subsidiary of the United States “American Locomotive Company” (ALCO), in January 1908.

It was assigned to the Ilo - Moquegua Railroad with the number 9 and the name "Pardo". It operated on this railroad until 1964, when it was transferred to the Tacna - Arica railroad. This steam locomotive has a cylindrical body in which the boiler and steam-powered engine are housed; it also has a whistle, sand dome, steam dome, hood and incandescent lamp, hydraulic injectors, a Westinghouse gauge to control the pressure, and a cylindrical smokestack.

The factory plates can be seen on the sides of the boiler cylinder. Its tender incorporates a tank for storing water and another for fuel. The locomotive’s bogies were fitted with a Symington brake system.

ALCO SCHENECTADY LOCOMOTIVE Nº 93, YEAR 1914. It was built at the Schenectady Works, the main workshop of the American Locomotive Company (ALCO), in 1914. It was bought by the Southern Railroads company and operated by the Peruvian Corporation Ltd on the southern Arequipa – Juliaca – Cusco line. It was temporarily assigned the number 93, and remained in service until 1964.

That year, the locomotive was transferred to the Tacna - Arica railroad. This steam locomotive has a cylinder where the boiler and the combustion engine (steam) are housed; also a sand dome, steam dome, hood and incandescent lamp; hydraulic injectors; a gauge to control the pressure and a cylindrical smokestack.

Its tender contains a tank for storing water and another small tank for fuel. Its bogies are fitted with the Symington brake system.

BALDWIN LOCOMOTIVE Nº 3, YEAR 1908. It was built at the Baldwin Locomotives Works for the company’s owner, Burnham, Williams & Co., in 1908. It was manufactured for the llo - Moquegua railroad company and assigned the number 3 and the name “Pacocha”. It operated on the Ilo – Moquegua line until 1964, the year the line was closed. It was then transferred to the Tacna – Arica railroad. This steam locomotive has a cylindrical body in which the boiler and steam-powered engine are housed; it also has a sand dome, steam dome, hood and incandescent lamp, hydraulic injectors, a gauge to control the pressure, and a cylindrical smokestack.

Its tender contains a tank for storing water and another tank for fuel. Originally, it ran on fossil fuel (soft-coal), and subsequently bunker fuel tanks were fitted.

BALDWIN LOCOMOTIVE Nº 2, YEAR 1908. It was built at the Baldwin Locomotives Works for the company’s owner, Burnham, Williams & Co., in 1908. It was manufactured for the llo - Moquegua railroad company and assigned the number 2 and the name “Moquegua”. It operated on the Ilo – Moquegua line until 1964, the year the line was closed. It was then transferred to the Tacna – Arica railroad. This steam locomotive has a cylindrical body in which the boiler and steam-powered engine are housed; it also has a sand dome, steam dome, hood and incandescent lamp, hydraulic injectors, a gauge to control the pressure, and a cylindrical smokestack.

Its tender contains a tank for storing water and another tank for fuel. Originally, it ran on fossil fuel (soft-coal), and subsequently bunker fuel tanks were fitted.

PASSENGER CAR Nº1. Its interior features indicate that it was a luxury car, intended for first class passengers. The roof has a ventilation system and two lamps were used to light the interior of the car. It has two bogies with a lever-operated brake system ("handbrake").

PASSENGER CAR N° 2. It has two compartments; one of them was for first class passengers, with seats for two people each; the other was second class, with four long wooden benches. It has two bogies with a lever-operated brake system ("handbrake").

PASSENGER CAR N° 3. It was adapted as a bar but was originally a third class passenger car. It has two bogies with a lever-operated brake system ("handbrake").

CHEVROLET TRUCK TYPE RAILCAR. This late-1920s Chevrolet truck was adapted as a railcar for transporting Tacna – Arica railroad maintenance personnel. It has a GMC engine and is fitted with six wooden passenger seats at the rear.

CHEVROLET MASTER DELUXE MODEL RAILCAR Nº 79. It belongs to the late-1940s Fleetmaster series and was adapted as a railcar for the Tacna – Arica railroad and assigned the number 79. It has a GMC "stovebolt" six-cylinder longitudinal engine.

RAILCAR N° 16. This 1920s Chevrolet automobile was adapted as a railcar for use on the Tacna – Arica railroad, and assigned the number 16.

TACNA STATION CONSERVATION AND RESTORATION WORK

The conservation of cultural heritage does not simply involve the material continuity of the objects of which such heritage is composed; it also entails the preservation of a set of values that validate their importance.

The notion of conserving cultural heritage began to be addressed in a formal, systematic and regulatory manner with the Athens Charter of 1931.

In the conservation of any aspect of cultural heritage, it is necessary to establish clear goals sustainable over time, so that the original character and significance of cultural assets can be maintained intact. The aim of any intervention involving cultural assets is to ensure that our own and future generations can continue to enjoy a shared cultural legacy.

In this context, interpretation of each individual item is essential, in order to enable citizens to appreciate it through the understanding they gain, thereby creating a personal link with their cultural heritage.

Industrial heritage is the result and expression of the moment in which the human race solved a specific problem creatively using technological and scientific resources.

In addition to being the second oldest railroad built in Peru, the Tacna – Arica railroad is the only one (of the first generation of locomotives, cars and railroad facilities in Peru) that remains operational. The

objects housed in the Tacna National Railroad Museum constitute the nation's most important railroad technology collection.

The importance of the Tacna – Arica railroad lies in its status as a unique testament to the historical moment in which it was built, as well as in its place as part of the functional processes that encapsulate the *raison d'être* of the stations of the period, when steam-powered railroads and other process were being introduced.

The technology employed to solve the spatial and infrastructure requirements of the railroad forms an essential part of the content and dynamic interpretation of the cultural heritage embodied by the old Tacna – Arica railroad station, and of its importance both as a museum and point of reference.

Restoration work in the conservation room and multiuse room.
Restoration work in the administration building.
Restoration work in the clock tower.
Restoration work in the tourist building.
Restoration work in the Peru room, Tacna – Arica room, and Teaching Workshop (previously the reference room).
Restoration work in the Foundry and Machine Shop.

BIBLIOGRAPHY AND SOURCES

1. Publicación de la Dirección de Obras Públicas y Vías de Comunicación del Ministerio de Fomento, Perú. (1932) *Ferrocarriles del Perú, Economía y Reseña Histórica*. Lima: Publicación de la Dirección de Obras Públicas y Vías de Comunicación del Ministerio de Fomento.
2. Cavagnaro Orellana, L. (2015) *Ferrocarril de Arica y Tacna, Leyes – Decretos – Contratos y demás Documentos relacionados con esta empresa y de la Extensión hasta La Paz – Bolivia*. Tacna: Archivo Regional de Tacna.
3. Galessio Castañeda, E. (2007) *Ferrocarriles del Perú, un viaje a través de su historia. Lima:* Aruntani SAC y Galessio Castañeda, E.
4. Ross D., Boocock C., Brown D. Lawford, N., Solomon B. (2003) *La enciclopedia de trenes y locomotoras.* Madrid, España: Edimat Libros S.A.
5. Ferrocarril Central del Perú (1947). *Reglas para el departamento de Tráfico.*
6. Dirección General de Publicaciones / Centro Nacional para la preservación del Patrimonio Cultural Ferrocarrilero (2013*). Interoceanic Railway of Mexico, Index of Standard Material with sketches, edición facsimilar.*
7. Ingunza Montero, E. (1961) *El tren de la codicia, una historia real de ferrocarriles, poder y desengaño en el Perú, Tomo 1.* Lima: Editorial Planeta S.A.
8. Vigué, J. (sin año de publicación) *Atlas ilustrado, Trenes muy antiguos*. Madrid: Susaeta
9. Lora Cam, J. (2011) La Guerra 1879-1979 Chile-Bolivia-Perú, Lima: Gutemberg editores.
10. *Castagnola, D. (1930) Economía en el trazo y la construcción de los ferrocarriles nacionales. Lima.*
11. Ministerio de Fomento y Obras Públicas, Dirección General de Ferrocarriles *(1957) Primer Centenario de la construcción del ferrocarril Tacna-Arica*. Lima: Ministerio de Fomento y Obras Públicas, Dirección General de Ferrocarriles.
12. Guajardo Soto, G. (2007) *Tecnología, Estado y Ferrocarriles en Chile, 1850-1950*. Recuperado de http://www.memoriachilena.gob.cl/archivos2/pdfs/MC0062438.pdf

13. Pereyra Plasencia, H. (2016) *Cáceres y el Contrato Grace: sus motivaciones.* Recuperado de http://revistas.pucp.edu.pe/index.php/revistaira/article/view/14551

14. Compañía de los Ferrocarriles Salitreros (1884) *3° Memorándum* https://www.bcn.cl/obtienearchivo?id=documentos/10221.1/30251/1/233395.pdf

15. Gerencia de Regulación y Estudios Económicos, Jefatura de Estudios Económicos (2018) Documento de Trabajo N°3. *Análisis de las concesiones ferroviarias en el Perú.* Recuperado de https://www.ositran.gob.pe/wp-content/uploads/2019/01/Documento-de-Trabajo-N-3-An%C3%A1lisis-Ferrov%C3%ADas.pdf

16. Irarrázabal Rojas, A. (2014) *Central, el Tesoro olvidado del F.C.A.L.P.* Chile.

17. Casapia Soto, G. (2014) *Carretera o Ferrocarril ¿Qué modo de transporte usar?* Lima: Universidad Ricardo Palma.

18. Cáceres, B. (2014) *Esta es la pequeña historia del ferrocarril en Chile*. Ñuñoa: Pehuén

19. Consejo Nacional de patrimonio cultural de la República de Cuba, Comisión Nacional de Monumentos de la República de Cuba, Ministerio de Cultura de la Nación Argentina, Comisión Nacional de Monumentos, Lugares y Bienes Históricos (2017) *Arquitectura Ferroviaria de América Latina, Cuba y Argentina*, Argentina: Suyin Morales Alema.

20. Pardo Abad, C. (2016) El patrimonio industrial en España.