

# **New Functions of the Mining Heritage in Mexico**

Miguel Ángel Sorroche Cuerva

<https://orcid.org/0000-0002-8063-4833>

## **Abstract:**

The silver mines of Zacatecas have loomed large in the history of New Spain's mining wealth. The extraction of silver here began in 1546 and yielded such surplus that it modified the policy of the Spanish Crown in New Spain towards mining. These mines substantially financed Spain's presence in the Americas, and they allow us to understand with greater clarity the northward expansion of the viceregal boundary in the direction of what were considered the Chichimeca populations and the founding of cities. New musealization initiatives find value in this Novohispanic mining history, and this chapter examines the different ways in which that past is being recovered in service of agendas in the present. Heritage models to this end are diverse. A number of cases, such as La Bufadora in Zacatecas, La Fundidora in Monterrey, Las Minas del Boleo in Baja California, and Mineral del Chico in the state of Hidalgo, serve to advance the social function of heritage as an element of economic development. This chapter illuminates how the various management models employed shed light on a vision of these mining centers and their Atlantic history as evolving nodes in Mexico's public heritage practice.

## **Introduction**

Mexico's mining wealth is one of the most distinctive features of the country. Being an extractive activity per excellence, its weight in the economic, political, and social history of Mexico turns it into a pillar and a key part of the current developmental dynamics. Since pre-Hispanic times, the Mexican subsoil has been exploited systematically, in one way or another, by the diverse groups that inhabited its lands, thus integrating the varied minerals in the creation of a rich and diverse material culture that represents its identity.

The economic objectives that promoted transoceanic travel in the 15<sup>th</sup> century made that, together with the unexpected finding of America, these riches soon became one of the immediate goals to the newly arrived. For instance, the discovery of the mines in Zacatecas in the 40s of the 16<sup>th</sup> century signaled a pivotal moment in the occupation process of the new Spanish more northerly territories.

The legacy left by that process is valued today from heritage parameters, with the potential that its recovery has from a social perspective, by reaffirming identities, and from an economic perspective, due to the development opportunities that it implies. However, this must not let us overlook the problems it poses: it devastates ecosystems and water basins, causes pollution, affects biological diversity and brings about almost no substantial improvement in the life conditions of the inhabitants of these regions, with a mining tradition, who have been deprived of their lands and displaced to marginalization and poverty situations.

This text aims at reflecting on the processes of identification and revaluing a heritage typology that is known internationally, but which even to date is not appreciated due to the negative perceptions associated with it.

### **Industrial Heritage**

One of the areas to which the concept of industrial heritage is related is mining. Its development reached such a degree of damage that affected the labor exploitation of miners, the environmental quality of the contexts close to the extraction areas, which were inexorably contaminated, and also the mere local development of the immediate surroundings, affected by the monopolization of the properties as well as the land use.<sup>1</sup> All of these aspects have turned this heritage type into one of the most controversial ones from the point of view of their acknowledgement within the area of cultural heritage. Linked to the already-mentioned processes of damage in connection to contamination, displacement, etc. this type of heritage does not achieve the positive perception of other heritage typologies with which people have a greater identification.<sup>2</sup>

At the end of the 20<sup>th</sup> century, the evolution of the heritage consciousness towards wider concepts permitted the appreciation of cultural heritage in all its diversity. Immersed in its urban, territorial, historic and social context, it has widened its dimensions until reaching a territorial scope that has turned the landscape into the scenario without which it cannot be understood today.<sup>3</sup> The so-called emerging heritage sites are born in connection to this new definition, as cultural heritage stemming from, among others, the history of the industry, the territory and landscape, the underwater environment, contemporary history as well as ethnology. Thus, the perception of these sites is enriched, and the complexity of a multifaceted reality is shown, which far from the traditional monumentalizing in force from the 18<sup>th</sup> century to the second half of the 20<sup>th</sup> century, it encompasses a greater diversity of expressions that reaffirm identity traits.<sup>4</sup>

This new definition of the limits of heritage was linked to other changes in the social, economic and cultural fields, such as, rapid transformations, made by technological revolutions that, since the 80s of the 20<sup>th</sup> century, have changed the systems of production of goods in the case of industrial heritage. The changes that derived from these dynamics and that affected consumption caused the accelerated deterioration of productive structures in western countries. Today, these structures are faced with the challenge of being studied, preserved, and reused. These systems, sets or elements which have their origins in the industrial sector have played a major role in the evolution of the territories, be it at urban or rural level, and in the formation of the historic and cultural character of their sites and landscapes.<sup>5</sup> In all the cases that we can refer to, the testimonies of industrialization constitute a fundamental legacy to understand the history of a place, thus becoming essential pieces to plan the future economic and territorial development of a region.<sup>6</sup>

The Nizhny Tagil Charter for the Industrial Heritage adopted by The International Committee for the Conservation of the Industrial Heritage (TICCIH) in Moscow in 2003

defines this heritage type as the remains of industrial culture which are of historic, technological, social, architectural, or scientific value. These remains, which consist of those zones where extraction and transformation activities are developed, the infrastructures that communicate them, their buildings and machinery, as well as the places where social life, customs and ways of living take place, constitute the diverse group that make up this type of heritage.

### **The case of Mexico. Some examples**

Mexico has witnessed the evolution and expansion of the set of elements that can be included under the umbrella term of industrial heritage. As a scientific field, and as it is the case of other heritage areas, it encompasses a plurality of scenarios ranging from research to conservation, education and training for its protection and maintenance.<sup>7</sup> Industrial heritage consists of the remains of structures, buildings, machinery, tools, or the marks that this practice has left on the territory in the shape of its landscape. It encompasses the whole industrial process, from extractive activities to those related to processing and refining goods, including the sectors indirectly connected such as transport, means of communication, the infrastructure, etc.

As in the rest of Latin America, the processes that began during the Colony created a situation where indigenous inhabitants were not exterminated. Despite all this, upon inserting them in the operating mechanisms of the new dynamics generated in the occupied territories, the local cosmologies were altered, transforming them from a Eurocentric perspective, which not only allowed usury but fostered it within the inhabitants themselves as a clear sign of the process that had begun. Thus, the dispossession of useful resources for the industry, mining and agriculture began. Accumulation was favored and not until the 18<sup>th</sup> century there would

start the trade with other American territories and with Europe itself, to which they would supply raw materials for the Industrial Revolution to begin.<sup>8</sup>

This way, Mexico became a fundamental export center for the development of the Industrial Revolution, which allowed Europe to become the nucleus of the new system with England as its vertex. Colonialism and modernity came together in a first phase where the transfer processes took place only in one direction, that is, from Mexico to Europe, establishing some dynamics in which the exporting territories were slightly differentiated among themselves.

The examples we can find in Mexico are implicitly related to the mechanized industrial processes of extraction and export that took place in different phases, to which other processes connected with more recent stages can be added. In any event, they all refer to preindustrial cases with a great presence of workforce as in the case of silver mining, and which encompassed other industries like *obrajes* (weaving workshops), sugar mills, tobacco manufactures or *haciendas* to produce *henequen*, among others. All of them are representative of the continuous automotive process that extends until today.<sup>9</sup>

The set of structures dedicated to the exploitation of mines and the surrounding buildings constitute an object of study that must be addressed from a cross-curricular perspective that integrates the related activities and the fields involved. The possibility to obtain diachronic and synchronic data, as a result of stratigraphic and topographic analysis respectively, enables us to understand the selection of the diverse infrastructures and their suitability for each period. As some authors remark "... from a careful reading of the architectural and engineering marks left by the productive unit, the existence of constructive models of reference can be inferred, which represents an important clue to understand the level of originality, imitation and adaptation undergone by the Mexican industrial structures".<sup>10</sup> And we should not leave behind the implicit message left by these

constructions, their eloquence towards the exterior, as they define: "...the solid territorial presence of the enterprise and it conveys a clear politico-social message based on discipline and public morals, the formation of the good citizen and the construction of national consciousness".<sup>11</sup>

Another work level that we cannot overlook in the Mexican case is that of the territory. Being the extraction scene, the diverse elements that make it up (the factory, extractive centers or transport networks) are not free from the tension in the relationship between the productive world and its surroundings. Here is where the negative perception associated with industrial heritage becomes more apparent and, as it already appears in the discourse built around its image, it is also present in the clear signs left on the territory. Thus, it is in the landscape level where we would find the answer to the productive changes that take place with the passing of time and we would verify whether they correspond to internal or external and natural or human causes by analyzing the evident environmental impact of the remains of the constructions and the accumulated production waste.

### **A mining scene, the *reales de minas***

Historically, ore extraction in Mexico has generated an exploitation of natural resources in full view of national and local governments, generating unconscionable plundering which, far from strengthening the economy, has left regional and environmental problems, showing a dynamic common to other countries.

The study of the extractive processes and the means of exploitation that made them possible in Mexico between 1500 and 1800 involves the analysis of the dynamics of occupation and territorial articulation. In the first case, the occupation of conquered space required that the city served as an essential element of territorial articulation and consolidation of the population. Far from the generalization of the planned and regular

urbanization model of the American city, the mining cities or *reales de minas* formed an urbanization model close to the mines characterized by its irregularity, which was more similar to the medieval European models than to the Renaissance utopian model. Taxco, Zacatecas, Guanajuato, Pachuca or Chihuahua cannot be interpreted without considering the dynamics born in the mining exploitations. This is an aspect that we can extend to the rest of Ibero-America during the period when the European presence was central to the continent: the 16<sup>th</sup>, 17<sup>th</sup>, and 18<sup>th</sup> centuries.<sup>12</sup>

One of the examples that illustrates this scenario is the city of Taxco. Located in the Guerrero estate, about 170 km (105 miles) south of Mexico City, it emerges under the influence of the silver mines that started being exploited from 1534 onwards. Its urban planning turns it into one of the clearest examples of a mining town, preserving its pre-Hispanic ascent and currently being the country's first silver craft exporter. Referent of the Mexican baroque style with its emblematic Santa Prisca church (1758), its presence minimizes the attention to its urban characteristics, with winding narrow streets traced following the contour lines that widen and open in small squares to decompress the labyrinthic characteristics of the design.



Figure 3.1. Taxco. Guerrero. Photograph by Miguel Ángel Sorroche Cuerva.

This model can be encountered in the foundation of cities in contemporary times and beyond as an example of a spontaneous and barely regulated process, which derived from the accelerated growth of these cities that witnessed how their lives became enriched due to the mines, eventually a powerful reward of land occupation and urban foundation.

### **Routes of circulation**

The exportation of natural resources to the production centers caused the development and emergence of new routes of circulation and sites that regulated the reception and distribution of products which had Europe as a final destination. In Mexico they were shipped on galleons from the port of Veracruz, heading to La Habana, where other routes from Panama or Colombia joined together. From Cuba they directed towards the Canary Islands and finally

to Seville or Cadiz. This circuit connected America and Europe during three centuries and was known as the *Carrera de Indias*.

In this sense, the *Camino Real de Tierra Adentro* is the best example of the articulation of the territory stemming from mining exploitation. As a structure it created a fast exit way for products like silver to get to the capital where other routes reached, for example those that came up from the Caribbean and Pacific littorals from Veracruz or Acapulco. The *Camino Real de Tierra Adentro*, which is about 2600 km (1600 miles) long, used to connect Mexico City and Santa Fe de Nuevo Mexico passing on its way through Querétaro, Guanajuato, Aguascalientes, Zacatecas, Durango, Chihuahua, Ciudad Juárez, El Paso, Albuquerque and Santa Fe.

The *Camino Real de Tierra Adentro*, was declared as Human Heritage by UNESCO in 2010. Thus, giving back its historic value to this structure, which served not only for the circulation of the silver extracted from mines like Zacatecas, Guanajuato or San Luis Potosí and the mercury that arrived from Europe, but also for establishing social and cultural relationships between Europeans and indigenous groups.

The planning of these routes cannot be understood as a whole without considering their taking advantage of the previous pre-Hispanic infrastructures that combined water and land sections. From the 16<sup>th</sup> century onwards, with the development of the roads where new means of transport should transit (like carriages), they became the channel for people, ideas, and objects to transit. For this reason, the roads were provided with the necessary structures so that both people and products could circulate more easily. In the case of ore, the circulation process encompassed from their extraction to their arrival at the centers of accumulation, transformation, and distribution and, finally, export.

Bridges, inns, *haciendas*, towns, etc. made up this environment that arrived at Santa Fe in New Mexico and that was the antecedent to other roads that, although not clearly linked

to the extraction process, did articulate the territory due to other needs, as in the case of Caminos Reales de Tierra Afuera<sup>13</sup> and las Californias.<sup>14</sup> In both cases, the defensive motivation was more important due to the tensions generated shortly after the end of the occupation of the Valles Centrales of the altiplano as a result of the confrontation with indigenous groups and other European powers like England or France, which competed against Spain to gain territories in the new continent.

### **Extraction Technology**

On a third level of the scale that we have established, we must integrate the production contexts. The testimony on the technology for the extraction of ore that each period offered is the most evident illustration of that industrial heritage today. In the case of Mexico, tracking the testimonies of ore extraction from the 16th to the 19th century let us understand some of the dynamics which reflect an evolution adapted to the demands of each time: from the pre-Hispanic heritage to original contributions and finally going through the incorporation of technologies imported from Europe.

During the Viceregal period, characterized by the limited development of the productive forces, the processes relied on the extraction, the beneficiation and the trading of metals. These were obtained, first, through excavation in open-pit mines and, later on, going deeper into the ground through tunnels. The improvement came with the introduction of solutions that allowed the installation of ventilation systems through sloping tunnels and caverns that connected the galleries, and with which the miners' breath, the drainage and the mineral extraction were facilitated. The first system was built in San Luis Potosi in 1556.

As early as the 17th century, the use of black powder became widespread in underground explosions, which allowed the perforation of big mineshafts and galleries that required complementary basic machinery, such as pulleys and *malacates*.<sup>15</sup> The first smelting

processes that allowed the refining of small quantities of mineral with high concentration of silver were also incorporated. In this sense, the metal processing technique with quicksilver or mercury developed expansively from 1600, when the *haciendas* began to expand so as to extract silver where there was plenty of water to perform the washing process in the process of amalgamation. To this end, a wider range of minerals was used. These were ground with hydraulic and animal-powered mills, when there was no water available.



Figure 3.2. Zacatecas. Photographs by Miguel Ángel Sorroche Cuerva.

A few examples allow us to understand the development and expansion of these extraction processes. Possibly, the mine of La Bufa in Zacatecas may be the one to better symbolize the mineral searching and extraction processes in New Spain in the 16th century.<sup>16</sup> Discovered by Juan de Tolosa in 1546, this deposit altered the dynamics of the Spanish

occupation, turning the Northern territories into the main expansion front until the 18th century.

Back to Taxco, the importance of this site in the mining history of Mexico places it in a privileged position to learn about the transition dynamics between the pre-Hispanic and colonial worlds. The pre-Hispanic mine site discovered during the remodeling of the *Posada de la Misión* hotel may serve as an example of the initial ways of extraction. After the excavation works, it was found that there was still presence of quartz, silver, and gold veins and that it dated back more than 500 years. Beyond the symbolic significance this may have, from the pre-Hispanic vision of the cave as a connecting space with the underworld and as a place for burial, these findings reflect the pre-Hispanic practice of ore extraction and the type of mines the Spaniards found when they arrived in these territories. As only 150 meters have been explored, this makes the mine preserve most of its metals, being currently protected by the INAH<sup>17</sup> (National Institute of Anthropology and History).

Undoubtedly, the city of Guanajuato symbolizes the occupation and foundation processes around the mining deposits in the 16th century and its later transformation into an urban center.<sup>18</sup> In 1558, in the place where the city of Guanajuato would be placed later on, the first mining extraction pits started being operated (The Rayas Mine and Mellado Mine) and the motherlode or main vein<sup>19</sup> was discovered. Afterwards, two more gold and silver main veins were found: La Sierra de Santa Rosa and La Luz, which provided the region with immense wealth and, at the end of the 18th century, turned it into the major world silver producer. The three of them, the Veta Madre, Santa Rosa and La Luz shape the most productive vein systems of La Sierra de Guanajuato.

Time has left on the surface a constellation of mines, small towns and old extraction *haciendas* which have created a unique landscape that has survived until the present day, as

an imprint of the articulation of the territory around the *Camino Real* and the emergence of *estancias* and *paraderos*, in this case, in the place known as Puerto de Santa Rosa.

The extraction systems that were implemented in Guanajuato exemplify the diversity of resources available. From the moment the activity began, a system of *lumbreras* (vertical mineshafts) was used, which consisted in heating and cooling the rocks quickly, taking advantage of the superficial presence of gold and silver.<sup>20</sup> To the beneficiation of the mineral, since the beginning of the 16th century, the smelting was used first and the amalgamation later on, “with the patio process, using salt, water, copper sulfate and cold mercury”.<sup>21</sup> This way the gold and silver were extracted together and were afterwards separated with sulfuric acid in the mint. This system worked until the 20th century.<sup>22</sup>

The dynamite was another method used in a generalized way in the 18th century, especially to obtain minerals located deeper underground, a method used in the Mother lode. Not until the end of the 19th century, after the passing of the Mining Law in 1892 electricity was introduced thanks to the participation of American industries that incorporated high technology machinery in the extraction process.

Undoubtedly, the beneficiation *haciendas* represent another benchmark stemming from the mining dynamics, and they are located all over the country.<sup>23</sup> These *haciendas* are centers where gold and silver bars are produced and, together with the mineral extraction *haciendas*, they symbolize a singular architectural typology. To a certain extent, they can be considered as the forerunners of the irregular urban planning of the mining cities since, originally, they looked for places close to water courses for ore management, which ended up being the germ of these cities’ urban nucleus. The oldest *haciendas* are located within the urban areas and are called beneficiation (*de beneficio*) as they receive the raw ore from the mining exploitations. Clogged the center, they were located in the periphery and reached a

peak in the 18th century with the Bourbon reforms. Between 1765 and 1808, they appeared as housing complexes on which, apart from the mining facilities, there were orchards and stables to feed the workers.<sup>24</sup> In the case of Guanajuato, the beneficiation *hacienda* of Valenciana Mine, built in 1791, is an example that lets us understand how the *haciendas* have survived until the present and the exploitation opportunities they offer, as it currently possesses a museum, which works as a referent in the construction of identity traits.<sup>25</sup>

What has given rise to the delineation of some characteristic mining landscapes is precisely the conformation of these peripheral areas around the cities. In this sense, Pachuca is a prominent example.<sup>26</sup> Being the Capital of the so-named Comarca Minera (Mining District), it is located in Sierra Madre Oriental some 100 kms (62 miles) north of Mexico City. In this region the development of the mining activities has been unequal. On the one hand, the bonanza periods for which it has been widely well-known and, on the other hand, periods of abandonment of these historical areas which have created an industrial landscape that has lasted until the present and which must be valued to guarantee its preservation. They are vestiges distributed in different points of the city's northwest area, which conform the facilities around the mines that were run and worked by different industrial groups and which are now a vivid testimony of Mexican mining history.<sup>27</sup>

Pachuca's heritage is integrated by *haciendas* and mines such as the ones of San Buenaventura, Camelia, El Paraíso, Hacienda Loreto, San Juan Mine and Hacienda Purísima Concepción where, at present, we can encounter in different degrees of conservation part of the spots from which metal was extracted and processed. Also, part of the residential neighborhoods for workers have been preserved, shaping the urban tissue of the area, where the mining facilities constitute a singular historic and landscape heritage.



Figure 3.3. Hacienda de Loreto. Pachuca. Estado de Hidalgo. Photograph by Miguel Ángel Sorroche Cuerva and Manuel Jesús González Marique.

In the case of Hacienda de San Buenaventura, there still stand the ruins of the facilities from which silver and gold were extracted by means of the patio process, windmills and waterwheels. As for Hacienda Loreto, situated south of the city of Pachuca, it remains active, keeping its buildings, machinery, equipment, tools and furniture in good state of conservation.

Finally, Lower California stands out in Mexico. Being a peripheral expansion area in the 18th century, it serves to exemplify that there had always been a combination of territorial exploitation and evangelization of the indigenous populations in the northern novo Hispanic territories. This way the Spanish sought to make their presence permanent in view of the persistent incursions of European powers which, from the 16th century, were interested in benefiting from the resources and strategic position of these regions.<sup>28</sup> The wealth of this area was a key factor identified since the end of the 17th century, when Manuel del Ocio<sup>29</sup> started to develop activities concerning the peninsula's mining wealth.

In this case, the interesting city of Santa Rosalía, declared a historical monument in 1984 by the Congress of Baja *California Sur* (South Lower California), was built at the end of the 19th century by the French mining company El Boleo, which had obtained the concession to exploit the copper deposits therein. This illustrates the ex profeso construction of a comprehensive structure for extraction, taking advantage of the technological capacities that steel had brought to the new construction systems.



Figure 3.4. Mina El Boleo. Santa Rosalía. Baja California Sur. Photograph by Miguel Ángel Sorroche Cuerva and Uriel Rafael Pabello Arvizu.

El Boleo, created in 1885 by the French bank Mirabaud et Cie. to exploit these rich deposits between 1885 and 1954, made use of the previous works in the Baja California deposits discovered in 1868 and originally exploited by the Mexican-German company El Progreso, created in 1878.

The deposit, located near the *Volcan de las Tres Virgenes* (Three Virgins Volcano) and Santa María silver mine, has a richness of 15% in copper, and received a 50-year exploiting concession granted by Porfirio Diaz in exchange for employing Mexican people and building a city in the middle of the desert. El Boleo company created the city of Santa Rosalía, offering agricultural lands, a hotel and a *casona* (manor house) with twenty apartments for their employees, a food warehouse, another industrial warehouse for spare parts and materials and a church made in France, in the Bibiano Duclos' workshops. Due to its excellent location, the company also built an artificial harbor to import coke from Germany and England, furnaces, four steam engines and an electric power station which made Santa Rosalía the second city in the country to lay electrical lines.

## **Conclusions**

America's wealth in natural resources has not brought about their rational exploitation. The potential of these territories overshadowed others like Europe, which had always benefited from the extraction of their minerals from the 16<sup>th</sup> century.

Nowadays, we seek to understand this mining past from an identity perspective. There, where the deposits have been overexploited and only the marks of the extraction are left, we want to get the activity back by resorting to revaluing projects that allow us to understand a past from which we can learn. Commitments such as the Mineral del Chico in Hidalgo or, the most spectacular Fundidora in Monterrey, open the gateway to putting forward management projects making use of the abandoned structures.

A country like Mexico, which has exploited its mining wealth since the pre-Hispanic times, has in this mark a means to understand what the relationship between its societies and the surrounding environment has been like, of them among themselves and of the foreign intromission to extract minerals for their own benefit creating inequalities, which can be observed even today. A reflection exercise that should contribute to improving the life quality of those territories that could find in that past a possibility in the future.

Further research into these aspects may allow a better understanding of the colonial period and the processes that were put forward once the Europeans arrived, so as to reach conclusions that prevent us from repeating past mistakes.

\*Translated by: Verónica P. Recchioni, English Professor, University of Granada and Soledad Montejo, Public Translator - UNCo

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<sup>9</sup> Ruth Robles; Guillermo Foladori, “Una revisión histórica de la automatización de la minería en México”, *Revista Problemas de Desarrollo* 197 (50) (2019): 157-180.

<sup>10</sup> Sergio Niccolai, “El patrimonio industrial histórico de México y sus fuentes”, *América Latina en la Historia Económica* 23 (2005): 61-76.

<sup>11</sup> Niccolai, “El patrimonio,”64.

<sup>12</sup> Francisco de Solano. *Ciudades hispanoamericanas y pueblos de indios* (Madrid: CSIC 1990).

<sup>13</sup> The *Camino Real de Tierra Afuera* was traced towards the north of Mexico City, from Querétaro to Zacatecas and from here it continued its way to Saltillo and finished at San Antonio, Texas, in its central part. It was initially thought as a way to supply the populations close to the mines, like those in Mazapil; however, it later adopted a defensive function in order to control the presence of French troops in the areas nearby the Gulf of Mexico and the Mississippi River. Ana Sofía Rodríguez Cepeda; Miguel Ángel Sorroche Cuerva (coords.), *El Camino Real de Coahuila y Texas, patrimonio cultural compartido* (Saltillo: Universidad Autónoma de Coahuila 2016).

<sup>14</sup> In the case of the Pacific front from the end of the 17th century onwards the Jesuits were allowed to head the occupation of a territory which, being far away and lacking riches, was not regarded as profitable by the Spanish Crown. Its strategic positioning was more important because it was on the coast where the Manila Galleon docked once it crossed the Pacific. From the southernmost part of the peninsula in Baja California some Jesuit missions were established which from 1767 onwards were complemented by other Franciscan and Dominican missions to reach the proximities of San Francisco

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Bay in the 19th century, completing this way the occupation under which the articulation of the territory was established in 1850.

<sup>15</sup> According to the Royal Academy of History dictionary (RAH): Word of náhuatl origin which makes reference to a rotating object: Machine as a capstan, widely used in mining to extract minerals and water, which has a drum on top, and, below it, the handles to which the horses that move it are fastened.” <https://dle.rae.es/malacate>.

<sup>16</sup> P.J. Bakewell, *Minería y sociedad en el México colonial: Zacatecas (1546-1700)* (México: Fondo de Cultura Económica, 1976).

<sup>17</sup> Archeologists and specialists determined that for every 20 tons of stone extracted, only 800 grams of silver were obtained, which were used for bartering. The silver was exchanged for seeds or grains such as corn, beans or cotton and, probably, for birds for consumption. Apart from silver, other metals and minerals were found, for instance gold, zinc, lead, iron and quartz.

<sup>18</sup> Diana Xcaret Azpeitia Jáuregui; Velia Yolanda Ordaz Zubia, “Guanajuato capital: identidad a través de su patrimonio minero,” *Jóvenes en la Ciencia. Revista de Divulgación de la ciencia* 4:1 (2018). Retrieved from: <https://www.jovenesenlaciencia.ugto.mx/index.php/jovenesenlaciencia/article/view/2452>.

<sup>19</sup> Stone or metalliferous mass that fills an old fracture (or crack) in a rock formation.

<sup>20</sup> Nieves Martínez Roldán; Lola Goytia Goyenechea, “Huella minera en la ciudad de Guanajuato (México) entre los siglos XVI-XIX: morfología urbana y planimetría en el Archivo de Indias en Sevilla (España),” *Contexto* 21 (2020): 35-49.

<sup>21</sup> Martínez; Goitia, “Huella,” 35-49.

<sup>22</sup> At the beginning of the 19th century another system was used, that of cyanidation, in which dynamite and cyanide were also applied. Cyanide was then poured back in the river course.

<sup>23</sup> C. René León Meza. *Minas y haciendas de beneficio en la Nueva Galicia durante el siglo XVIII*, (Guadalajara: Universidad, 2020).

<sup>24</sup> Between 1686 and 1740, in the city of Guanajuato there were 64 beneficiation *haciendas* which were later divided to separate the groups of workers in teams being, in some cases, the germ of towns such as the reales de minas, like Mineral de Valencia or Mineral de Santa Ana, located around the *haciendas* or even neighborhoods in the same city.

<sup>25</sup> Diana Xcaret Azpeitia Jáuregui; Velia Yolanda Ordaz Zubia, “Guanajuato capital: identidad a través de su patrimonio minero,” *Jóvenes en la Ciencia. Revista de Divulgación de la ciencia* 4:1 (2014). Retrieved from:

<https://www.jovenesenlaciencia.ugto.mx/index.php/jovenesenlaciencia/article/view/2452>

<sup>26</sup> Elvira Eva Saavedra Silva; María Teresa Sánchez Salazar, “Minería y espacio en el distrito minero Pachuca-Real del Monte en el siglo XIX,” *Investigaciones Geográficas* 65 (2008):82-101.

<sup>27</sup> María Elena Sánchez Roldán; Elizabeth Lozada Amador, “El paisaje Minero de Pachuca, Hidalgo, México. Patrimonio Industrial en la Comarca Minera,” *Gremium*, 7:13 (2020 enero-julio) [<https://editorialrestauro.com.mx/gremium/>].

<sup>28</sup> Enrique Esteban Gómez Cavazos. “Una Company Town francesa en el desierto de la Baja California: Compagnie Du Boleo, Santa Rosalía, 1885,”. *Labor & Engenho*, Campinas [SP] Brasil, 10:1 (2016): 74-84, jan./mar. [<http://periodicos.sbu.unicamp.br/ojs/index.php/labore/article/view/8644334>].

<sup>29</sup> Manuel de Ocio was the first businessman and industrial civilian of the northeast of New Spain. A missionary soldier, who traced a great quantity of pearls with which he raised a large capital and, thus, he gave up his profession as a soldier to get involved in commercial activities in Baja California. In the middle of the 18th century, he was granted a mining concession south of La Paz, in a zone close to the current towns of El Triunfo and San Antonio, in the vicinity of Sierra de la Laguna.