The historical mines of Almadén

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Introduction

The historical mines of Almadén, which were actively functioning for over two millennia, produced a third of the world's mercury — a total of 7,500,000 flasks (Hernández, 1995). After mining and metallurgical production ceased in 2003, the mines were turned into a museum. Efforts are currently underway to have the mines declared a World Heritage Site.

Almadén is situated in the southwestern part of the province of Ciudad Real in Spain. A Roman roadway passed by the Alcudia Valley, to the south of Almadén, between the cities of Emérita Augusta (now Mérida) and Cástulo (now Linares). Another roadway, a bit further to the west, started in the Alcudia Valley and went via Cordova to the centre of the Iberian Peninsula, with a branch going to Almadén. This exceptionally well-networked geographical location contributed to the discovery, exploitation and commercialization of the extensive resources at Almadén. Although these historic Roman roadways are no longer in use and have been replaced by modern roads, along many stretches they remain quite well-preserved.

In geological terms, Almadén is situated in the central area of the Iberian Peninsula, a part of the Central Zone of the Hercynian mountain range. It is part of the Vertical Folders Domain. However, in northern Spain, this area abuts the Recumbent Folders Domain. The succession of compact quartzite and soft slate beds found in this setting, together with the vertical position of the layers, results in a characteristic and spectacular Appalachian landscape. Unique minerals such as massive cinnabars (extraordinary pieces of crystallized mercury sulphide) and barites with cinnabar inclusions are found in abundance in this region. The epigenetic mineralization of cinnabar and other minerals (barytes, dolomites, etc.) is associated with Hercynian orogeny. An exceptional universal geochemical anomaly has generated the deposit.

Cinnabar crystals, Mina Vieja de Almadén (Puche, 1989)

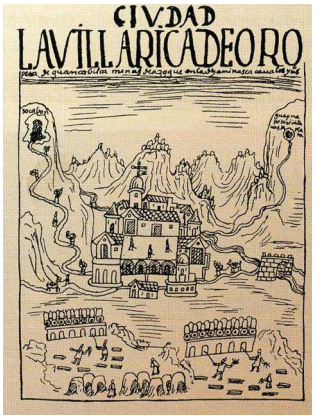
Historical heritage

The first known use of the resource was in making the mineral pigments that were used in numerous prehistoric paintings. The name Almadén comes from the Arabic word for mine. The Almadén mine was described by the Arab geographer Al Idrisi of Ceuta in the 12th century. At that time, more than a thousand men worked at the mine, which had already been excavated to a depth of 420 metres. Centuries earlier, the Romans had begun extracting cinnabar in this area after vermillion had been successfully commercialized throughout the Mediterranean. Pliny the Elder (AD 23-79) had described the distillation of native mercury from cinnabar in marmites. Lead, silver and copper were also obtained at the mines of Quinto del Hierro and El Mesto, east of Almadén. Although there were many other mines in Spain, the one at Almadén was the largest and most extensively developed.

In the Middle Ages, alchemists were preoccupied with concocting the philosopher's stone — a magical substance that could purportedly transmute base metals into gold. Mercury was thought to be one of the basic reagents of philosopher's stone. Mercury was also an important ingredient in many medieval medicines. The Swiss chemist and doctor Theophrastus Bombastus von Hohenheim (1493-1541), who was better known as Paracelsus, rejected traditional medical orthodoxy and successfully identified the main symptoms of various illnesses such as goitre and syphilis. To treat them, he used sulphur and various mercury-based compounds.

The importance of Almadén is evident from its role in one of the defining events of Western civilization — Christopher Columbus' voyage to the Indies. In *The History of the Indies* (Book 1, Chapter LXV and LXVI), Father Bartholomew de las Casas (1474-1566) reports that Columbus, before embarking on his journey to the New World, had asked the Catholic Monarchs Ferdinand and Isabella to furnish him with the services of gold panners and miners from Almadén (Prieto, 1968). Between 1525 and 1645, under the reign of Charles I, Almadén was controlled by the Fugger family. Later, from 1835 to 1911, control of the mines was vested with the Rothschild family.

With the discovery of mercury mines in Huancavelica in 1563, colonial South America's needs of mercury were



A drawing depicting the xabecas furnaces at Huancavelica, Peru

met by the Vice Royalty of Peru. However, New Spain (as Mexico was then called by the Spanish), continued to rely on the mercury supply from Almadén. Quicksilver would be transported from Almadén to Seville. Protected by warships, a flotilla bearing mercury and other goods would leave from Seville and sail to Veracruz, Mexico. The cargo would then head to Mexico City and the rest of the territory over the Royal Roadway. On the return trip, the ships would carry silver ingots bearing the royal stamp.

Even in those early days, there was great cultural exchange between South America and Europe. At the beginning of the 16th century, a special type of mercury furnace, called xabecas, was introduced to Almadén. In the xabecas furnaces, ceramics pots were filled with cinnabar, sealed with clay and heated from below. These furnaces found their way to the Huancavelica mine in 1598.

Another such example was the use of gunpowder in mining. First employed in 1626 in the town of Schemnitz (now known as Banská Štiavnica in present-day Slovakia), gunpowder reached Almadén in 1689; it was also used to build the drainage gallery of the Our Lady of Bethlehem adit at Huancavelica. Technology also flowed in the opposite direction. Kilns invented in 1633 by the prospector Lope Saavedra Barba in Peru were introduced at Almadén in 1646 by Juan Alfonso de Bustamente.

For a very long time, the Spanish economy subsisted on the mining of mercury and precious metals coming from the Indies. To ensure its sustenance, the best Spanish scientists were sent there to develop mining activity. Examples of Spanish scientists who played important roles as expatriates include Antonio Ulloa (1716-1795), who mentioned the existence of platinum in his work *Historical Account of the Trip to Southern America* (1748); the Elhuyar brothers, Juan José (1754-1796) and Fausto (1755-1833), who discovered tungsten in 1783; and Andrés Manuel del Río (1764-1849), who discovered vanadium in 1801.

Another important Spanish scientist who travelled to conduct research in America was Jerónimo Ayanz (1513-1613), who in 1606 invented a steam pump for the extraction of water in the Potosí mine. His invention was one step ahead of the pumps that Thomas Savery invented in 1698 and Thomas Newcomen invented in 1712. All of these pumps were the precursors of the steam engine that Watt famously invented in 1768 (García Tapia, 1992). The Watt pump itself was introduced in Almadén at the beginning of the 19th century.

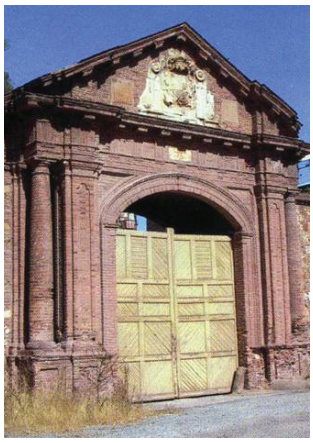
Almadén as a centre of teaching

In the 18th century, Mexican silver mining was expanding rapidly and there was a growing need for quicksilver to extract silver through amalgamation. However, in 1755, a major fire at the Almadén mines created serious supply problems for the next two years. Several projects were implemented in the area during that period to forestall the labour migration. The Buitrones de Almadenejos enclosure was raised, the San Rafael hospital for miners was built and a hard labour prison camp was set up. Another venture undertaken at that time was the search for new mineral deposits. It resulted in the discovery of the Las Cuevas (1774) and La Nueva Concepción (1779) deposits in the Almadén region. The second half of the 18th century also bore witness to the development most of Almadén's mining infrastructure and architectural heritage including the hexagonal bullring (1752), the Mining Academy (c. 1785), the door of King Carlos IV (1795) and the winch at San Carlos, Almadenejos.

Also in the second half of the 18th century, German miners were hired to restore Almadén's mining works. They introduced systematic mining using the compass, the theodolite and other modern instruments. In addition, they introduced the teaching of mining engineering, which resulted in the founding of Almadén's Mining Academy by King Charles III in 1777, just a couple of years after the foundation of a similar academy at Freiberg.

Between 1745 and 1747, there was an unsuccessful attempt to create a School of Mines in Guatemala (López, 1983). In 1757, an Academy of Mines was created in Potosí (Habashi, 2003), but it proved to be short-lived (Serrano, 1994). The Mining Academy of Almadén, being the first Spanish school of mines, was significant enough to influence the reopening of the Mining Academy of Potosí in 1779) and the creation of the Royal Seminary of Mining in Mexico in 1792.

A fire at the Almadén mines provided the impetus for the introduction of new methods of timbering (in 1790) and extraction. In the Larrañaga method (c. 1804), large brick arches were used instead of wood to eliminate the presence of combustible material. This technique would be supplanted later on by other methods such as cut-and-fill (at Mina Vieja, around 1914), open pit mining (El Entredicho


The door of Carlos IV (1795)

mine, 1978) and vertical crater retreat (Mina Vieja, 1981; Las Cuevas mine, 1986).

Modern installations, machinery and technologies deployed at Almadén contributed greatly to the development of mines and mining in general. Idria furnaces (1806), mine shaft extractions machines (about 1870), Cermak Spirek furnaces (1905), compressed air (1914), electrification (1918), workshops and compressor rooms (1924), mercury stores (1941), San Joaquin's shaft (1952), Pacific-Herrshof furnaces (1954), and the structural reform of San Theodor's shaft (1962) were some of the more influential developments at Almadén. Many of these still exist and have shaped the cultural and technical landscape of the mining industry in this territory.

Other patrimonial values

In addition to its natural, archaeological, historical and architectonic heritage, nonmaterial cultural heritage has also been significant. The religiousness of Almadén's miners remains an important spiritual force among the people. The miners entrust their lives to the protection of the Virgin Mary in the form of various local Madonnas like the Virgin of Linarejos, the Virgin of the Caridad del Cobre, the Virgin of Candelaria, etc. The most important patroness of miners, the Virgin of Estrella de la Mina (or Virgin of the Star of the Mine), continues to be present at all opencast mines. Similarly, because of the association of her legend with lightning, Saint Barbara became the patron saint of artillerymen, military engineers, miners and others who work with explosives. Interestingly, the patron saints of mineral extraction shafts were the Germanic saints of Freiberg — Saint Joachim, Saint Theodore and Saint Aquilinus. They were introduced by German technicians who worked at Almadén during the second half of the 18th century.

Almadén today

Until recently, neither the archaeological and industrial heritage of Almadén nor its monumental architectonic patrimony had received any recognition from Spain's central government or the region's local authorities. In fact, important parts of the Almadén heritage were destroyed in the 20th century, especially during the early years of Spanish democracy. The hard labour prison camp was demolished at the end of the 1960s to make room for the new School of Mines. The winch at Vadeazogues mine was pulled down to facilitate the opening of the El Entredicho mine. Finally, at the beginning of the 1990s, the large gate of El Pozo mine was destroyed to accommodate the widening of the road from Cordova to Almadén.

Fortunately, by the 1980s, attempts to safeguard the site's mining heritage were underway. A mining historical museum was founded in 1985. The Spanish Society for the Defence of the Geological and Mining Heritage was constituted a decade later. The Society issued a comprehensive list of monuments that it considered essential to conserve. In 1999, the Fundación Almadén was established to commence several restoration projects. Among its first tasks was the restoration of the San Raphael mining hospital. Using funds put up by the Spanish ministry of science and education, the Foundation assembled a team of architects in 2002 to guide the restoration work. CIM

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