

THEN, THERE WERE MINES

Volume
2



Margaret Davies

2020

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Acknowledgements and Bibliography

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Chapter 1. Las Herrerías.

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1.1 The giant awakes.

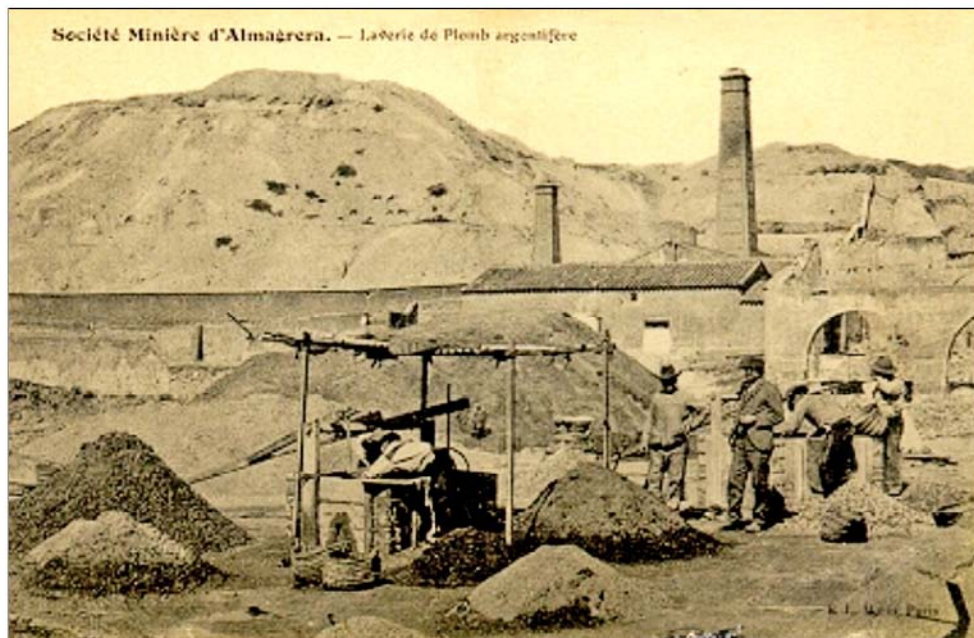
Las Herrerías is a small natural massif, or rock outcrop, sandwiched by two mountainous slag heaps, the result of a millennia of exploitation and open cast mining. Like the Sierra Almagrera, its history is fascinating but, alas, is mostly buried under the debris. The preservation of the head-frame of the mine Alianza, is small compensation for the obliteration of a thriving mining area which, in its day, produced two thirds of the iron ore in the province of Almería and whose silver was renowned for its beauty.

The head-frame of the Mina Alianza.



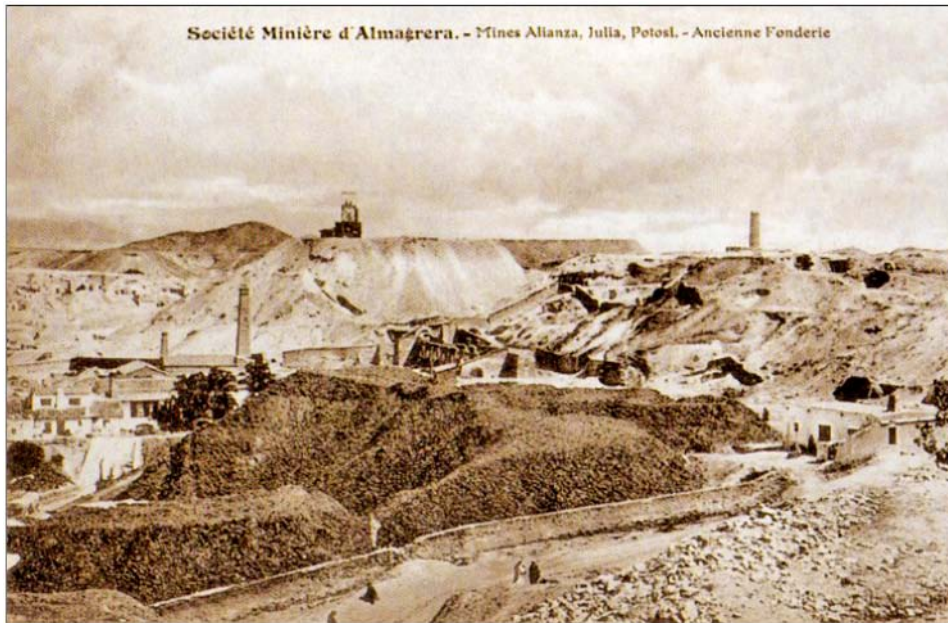
In the 15th century, when the Moors were expelled by the Catholic Monarchs, their knowledge and skills were lost and the area we know as Las Herrerías fell into obscurity. With the passage of time, a belief grew that the slag heaps in the area were the result of ores that had been brought down for processing from the mines in the Sierra by the Romans. Only in the 19th century was it realised that Las Herrerías itself had been extensively mined by the Phoenicians and Romans, and that there were still riches to be found.

With the discovery of silver in the Sierra, the hunt was on for other places that it might be found. In 1849 concessions were granted to the company, Esperanza, for the exploitation of lead at Santa María de Nieva and Virgin de las Huertas situated in the south west of the Herrerías outcrop. They found that the extracts from the shallow workings were financially worthwhile.



Lead washing in Las Herrerías below the Atravida foundry at the turn of the century. E.L.Morin.

In the north, Antonio Abellán Peñuela, who later became the Marqués de Almanzora, established the Atravida foundry in 1850 in the area above Eugenio's bar, between the old head-frame and the church. Las Herrerías came into being as a result.



The ruins of the Atravida foundry in Las Herrerías. Mina Alianza can be seen on the skyline. The foundry's chimney, on the skyline to the right, is still standing. E.L.Morin.

In the south, Guillermo Huelin established the Araucana foundry to process the results of his open cast mining in the Sante Matilde mine. This southern area became known as the Roza de Huelin, meaning Huelin's clearing, and later when the number of open cast sites increased simply as Las Rozas.

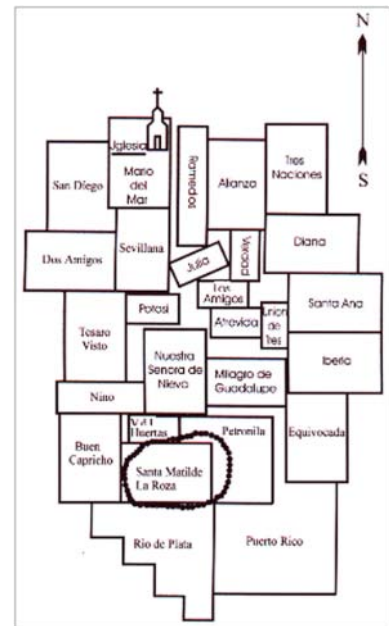


Guillermo Huelin's Araucana foundry in Las Rozas

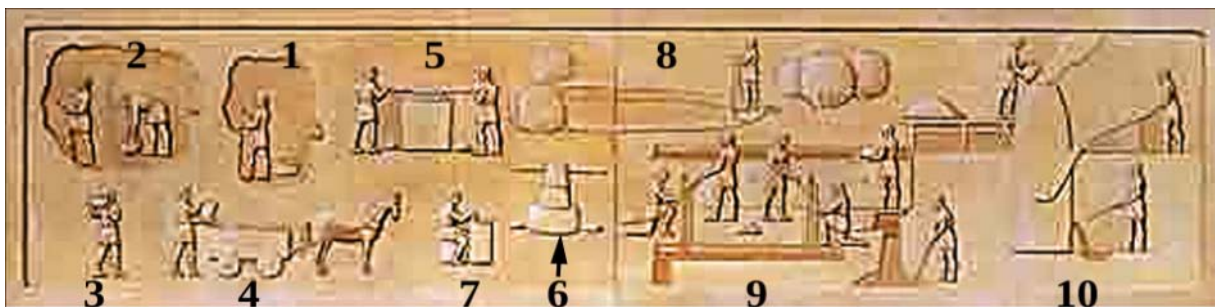
1.2 The silver rush.

In 1870, by chance, the engineer Gomez de Salazar, had a sample of what was considered worthless waste analysed. It was found to be rich in silver. The discovery was followed by the inevitable “Herrerías silver rush”. The fever was such that 50 speculative concessions were granted on the small outcrop, of which about half rapidly exhausted the thin, silver bearing seams and were abandoned.

Plan showing the successful concessions in Las Herrerías.



The remainder were luckier. The old, relatively shallow, mine workings were discovered and explored. To everyone's surprise, the infill used in these old galleries and shafts contained enough silver to be worth processing using the modern techniques of the day. It was evident that these mines had been hurriedly abandoned by the Phoenicians as underground seams were still rich in ore. Picks and iron wedges were found, along with the remains of ropes and wooden shuttering, clay lamps and human bones, possibly those of slaves.



Frieze depicting the processing of galena in antiquity. Not much had changed in the intervening millennia.

Key:

- | | |
|--|--|
| 1. Exploring the vein. | 6. Grinding the ore in a stone mill. |
| 2. Mining the ore and loading it into baskets. | 7. Further grinding by hand. |
| 3. Carrying ore to a horse-drawn cart. | 8. Drawing water from a cistern. |
| 4. Transporting ore to be crushed. | 9. Washing the ore. |
| 5. Crushing the ore with hammers. | 10. Creating lead pigs by processing in a furnace. |

In addition to the argentiferous galena an enormous quantity of pure silver was found, occurring in “nidos” or “nests”. These were holes filled with beautiful silver thread or filaments. In 1875 the Unión of Tres mine extracted 50 kilograms of such silver in 24 working hours. In the Iberia mine, nests of more than two kilograms were found. A nest of amazing beauty, found in the Milagro de Guadalupe, was presented to the Pope earning the mine owner the Pontifical title Conde, or Count, Miguel.

A nido, or nest, of silver of the type found in Las Herrerías.



The mines in the northern sector generally found silver from about the 50 metre level, while those nearer the roza found it in a narrow band closer to the surface. Beneath this band was an even more valuable mineral, iron. So began a new era of growth and wealth for Las Herrerías as open cast mining of this sought after commodity began in earnest.



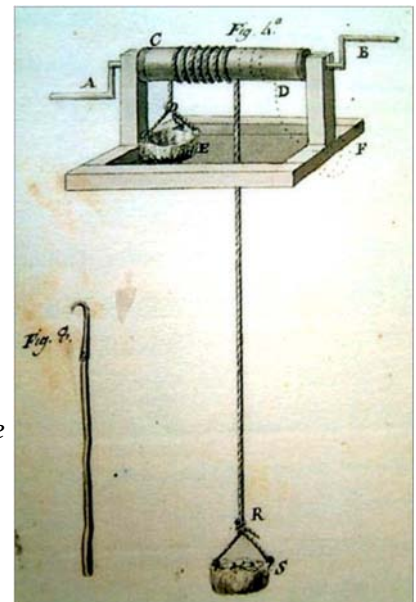
A vision of Hell! The eastern side of Las Herrerías in the 1880s, looking over the Union de Tres, Iberia, Santa Ana and Diana mines.

Rodrigo

1.3 The enemy approaches.

As both subterranean and open cast mining delved deeper the consequences were inevitable. Water started to appear. Here, it was ingress from the Almanzora and not thermal springs as in the Almagrera mines. The depth at which it started to appear varied from 30 to 65 metres and corresponded to the thickness of the argentiiferous layer.

The earliest attempts at counteracting the flooding involved bailing the water out, using two barrels on a winch, manually operated day and night by two teams working 12 hour shifts. This laborious and costly system was sustained, in the early years, because of the high returns that the mines were enjoying. However, the unwillingness to make any capital investments and the reluctance of the various mine owners to participate in any cooperative ventures saw more and more water entering the workings.



Manual winch of the type used for bailing water from the mine workings.

As a result, in 1874, the owners of the Unión de Tres installed a steam pump enabling them, and some of their neighbours, to increase the depth of their workings. However, by 1875 other mines needed to install similar machines in order to continue with their exploitations. A multitude of small desagües was not a sensible way to deal with a common enemy. The high cost of installing, running and maintaining these pumps was a burden to most companies. Many owners were in the practice of ceasing pumping, confident that they would benefit from reduced water levels brought about by a neighbour's efforts. By 1882, much of Las Herrerías was in a state of neglect. Those in the southern areas who, as well as open cast iron ore extraction, were still able to exploit the thin argentiiferous layer and glean enough from ancient workings, could continue to operate. However, there was no doubting the need for a common enterprise to dry the whole of the massif.



*The old desagüe of the Mina Santa Matilde.
Rodrigo.*

A feasibility study calculated the cost of a central desagüe and demonstrated that the expected outlay was more than affordable by all companies. The principle promoter of the scheme was the president of the Unión de Tres who reasoned that the best place to install the machinery would be in the deepest shaft which happened to be in the Unión de Tres.

Needless to say, agreement could not be reached, with those companies who had already installed machinery each arguing for the desagüe to be sited in their shaft. The reason for the acrimony was because the levy imposed for its operation would be less for the mine owner whose shaft and other infrastructure would be requisitioned for its installation. Eventually agreement was reached and in 1884 the Sociedad Desaguadora Unión de Tres installed the Desagüe de Herrerías not in one of their own shafts, but in the Santa Ana shaft.

Santa Ana.



Las Herrerías was back in business!



The remains of the Santa Ana installations were deliberately destroyed in 1993 before the Villaricos Heritage Protection Scheme could come into force.

1.4 The perfidious French.

Enter Public Enemy No 1!

While all the arguing about the desagüe was going on, La Compañía de Águilas was excavating closer and closer to the Almanzora in its Santa Matilde mine.



*Part of the Santa Matilde workings in the 1880s.
Rodrigo.*

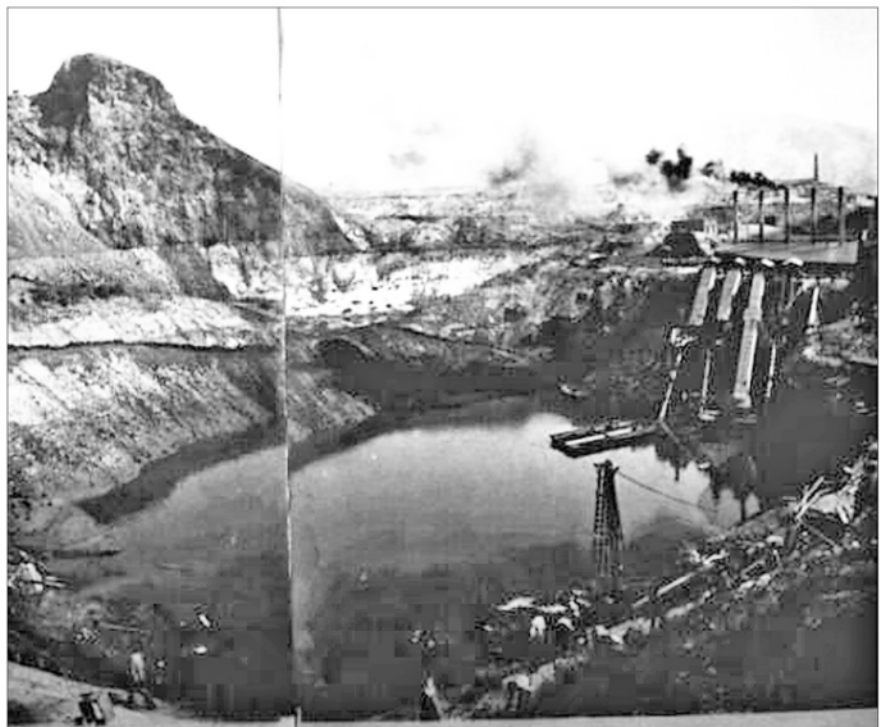


Santa Matilde as it today

The strip that the mine's former owner, Huelin, had maintained as a safety precaution between the workings and the river was being progressively worked out. Disaster struck in June 1884. The Almanzora, swollen by unusually heavy rain, burst its banks and 1,800 litres of water per minute entered the mines with devastating consequences. Every shaft of every mine was affected. The whole of Las Herrerías came to a standstill. The Santa Ana desagüe was paralysed, unable to cope with water ingress of such a magnitude.

*Pumping out the flood waters
at the Roza of Santa Matilde.*

Rodrigo.





Santa Matilde in full production. The old desagüe can be seen at the top left of the picture.

F. de Blain.

It wasn't until nearly 3 years later that La Compañía de Águilas, together with the owners of La Virgen de las Huertas, set about pumping the 20 metres of accumulated water out of the Rozas.

The pumping operation was a typical Águilas affair. Three months after commencement, 11 pumps were in place. 3 on a floating platform, 3 on the surrounding ground, 4 on the inclined planes used to raise the ore up to ground level and one additional small pump. All were powered by a steam generator. The company's engineer had calculated that it would take 8 days to lower the water level sufficiently to enable the points of water ingress to be pinpointed and to assess where to site a contention wall that would divert the water away from the mines. On the 29th of June 1887, with much pomp and circumstance, the 11 pumps were started. 28,500 litres of water per minute were pumped out and the level dropped by 28 cm. in the first four hours. However, the calculations proved to be incorrect. After 3 weeks of continuous pumping the level had only dropped 4.5m and water was still flowing in from the Almanzora. It's an ill wind that blows no good and the slowly receding flood waters exposed further massive deposits of iron ore.

It was decided to try out the pumps in the desagüe of Santa Ana to see if, several years down the line, they would still function. Much to everyone's surprise they did. It was recorded that the liquid that was extracted was as black as ink and gave off a foetid odour. The Santa Ana efforts benefited the mines north of the Roza but in the Roza itself things weren't going well for the French. Despite pressing into service the pumps from both their abandoned desagüe in the Barranco del Francés, and those from their San Jacinto foundry in Garrucha, the water still hadn't receded enough to dam the ingress. In addition, the irrigation ditch that skirted round the Roza, was a further source of flooding that could not be addressed by simply in-filling as they had no rights to it. In July 1888, La Compañía de Águilas ceded the rights of Santa Matilde, and those of their railway, to a Spanish company. The new company was obliged under its terms and conditions to drain the Rozas by the end of the following year. They made several pronouncements about what they were going to do but never fulfilled their commitments then, in December 1888, further flooding of the Rozas exacerbated matters. The Santa Ana pumps, unable to cope with both the quantity of water in the deeper mines and that which was pouring into the Rozas, shut down.

Las Herrerías was at a standstill!

1.5 The battle is won.

There was too much potential wealth at stake for this state of affairs to continue. In 1891 the London firm H. Borner and Company, who also had interests in the Sierra Alhamilla, contracted the exploitation of iron ore in the Rozas and set about the desiccation of the area. The Herrerías to Palomares railway was repaired in order to bring new pumping equipment from the coast to the Roza. A canal, 2m deep, was constructed in order to channel the pumped water into the Almanzora. By June 1892 the contention wall was finally completed and for the first time in eight years the Roza was free of water. Open cast mining in Santa Matilde and half a dozen nearby mines resumed, with the ore destined for foreign foundries. By now the silver mantle in the south had been exhausted.



The contention wall, seen on the right-hand side of the picture, was vital in keeping the Rozas dry. E.L.Morin

Borner was approached by the owners of the mines in the north of the massif with a view to drying out these deeper mines as well. However, in true Spanish style, a squabble broke out. The 12% levy that Borner proposed was unacceptable and the Union de Tres claimed that they could do it for 11%.

In the end it was the German company Brandt and Brandau, together with their engineer Luis Siret, who put forward a proposal to dry the whole of Las Herrerías. All of the owners were in agreement except . . . Borner and the owner of Virgen de las Huertas. The Anglo- German stand- off resulted in Borner pulling out of Santa Matilde. As a consequence the water level there rose 19m, the retaining wall was breeched and the entire Rozas was again flooded.

Brandt and Brandau pushed ahead with the Desagüe General de Herrerías. The principle shaft was sunk in the confines of the disused Araucana foundry and was christened Ana Josefa. The pumps were anchored at a depth of 108m, 8m lower than those in Santa Ana.



The Ana Josefa shaft, where the pumps were housed, is situated under the structure to the left of the chimney.

J.M Sanchis



The delivery shaft was one of the two shafts close to Ana Josefa. Of the two, I'm inclined to think that it is the one nearest to Ana Josefa. This one has an extraction opening a short way down it. I think that the pumped outfall passed through this opening, and then ran behind where the houses are now, and into the irrigation ditch.



Two views of the smaller of the two possible delivery shafts.



The top of the more likely delivery shaft,

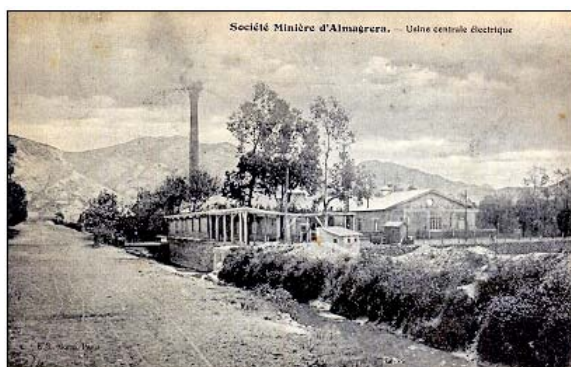


A view of the extraction aperture in the shaft

All photos, G Garcia 2008.

Some of the Araucana buildings were re-purposed as offices and maintenance sheds for the desagüe. A network of tunnels, for the purpose of channelling water to the main shaft, was constructed. In addition, some of the northern mines had individual pumps installed to clear accumulations of water. For the time being Nature was held at bay, the area was dry.

Brandt died in 1900 and was buried at El Arteal. In 1901 the company, Brandt and Brandau transferred the service contract to Luis Siret and the French company Société Minière d'Almagrera. Siret introduced modern technology in 1905, powering the desagüe by electricity, generated in the new power station that the Société had built at Las Rozas.



The electricity generating turbines were housed in the building on the right of the photograph.

E.L. Morin.



The same building is surrounded by a high wall today.

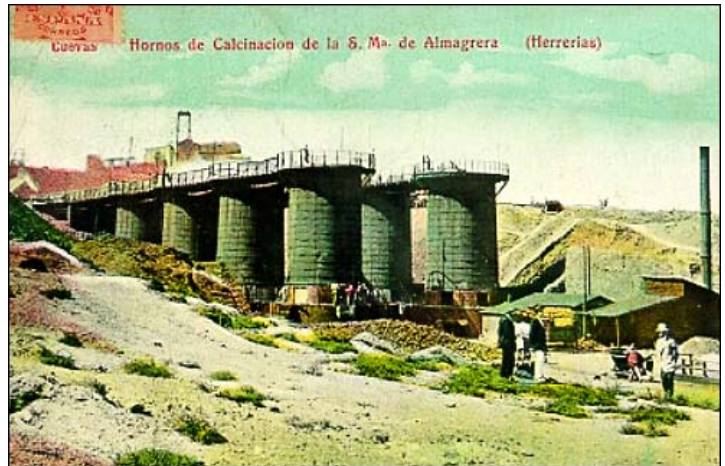
The French maintained the desagüe until 1929 when the Spanish firm Empresas Eléctricas e Industriales took it over and operated it until the Civil War.

1.6 The glory days.

With the indefatigable Luis Siret at the helm, the Société Minière d'Almagrera quickly became the major player at Las Herrerías. Through rationalisation and the implementation of modern techniques and innovations Siret was able to make the mines profitable. In a short space of time the Société either owned or rented almost all of the concessions in the massif. The 8 modern calcination ovens that they constructed at the Milagro de Guadalupe were the wonder of the day.

Société's Calcination ovens.

F. de Blain.



The massive extraction of iron ore in Las Rozas was the principle activity and it was in Las Rozas that they had their base, and where their presence is still felt. Driving or walking through Las Rozas it is impossible to miss the buildings that housed the Société's workshops and power plant. These classic examples of French, turn of the century, industrial architecture have been converted into apartments, mainly by the English.



Above left, E.L. Morin.



Above right, F. de Blain.

The two pictures above show both sides of the workshops as they were in 1905. The photograph on the right shows the workshops converted into apartments as they are today.



The elegant mansion house, partially hidden behind a later perimeter wall, on the north side of the irrigation ditch, housed the Société's engineers, while the adjacent building accommodated the domestic staff.



The engineers' accommodation.



Servants' accommodation.



Details of the mansion. Above, the moulding from over an archway in the entrance hall. On the right, detail of the patio tiles.



The mansion was later used by MASA as a recreation centre for their employees until they ceased activities at El Arteal after which it became part of a naturist camp-site run by an Irish couple. I suspect that the ugly breeze block wall dates from then. The motto, in Gaelic, above the entrance certainly does. It is currently in the hands of a developer, but plans, shown below, have been shelved for the time being. Even in it's state of decay, it is a beautiful building that deserves better.



Siret and his family lived in the house beyond the workshops. There were plans to turn the building into a Luis Siret museum, but a combination of squatters and exhausted funds have stymied these.



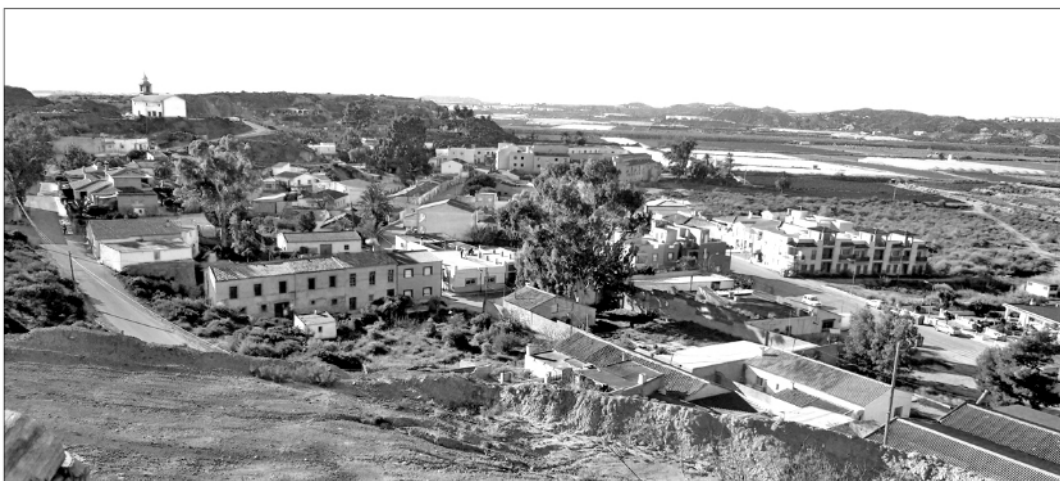
The greatest boost to the Société's profitability was the construction of the loading pier at Villaricos and the railway from there to Las Rozas and, later, to El Arteal. (More on the railways in the next chapter).

By the time of the First World war, Las Herrerías was a thriving, industrial town with thousands in full employment. The old Atravida foundry above Las Herrerías had been taken over by the Société and Siret converted its main building into a hospital and pharmacy. In addition, there was a school, shops and a workers' casino, or social club.



Las Herrerías, 1915.

Sierra Almagrera y Herrerías. Bolea.

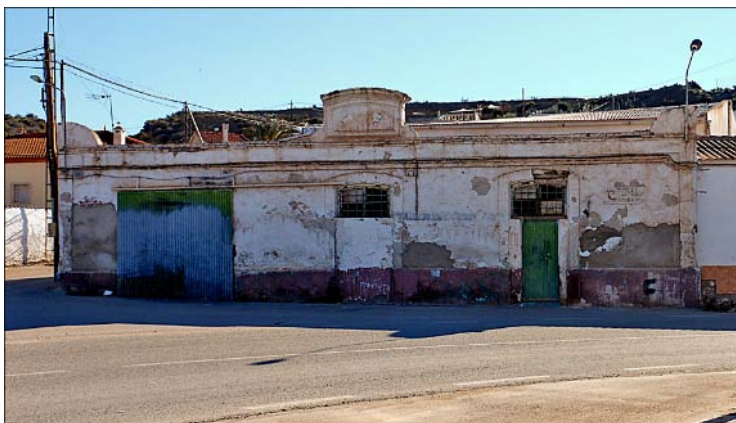


Las Herrerías, 2015. The hospital building is central with the 'Spanish' church in front of it.

Following the death of his wife in 1895, Siret commissioned the church that dominates the Las Herrerías skyline. Its Northern European design, with its tile hung spire seems so out of context in a Spanish village. One is reminded of a victor's standard, planted on high, for all to see. However, I suspect that the indigenous population continued to worship in the Spanish church situated next to the hospital and that only the gentry frequented the “foreign” church.



Another Atrevida building put to use by the Société was the one at the bottom of the hill, next to the workers' cottages. This was converted into a “Company Store”. It was fairly standard practice in Northern Europe and indeed North America in the late C19th and early C20th to pay part of an industrial workers' wages in the form of “vales”, or tokens, redeemable in such stores. These establishments were renowned for their profiteering and this system of payment was being challenged by the 1920s. The real or perceived injustice of the system is still felt in Las Herrerías, where it is seen as a uniquely foreign imposition, something meted out by the French on the Spanish.



On the left, one of the old Atrevida buildings that was converted into a company store.

Below, street views from 1905 (E L Morin) and 2015.

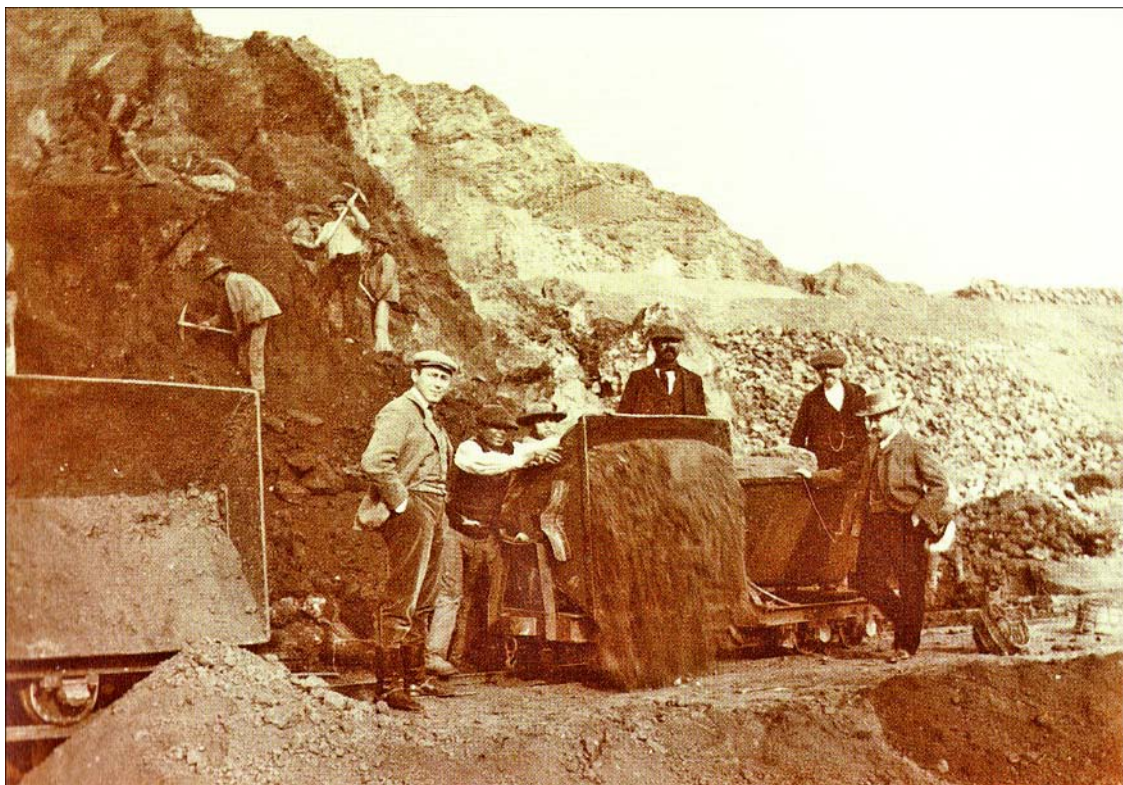


The other grudge still held against the Société is the fact that they were forced to reduce the workers' wages when the First World War took its toll on the business. Virtually everything came to a standstill, coal and coke could not be imported from Britain nor ore exported for steel processing. The 1920s saw a bit of an upturn but things were never the same again.

In 1926 the Société relocated to North Africa where it had other mining interests.

The end of an era!

The more I read about the Belgian, Luis Siret, the more I appreciate what a great man he was and how much he contributed to this little known corner of Spain. A brilliant engineer, whose part in extending the life of mining in the area by 40 years, thus providing employment for thousands, should not be underestimated. Also, it was largely due to his efforts that Cuevas had potable water by the middle of the C19th. Siret, the amateur archaeologist, who on discovering artefacts in the mines, went on to become a famous and respected author of several seminal works on the history of the area. My favourite image of him is this one, with his flat cap on his head, his hands in his pockets and a big smile on his face.



The smiling Luis Siret is on the left of the photograph. Sierra Almagrera y Herrerías. Bolea.

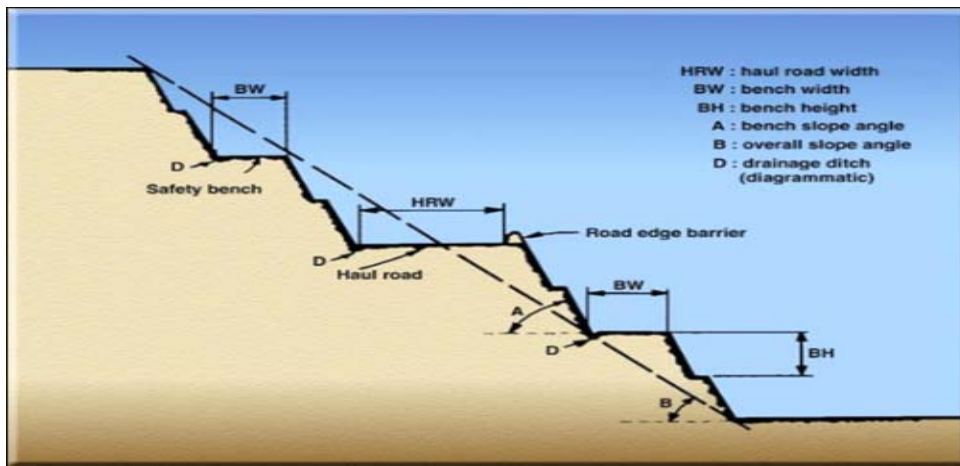
It was with great sadness that I heard a 50 year old native of Las Herrerías blaming him for the flooding of the Roza. So much for oral history!

1.7. The big white hole.

In the late 1980's, the Almanzora was canalised between the newly constructed dam at Cuevas and the coast at Villaricos. With the flow of water down the course contained by the ugly concrete channel, the problem of water ingress at Las Rozas was removed. The Basque company Minersa, part of the Grupo Berja, started to extract the barite present in great quantities in the roza. The Corta Santa Matilde was the result.

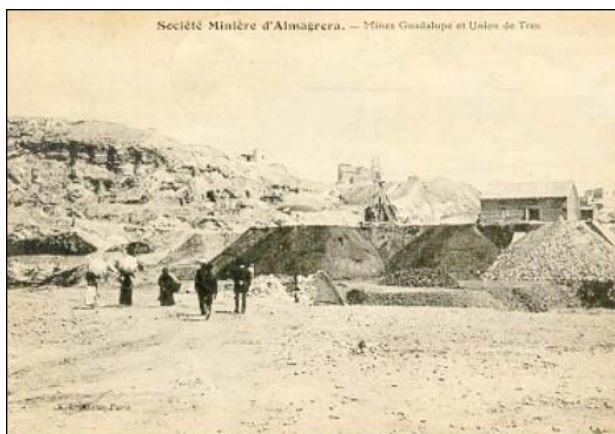
The Corta Santa Matilde in 2004.

J.M. Germán Cecilia.



A corta, in mining terms, is an inverted pyramid, excavated in steps by heavy machinery.

Although called Santa Matilde, it is actually on the site of the Milagro de Guadalupe.

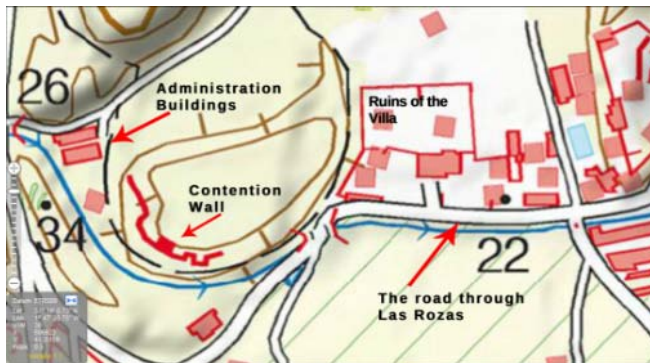


The site as it was in 1905 E.L. Morin.

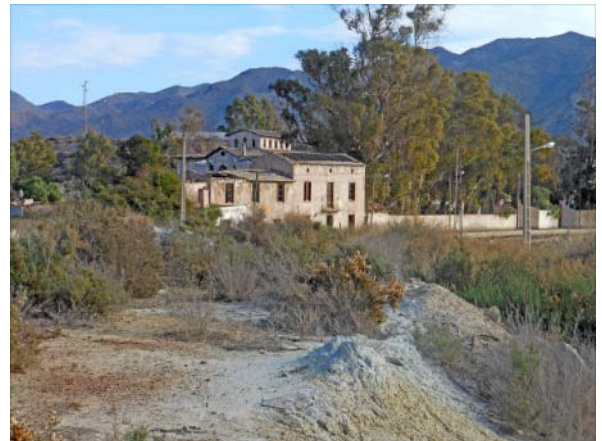


the view today. The remains of the Unión de Tres are still standing.

The grey marl spoil from this enormous hole in the ground was dumped upon the remains of the mines Santa Matilde, Petronila and Virgen de las Huertas. The contention wall, built to prevent flooding, is still shown on the current National Geographical map, but is in fact buried beneath the waste. Nowadays, the whole site is used for the fly-tipping of every conceivable sort of rubbish.



The contention wall as shown on the map and the site as it is today.



As well as Guadalupe, the corta cut through the workings of the mines Union de Tres, Iberia, Atravida and Conciliación. As they cut down, many old underground workings were compromised by the new excavations. Probes were used to track these old shafts and galleries.



Probing for old workings using a percussive drilling rig.

Gonzalo Garcia

In the picture below, the interface between the white clay and the mineral can clearly be seen, as can some of the old, previously underground, workings.



Note that the excavator arm in the bottom right-hand corner is not a toy and neither is it at the bottom of the corta.

Gonzalo Garcia.

This hole was immense!

Apart from initial milling and sorting, I don't think that any further processing was carried out in the roza. There were two or three buildings at the entrance to the site, but I think that these were administration blocks rather than part of a processing plant.

The on-site milling and sorting of the barite.

J.M. Germán Cecilia.



When excavation ceased, Minersa should have levelled the site but failed to do so. While the present day hole is only a fraction of the size that it used to be, it is still dangerous. The drainage ditches on the benches and haul roads have already eroded. Serious land slip is occurring as a result. Fortunately, the arid nature of the area prevents the accumulation of vast amounts of water at the bottom of the hole.

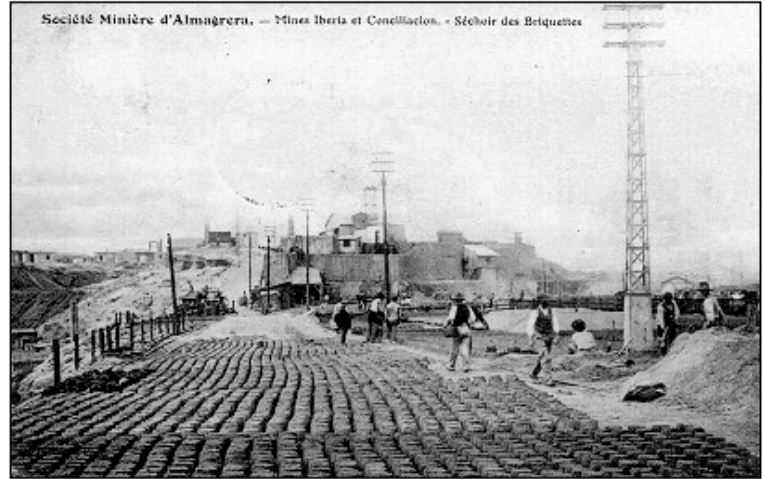
1.8. Of this and that.

A puzzle solved.

In the series of postcards produced for the Société and recently released by the Diputación de Almería, there is one of the mines Iberia and Conciliación showing hundreds of blocks laid neatly on the ground. The caption referred to the “secadero de mechas”, or fuse drying. The French caption on the card read “Séchoir de Briquettes”, as in barbecue starters. Could the blocks be home made fuses for dynamiting the face of the slopes to loosen the iron ore? Unlikely.

Postcard showing the Iberia and Conciliación mines with the mystery blocks in the foreground.

E.L. Morin.



Could they be mineral ingots? The iron ore was simply calcined on site so that was dismissed. Then I uncovered an interesting piece of information. The Sociedad Argentífera de Almagrera leased part part of the Araucana foundry from Luis Siret. They equipped it with mills, centrifuges, dissolution tanks and vacuum pumps and scavenged silver from the waste dumps in Las Herrerías, using the Macarther-Forrest Cyanide Process. The silver extracted by this chemical method was formed into “panes” or loaves. Could this be the answer? Nice try, but the experiment was short lived as the results were too poor to justify the costs, and certainly not good enough to be the mystery blocks. So what were they?

Bolea gave me the answer. The same print was in his book of postcards 'Memoria Visual del Siglo XX (1901-2000)', His caption noted the drying of bricks for use in the mines. How obvious was that? The calcination ovens would have taken thousands of bricks. The desagüe and auxiliary shafts were brick lined and I suspect that the tunnels, built to channel water to the desagüe, were also brick lined. There was a brick kiln at El Arteal but was there a brick kiln in Las Rozas? There is no trace of it today.



A pile of bricks (unusable?) in front of the calcination ovens.

F. de Blain.

Bricks, possibly produced on site, were used to line the main shaft of the desagüe.

mtiblog.



Where was this?

I was intrigued by this photograph of Luis Siret, and his family, together with other company directors and officials. It was obviously taken somewhere in Las Rozas, but I couldn't figure out where. After several visits, clutching a copy of the picture and trying to work out the angles of the shot, I finally placed it. The archway (left of picture behind the carriage) led into a courtyard behind the lower of the two rows of company buildings in Las Rozas. While the upper row housed the workshops, the lower row served as the office and administration block. Nowadays the courtyard serves as the gardens of the dwellings into which the block was converted. There is an old well in one of them.

The board of directors in Las Rozas.

E.L. Morin.



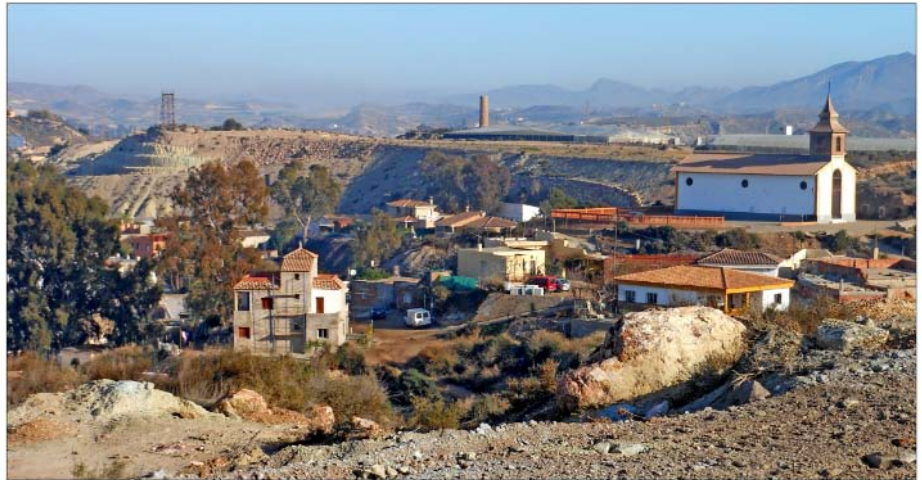
The same arch today.

New Settlers.

Much of this account of Las Herrerías has concentrated on the southern roza, possibly to the detriment of the northern areas. Unfortunately, care needs to be taken in the area around the church in the demarcations

of Remedios, Mario del Mar and San Diego, and in the area behind the vandalized block of flats, where the remains of the mine San Andres are situated. The gypsies, who have colonized these areas, do not take kindly to strangers - particularly those with cameras! Three or four years ago, the area round the church was very much a shanty town, nowadays, those huts are far more substantial and there are fewer gypsies.

*The huts are nowadays
far more 'des res'.*



A sign of the times is their web site, where they are demanding rights. One wonders what the mine workers would have thought about that. At Las Herrerías, the early miners lodged in caves, no bigger than burial niches.

Chapter 2. The Las Rozas Railways.

- 2.1. Las Rozas to Palomares.
- 2.2. Las Rozas to Villaricos.
- 2.3. The runaway success.
- 2.4. The extension to El Arteal.
- 2.5. The boat train.
- 2.6. Hitting the buffers.
- 2.7. The locomotion.
- 2.8. Along the lines.



2.1. Las Rozas to Palomares.

Following the purchase of the Roza of Santa Matilde and other interests previously belonging to Guillermo Huelin, La Compañía de Águilas recognised the need for a cheaper and more efficient way of transporting iron ore to the coast than the ubiquitous mule trains and donkey carts. The good returns on low volumes of lead and silver enjoyed at the time could support the cost and the 10% load loss suffered by using these traditional modes of transport. However, iron ore was different; high volumes and the need to keep the final price down in order to remain competitive in the world market required a more modern form of transport. The solution was the building of the first mineral railway in Almería Province linking the company's interests in Las Rozas with their San Francisco Javier foundry on the coast at Palomares, enabling them to export refined ore at no extra cost.

Work started in 1884 and the line opened in 1885. The Santa Matilda and Virgen de las Huertas mines employed motorized, double track, inclined planes to move ore up to level ground. From there it was moved to the loading bay, close to the river by means of a short inclined plane situated just off the Las Herreras to Palomares road, north of the irrigation ditch. The initial bridge over the Almanzora was constructed of wood. There was a method in this madness since the cost of replacing it every time that it was washed away by flood waters was less than the cost of constructing an iron bridge that may, or may not, withstand the ferocious might of the river. (A support for the iron bridge over the Amanzora at Cuevas, started in 1882, was destroyed by flooding in 1888, before construction was even completed).

In Cuevas an arch was built to span the gap left when one of the support pillars was washed away before the bridge was even completed.

F. de Blain.



Later, an ingenious crossing was devised similar to a lock gate, whereby the two halves could be moved to the side by means of heavy chains, so as not to impede the flood waters. Whether the locomotive crossed the bridge or not is unclear. One source speaks of tip wagons crossing the bridge, so it is likely that the loading bay was on the west rather than the east bank, and that the locomotive remained on the west bank. (Tip wagons could be moved manually on level track and were extensively used in the roza).

The line skirted the Palomares hill on the river side, and then ran parallel to the coast to the San Francisco Javier foundry, where the ore was processed before being loaded onto ships from Quitapellejos beach. One of these ships would have been the Carolina, which the Compañía de Águilas had bought from Carlos Huelin along with the Palomares foundry.

*The Carolina sold to the
Compañía de Águilas
by Huelin.*

Vidamaritima.com



Serious concerns were felt by land owners in the Nati, Lombardas and Casa Marqués districts about the dangers of sparks from the locomotive setting fire to crops along the line. Extensive clearanced was carried out to mitigate the very real danger of fires.



The San Francisco Javier foundry in Palomares. Monika's Restaurant is now on the site of the tall building on the right of the photograph.

Rodrigo.

Almost the entire length of the line was washed away in the floods of 1888 and it wasn't until 1891, when Casa Borner took over Santa Matilde, that the line was repaired in order to transport the equipment needed to dry out the roza following its catastrophic inundation in 1884. When Borner pulled out of the roza in 1895 the line was thought to have fallen into disrepair. Luis Siret may have used it before his Las Rozas to Villaricos line was operational.

Records show that Siret sold an old Compañía de Águilas locomotive in 1908, one of the four that were constructed in 1883 by the Franco-Belgian company La Construction de Machines et Matériel pour Chemin de Fer in their La Croyère works in Belgium. These series 030T, 20 horse power engines were some of the first narrow gauge locomotives that they made. The construction numbers of those bought by La Compañía de Águilas were 495-498 and it is believed that one of these was in service on the Palomares line. The tall smoke stack, circular smoke box cover, and unusual cabin, covered front and rear and having cantilevered overhangs, were characteristic of these early locomotives.

A locomotive of the type used on the Palomares line.
Asafel.es.

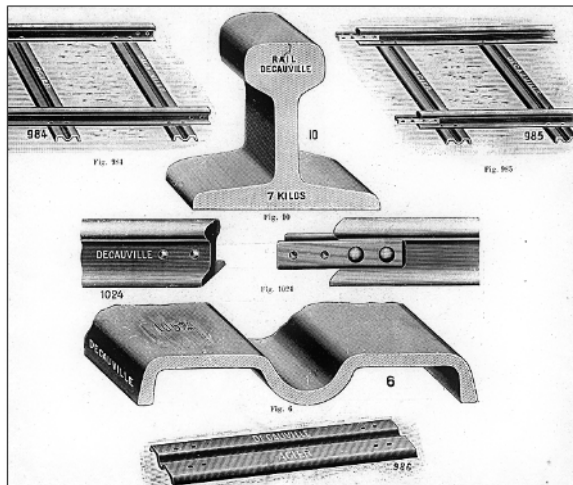


No trace of this line remains today.

2.2. Las Rozas to Villaricos.

Luis Siret's answer to the problem of moving iron ore cheaply was a railway running from the Petronila mine in Las Rozas to the quays and wharfs in Villaricos. Nobody foresaw how successful and long-lived it would be. Started on May 31st 1897 and opened on August 1st of the same year, it was in use until 1959 when MASA's activities in the area ceased.

In those three short months, 3.50km of narrow gauge (600mm) rail track had been laid on embankments six or seven metres high, over a bridge spanning the Rambla de Muleria and through a 140 metre long tunnel. The rails were flat-footed, "Vignole" type, manufactured by Decauville. The track consisted of light, ready made, portable sections with integral sleepers which could be fastened directly to the ground. Even allowing for the "train set" nature of the track, 13 weeks from start to finish was quite an achievement!



In the 1890s, long before the Almanzora was canalised, the final stretch of the 828 was frequently a virtually impassable quagmire despite being the main road linking the mines of the Sierra Almagrera and the Carmelita foundry situated behind the watch tower at Villaricos. Siret constructed the road which snakes from the Palomares crossing, behind Los Conteros, up the hill where the condensation tunnels and chimney of the Carmelita used to be, and out on to the coast road. I suspect that there was some sort of a deal here, whereby access to the foundry was improved in return for permission to tunnel under the hill.



The line of the railway is shown in green.

This new road was constructed wide enough to accommodate both carts and trains for the first part, until the track veered east, behind the Phoenician necropolis, and entered a 140 metre long tunnel, exiting on the other side of the coast road.



The tunnel entrance in the fenced area of the necropolis.

The tunnel exits in the area below the roundabout at the top of Villaricos.

The line then ran down to a yard, constructed on the southern side of what is now called Calle Central, above the beach. From here, ore was ferried to waiting cargo ships using the quays and small metal piers that had been built for the Carmelita, in the area known as the Balsica. I think the term means a small pontoon, a reference to the original loading piers. The area has undergone a radical transformation and is now a small modern harbour with the Balsica bar. The glass “bottom” boat is moored there.



*Ore was loaded onto small lighters in the Balsica and ferried out to waiting cargo ships.
E.L. Morin.*

During my research into the construction of the railway I uncovered two snippets of information. The first, was that the owner of the area known as Los Conteros did very well out of the construction of the new road. He was paid handsomely for the land that was required and, in addition, he was able to retake possession of the land that had been used for the earlier road. I suspect that the land in question is the strip between the building line and the modern road, currently used as a car park. The second snippet was the fact that the Carmelita foundry didn't operate during the summer. This was because the combination of standing water in the mouth of the Almanzora, and the heat, meant that malaria and other fevers were endemic.

The workforce could die of lead poisoning some other time!

2.3. The runaway success.

From the very start the line was a success. The 30% reduction in transport costs together with negligible transit losses attracted the attention of other mine owners. The British firm, Las Rozas Mines, approached Siret who agreed to carry their ore, levying a fee for every tonne carried. Soon the owners of the Virtud de San José and the Milagro de Guadalupe mines signed up as well. An unusual show of cooperation on the part of the Spanish! Within four months the line was extended all around the roza, and the tunnel widened to accommodate passing points. A second loading yard or “patio borracho” was constructed in Villaricos and a branch line extended to it. When the site was used by the Central Eléctrica from the 1940's to the 1960's, it was known as Tío (Uncle) Borracho. A play on words as “borracho” can mean both loaded and drunk. The line ran along what is now called Calle Borracho. A sign reading Patio Borracho is fixed to the wall of the edifice that was built over the yard despite it being within the Villaricos heritage protection zone. From here, the ore was loaded onto the ships via metal loading piers in Cala Verde.

*The initial line in Villaricos is shown in green.
The later extension to the 2nd mineral yard
(known as Tío Borracho) is shown in blue.
By 2012 the yard had been built over*



patio borracho



Between its inauguration on August 1st 1897 and December 31st 1899, just under 200,000 tonnes of ore had been carried from San José, Guadalupe, Petronila, Santa Matilde and Virgin de las Huertas. In addition untold amounts of British coal and coke for steam engines had been carried in the opposite direction.

In 1901, La Société Minière d'Almagrera was formed with Siret at the helm. By 1903 the company had taken over both, the Guadalupe concession and those of Las Rozas Mines' Santa Matilde, and Virgin de las Huertas. This gave them a virtual monopoly in the roza. In 1903, Siret transferred the rights of the railway to the Société. Baltasar Flores' buy out was 50¢ for every tonne load carried.

To make the main line double track, a second tunnel was constructed at Villaricos, alongside the original.



The entrance to the second, more solidly built, tunnel.

*The entrances to both tunnels by the necropolis.
(The second one is on the left hand side)*





The exits of the tunnels. The area has been cleared recently, because it is earmarked for development.

In 1904, a request to replace the original bridge over the Muleria was refused. By 1910, the line was carrying 240,000 tonnes a year (up from the 148,00 tonnes of 10 years previously) on a double track except for the bridge crossing. Authorisation was again requested to replace the bridge with a wider one

This time the authorities, having regard to the benefits of having 1500 workers in full employment in Las Rozas, not only allowed the new bridge to be built, but allowed it to be built alongside the old one so as not to interrupt the service! The new bridge was still in use when the line was closed in 1959.



The new bridge spanned the Rambla de la Muleria close to the house with the cypress trees on the Villaricos to Las Herrerías road.

Coll. Pedro Perales Larios.

2.4. The extension to El Arteal.

In 1904, Siret applied for permission to extend the line to the desagüe at El Arteal and to upgrade the existing infrastructure and driving a second tunnel to Villaricos. The application was blocked by the Spanish authorities, despite the importance to the area of maintaining the desagüe. (The line was for the transportation of the vast amounts of coal required to keep the steam driven pumps running.) The reason for the embargo was, that while Siret owned most of the land over which the line would pass, some of it was in the public domain. There was probably also an element of anti- foreign attitudes at play in the refusal. Undeterred, Siret continued to petition, and in 1906 permission was granted, with the proviso that anything on public land be maintained in good condition.

There is a certain amount of evidence indicating that Siret applied for permission retrospectively. On the 23rd of November 1902, a gentleman writing under the pseudonym of Chórcholis, wrote in El Eco de Levante about his trip to El Ateal by rail.

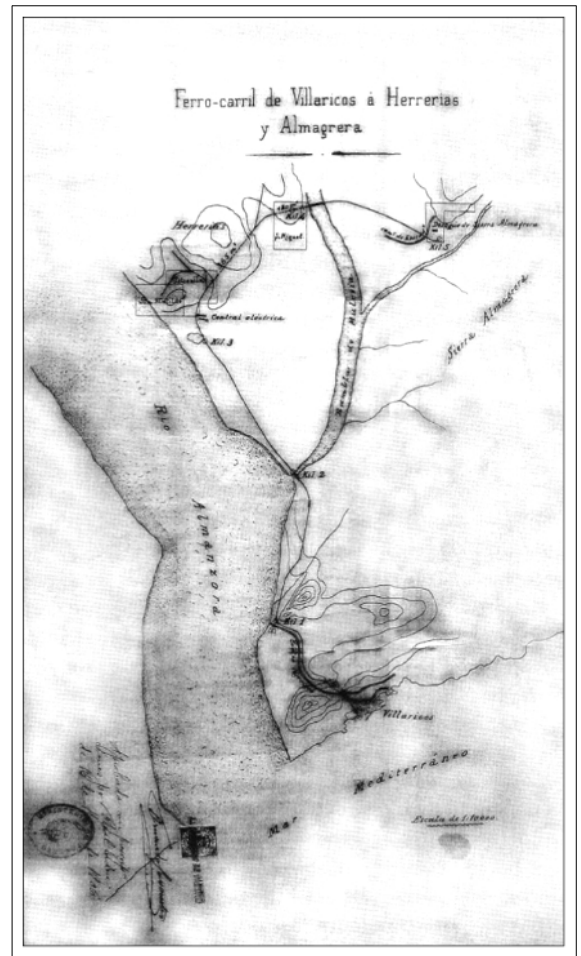
The plan submitted in 1904 for the extension of the railway to El Arteal.

Un Siglo de Historia Minera. Bolea.

A detailed description of the line was included in the 1904 petition and the remains of much of the extension can still be seen today.

It ran from the coal yards on either side of the roadway through El Arteal (one now covered by a greenhouse, and the other re-purposed as washing tanks). By the desagüe building it left the road and ran to a bridge over the track by the olive grove. At the time this was the main public track to the Sierra.

From the bridge it ran 800 metres on a raised embankment curving to the Rambla de Muleria which it crossed on a 90m bridge.



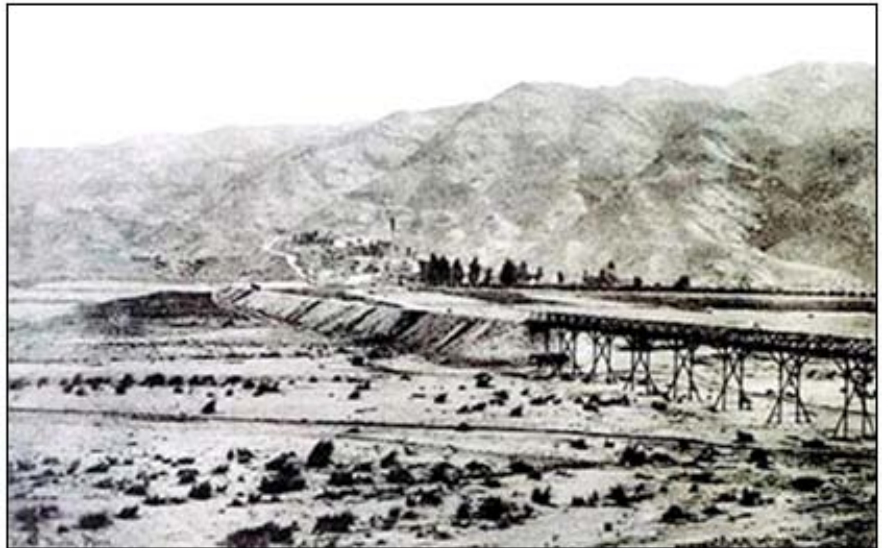
The re-purposed coal yard.



The supports for the bridge over the track.

The bridge across the rambla can be seen in this early photograph. The chimney at El Arteal is in the centre of the picture.

E.L.Morin.



Both supports for the rambla bridge are still in place. One is very obvious, the other often goes unnoticed.



From the rambla, via a deep cutting, it went into a tunnel 180m long, 1.60m wide and 2m high. The tunnel entrance is very overgrown, but its exit can just be seen below the track on the west side of the top field (below left). From here it ran through the overgrown area below the tower at the start of the track to El Arteal.



From this point I wasn't quite sure where it went. Bolea describes it as turning quite sharply towards the south and heading towards the head of the massif, where a 365m long tunnel was bored beneath its eastern flank. As can be seen from the plan submitted in 1904, this was the proposed route, with the line exiting in the demarcation of the mine Costa Rica, where it joined the main line to Villaricos.



The exit is situated just past the retaining wall of the Araucana foundry.

The same exit can be seen on the extreme left in this early photograph. Luis Siret, in the white hat, is on the right.

E.L.Morin



I think that the entrance to this long tunnel was somewhere opposite the turning for El Arteal.

The entrance to the long tunnel was probably somewhere in the area by this sign.



This left me with the mystery of the tunnel in the garden of the first house on the Las Rozas road. It was obviously part of the El Arteal extension as its style is the same as the second Villaricos tunnel. An elderly Spanish gentleman told me years ago that the trains from El Arteal went through it, but I couldn't see how it fitted in with the 1904 submitted plan, nor with the description of it. Its entrance was at the end of the wall which runs parallel to the main road.



Above, the tunnel exit in the garden of the first house and right, a more recent view.

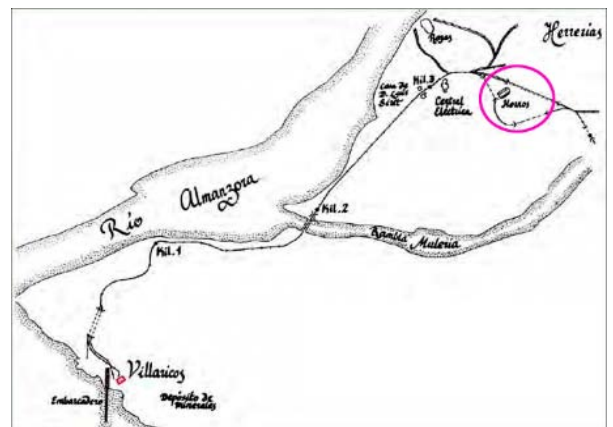
After years of puzzling, I went back over all of the information that I had collected and I revisited several web sites. Sure enough, I had had the answer all along. I re-examined this sketch map from “The Mines of the Sierra Almagrera” faydon.com/almagrera which I had long since discounted as I knew that something was wrong with it.



Faydon's plan.

I also re-found “Intervención arqueológica preventiva en calle Playazo zona arqueológica de Villaricos” by Carrillo and Ballesteros where I looked again at this plan from the Archivo General de la Administración Sección Obras Públicas. Caja 23.116.

Carrillo and Ballesteros's archive plan.



When I compared the two plans I realized that the author of faydon.com and I had both made the same error. We had both thought that the “hornos” circled in the archive plan referred to what looks like a calcination oven at the entrance to El Arteal, which was why the Faydon plan had shown the loops and branches on the El Arteal side of the Villaricos-Las Herrerías road. When I realized that they actually refer to is the ovens of the Araucana foundry it all made sense.

The archive plan shows that there were two lines built and that the tunnel in the garden was part of the second one. The entrance to it was at the end of the wall which runs parallel to the Villaricos to Herrerías road.

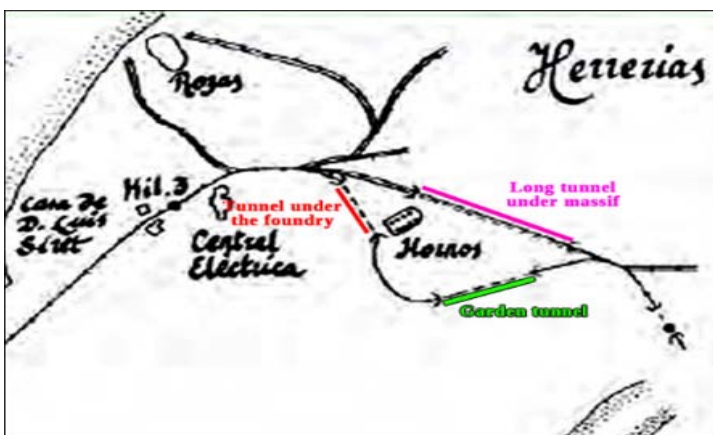
On leaving the garden tunnel, the line curved round, parallel to the road, and, to avoid the hill on which the Araucana foundry stands, entered a second tunnel. I think that the entrance to this was in the corner of the garden of the second house on the Las Rozas road.

I think that the line ran through this olive grove and entered a tunnel in the corner.



I think that the exit can be seen in this 2008 photograph of the retaining wall of the foundry when the houses were being built in the roza.

Photo. G García

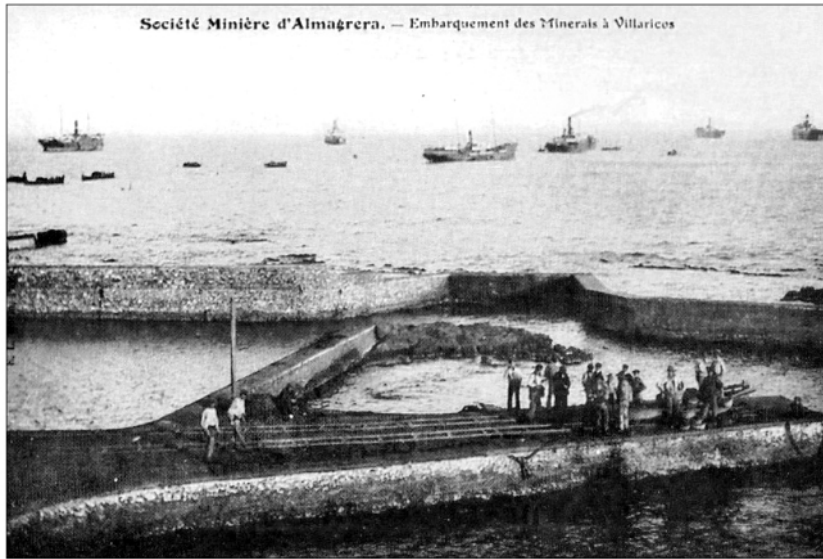


Detail from the archive plan showing the three tunnels.

It took me several years to solve this mystery!

2.5. The boat train.

Prior to 1913, ore was transferred from the beach, via metal jetties and stone quays, to barges and lighters and taken out to sea, where it was hauled up on to the decks and into the holds of the waiting steam ships. With as many as seven vessels anchored up at one time, loading was a slow and costly business.



Lighters ferrying ore to steamships waiting off Villaricos.

E.L. Morin.

In 1913, in order to reduce the costs and speed up the process, work started on a third mineral yard, more railway branches and a magnificent cargadero or loading platform. Built by the Marseilles company Ateliers Terrin and opened in 1914, the cargadero was capable of loading 500 tonnes an hour directly into the ships' holds.

The mineral yard and loading quays in the Balsica.

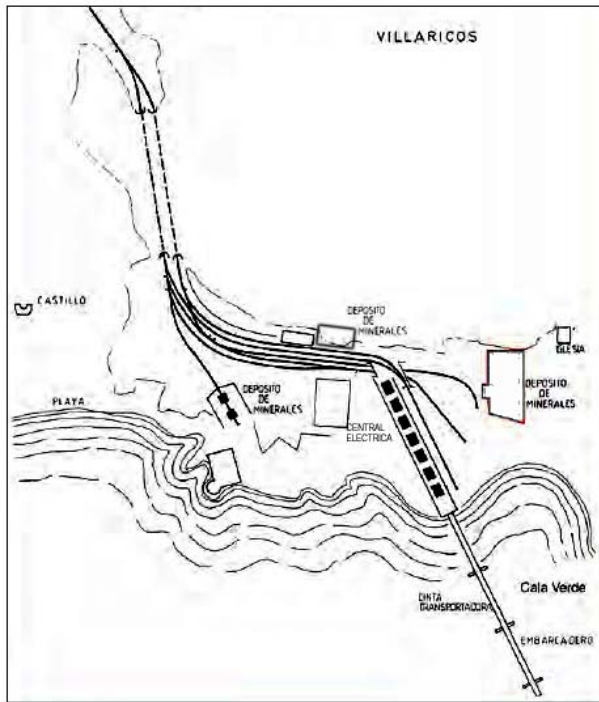
Part of the landward section of the new cargadero can be seen under construction on the left.

E.L.Morin.



The cargadero consisted of two distinct parts. One on land, and the other out to sea, with the mineral being moved on metal conveyor belts, driven by electric motors.

On land there were seven enormous hoppers, each capable of holding 60,000 cubic metres of mineral. Ore was fed in either, directly from the side- tipping rail trucks, or, from a large, walled deposit situated at the end of the line of hoppers.



In the plan the seven blocks indicate the hoppers. The various railway tracks can be seen linking the mineral yards.
J. González Ballesteros.



The mineral yard today. From Calle La Central and from the main road into Villaricos.

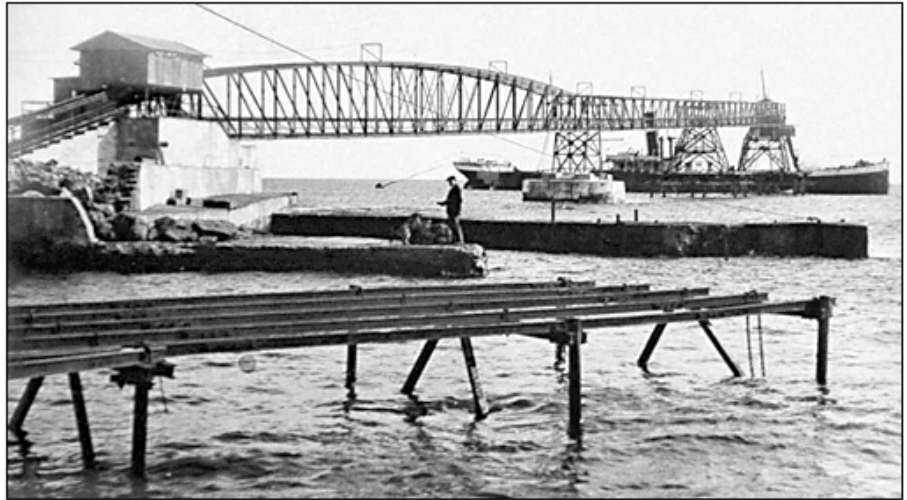
(top)



Google screen shot of the installations.

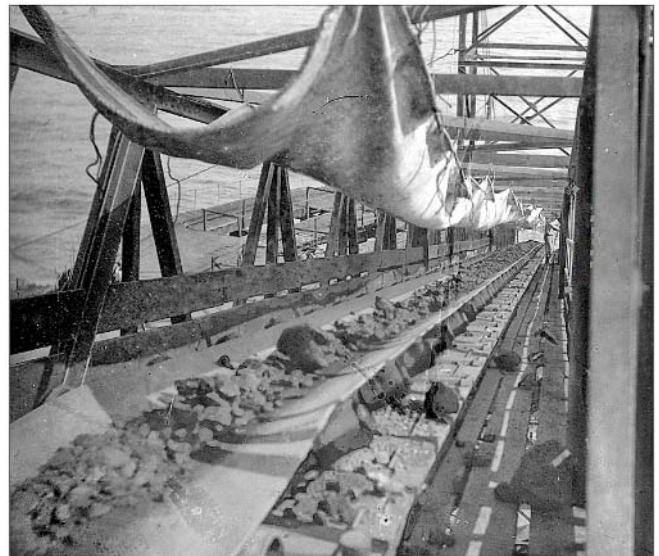
Beneath the hoppers was a tunnel, housing a conveyor belt and a 60 H.P. motor. The ore dropped from the hoppers on to the 1.20 metre wide belt and travelled through the 100 metre long tunnel and then a further 36 metres up to a transfer tower. The second section, the loading pier, ran from the tower out to sea.

*The transfer tower
and loading pier.
Mti blog.*



The loading pier was a kind of mobile bridge that could move up to 16 metres backward or forward. This section was carried by a pair of stone supports and two metal ones. The ore was dropped off the end of the first conveyor belt on to a second one, powered by a 12 H.P. motor, and carried along the metal bridge to the cargo ships. The ability to advance and retract the bridge meant that as one hold was filled, the vessel could move forward and present subsequent holds for filling.

*An ore carrying conveyor belt,
similar to the one at Villaricos.*



While this mechanical wonder was fêted by many, the majority of the boat-men lost their livelihood although some were still needed to off-load coal for the boilers. Electricity was being used to power the mining machinery, so only the power stations needed coal. Also, because of the First World War, very little British coal arrived in Spain.

This engineering feat stood the test of time as, like the rest of the railway, it was in use until 1959 when it was dismantled. Few traces of it can be seen today. The remains of one of the circular, stone supports is a popular fishing platform. Traces of the foundations of the transfer tower can be seen on the old, lower, seaward part of the promenade wall called El Mirador. One of the mooring points for the steam ships is also still visible.



The remains of one of the supports seen from the 'mirador' on the Paseo Marítimo.



The 'mirador' was built over the old walls and supports Of the Cargadero.



One of the mooring points for the cargo ships.

2.6. Hitting the buffers.

The First World War and its aftermath were disastrous for the whole of the mining sector in the region. With rising costs and increasing instability in the labour markets, La Société Minière d'Almagrera looked for other areas in which to begin exploitation. In 1923 a sister company was formed, Compagnie Minière de l'Afrique du Nord and operations started in Morocco. From then onwards, there was a progressive abandonment of the Société's interests in Las Rozas until 1928, when it transferred all of its activities to North Africa.

Luis Siret however remained in Spain. Two years earlier he had again taken over the running of the desagüe at El Arteal and now, took over the running of the railway. (It had always been very much his train set.) La Société granted him 6,000 pesetas per annum, and a levy of 10 cents per tonne carried. In addition, he was allowed 12,000 pesetas for the maintenance of the cargadero. In return he was contracted to replace any worn or defective elements and to repaint the cargadero every 18 months. This contract lasted until 1931.

Although Siret ran the railway, in 1929 the infrastructure and actual rights to it were ceded to a Spanish company, La Sociedad Anónima Consorcio de Almagrera who agreed the same terms with him. They took over the running of the desagüe at El Arteal and, in addition, Siret sold them some of the mines that he had in the Sierra Almagrera.

One of the conditions of the original licence for the railway was that it could only carry minerals extracted from Las Rozas and Las Herrerías. It was barred from carrying anything from the Sierra Almagrera. It could carry coal to El Arteal, but could take nothing from there. Using his 40 odd years of experience of negotiating with Spanish authorities, Siret was able to change the conditions of usage of the line. The Consorcio was able to use the railway to transport iron, lead and barite from the numerous mines that it had acquired in the Sierra.

Siret scrupulously maintained the railway but the Consorcio reneged on the deal. Siret took them to court in 1931 as they had not paid their dues. By now the quantity of mineral carried was a fraction of what it had carried in the past so Siret terminated his contract.

In 1932, the Consorcio petitioned the authorities to allow them to run a line directly from El Arteal to Villaricos on the eastern side of the Rambla de Muleria, rather than having to go via Las Rozas but permission was refused. They continued to use the railway until the Civil War disrupted production.

Franco's initiative to revitalise Spanish industry after the war led to the formation of Minas de Almagrera S.A (M.A.S.A). This company used the railway and the loading pier until 1959 when everything was dismantled.

2.7. The locomotion.

*A train entering the roza by the
side of the Araucana Foundry.
E. L. Morin.*



In the castle museum in Garrucha is an old photograph of a Mercedes-Benz car pulling, probably as a

prank, wagons on the stretch of line between Las Rozas and the rambla crossing. But, in all the years of its operation, no photograph of a locomotive steaming along the track was taken. No children ever waved to the engine driver and no train-spotter ever noted down the names and numbers of the locos. Siret's locos did have numbers and I'm sure that some, at least, had names but the man who introduced the most modern technology to the Roza used the humble donkey to pull his trains! To be precise, he used mules, each one numbered, and it was mules that hauled the hundreds of thousands of tonnes of ore down the line to Villaricos right up until 1959.

Why? Why construct a highly engineered railway and run mule trains on it? The mules, for the most part, belonged to the Société's workers and were hired as required. Was Siret being philanthropic, providing the men with an extra income? He was an Hispanophile, so did he view the beasts in the same light as those 70's and 80's British holiday makers who arrived home clutching straw and even concrete donkeys?

I could understand why he moved away from the old pack mule trains. Assembling sufficient mules in one place to haul the large quantities of ore would be a logistical nightmare. It would also be a very expensive option, muleteros (muleteers) and carreteros (carters) were the crème de la crème of the 1890's workforce.

Carreteros were self-employed. They earned good money and, presumably, had some standing in the community as this photograph seems to indicate.
Memoria Visual del Siglo XX. Bolea.

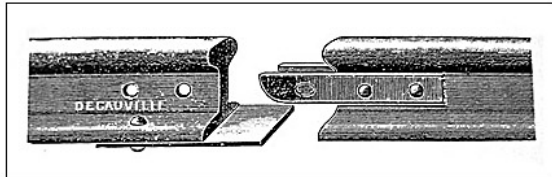
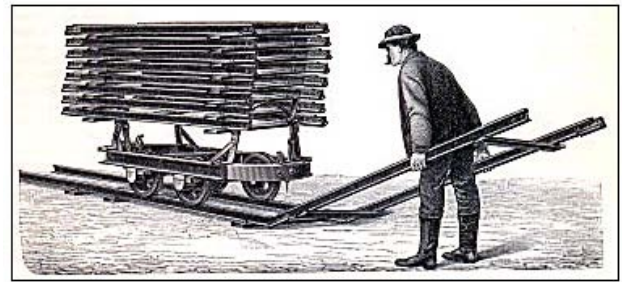


Is it possible that Siret never expected the line to be so successful, or long-lived, so saw mules as a cheap short term motive power? But then, were the mules themselves the secret of the success?

Siret was a genius, an experienced engineer, an astute businessman, so why would a man with such acumen run a railway with mules not locomotives? Was it for financial reasons? With no capital investment, depreciation, maintenance or replacement costs, that could make sense. Was it a question of available land? The mineral yards in Villaricos would have needed to be much larger, with turntables and shunting sidings. Unhitching a mule was certainly easier. Old photographs of Santa Matilde, Guadalupe and Petronila shown rail tracks everywhere. Certainly mules were a good option in the confines of the roza.

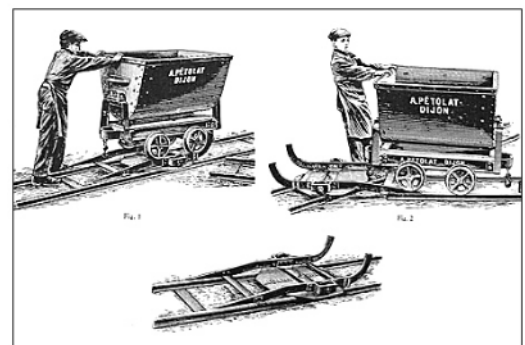
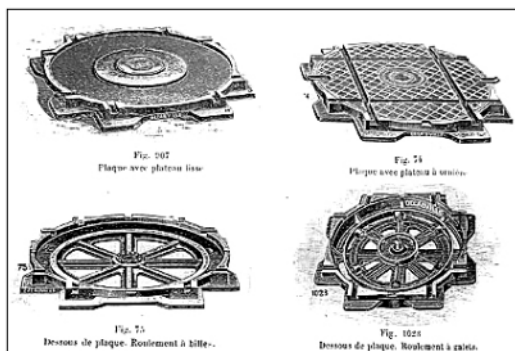
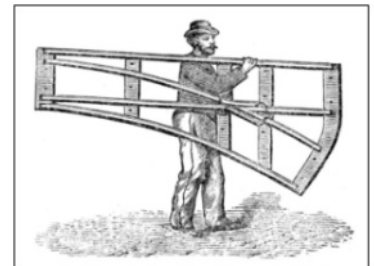
Finally, as I was drafting this section, I found the answer. DECAUVILLE. Siret had bought the whole train set, one of the most successful ever produced. By chance, when looking for illustrations of the wagons used on the line, I opened up a site on the history of the Decauville company. Bingo! The Original Decauville system was designed for animal traction, in this case, by horse. The Frenchman, Decauville, owned large fields planted with beetroot. He reasoned that if a horse was capable of hauling a wagon containing one tonne of beet, then, the same horse could haul 7 tonnes if the wagons were on rails. Not much of a discovery, but it was the ingenuity, flexibility and simplicity of the components that made it one of the most successful narrow gauge systems ever. Designed for use on farms and plantations, in quarries and in both open cast and subterranean mines, it was tuned for man and beast.

The rails were light, 4 kg. per linear metre. They were easy to carry and install. They could take changes in elevation of up to 3 metres without buckling. For long term use, they could be fastened down using bolts through holes in the cross members.



Joining lengths was a simple matter of slotting together the male and female elements and inserting a pin.

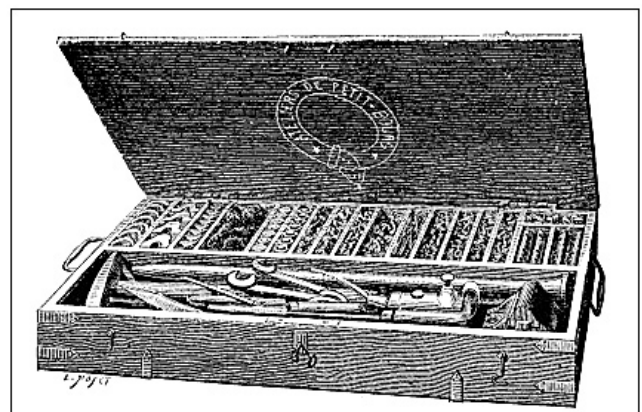
Curved sections had either an 8 metre curvature for animal traction, 6 metre for manual traction, or curves of between 2 and 4 metres formation use in extremely tight spaces. (A lot of grease was required on the outside rail.)

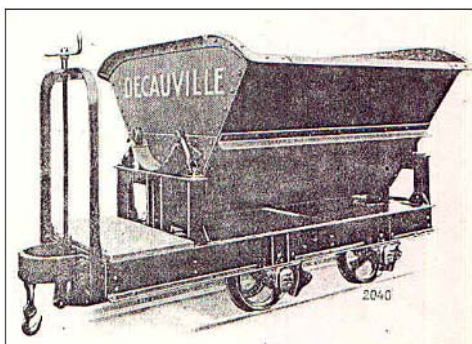


A variety of turntable plates were available, the most ingenious being the dérailleur plate where a wagon could be moved from one track to another, even if they weren't connected.

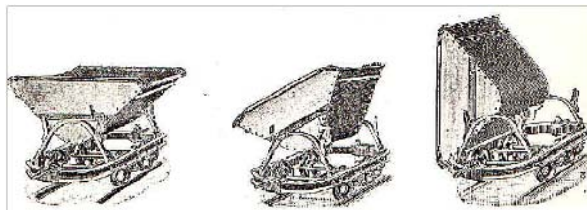
A boxed repair kit was supplied with the rails containing “une enclume portative, un bec d’âne, des clefs, une bouterolle, et des pièces de rechanges de wagonnets.”

(A portable anvil, a mortise chisel, spanners, a riveting punch and spare parts for the wagons.)





The tilting trucks could be down loaded with the minimum of effort. Siret generally used a line of six, standard, one tonne, tilters and one, braked tilter. In the description of the line submitted with the application to extend it to El Arteal, the position of the brake wagon was stated as being at the front.



This photograph of a train crossing the Rambla de Muleria shows the brake wagon at the rear. This may have been because the train, returning to Las Rozas, was running empty.

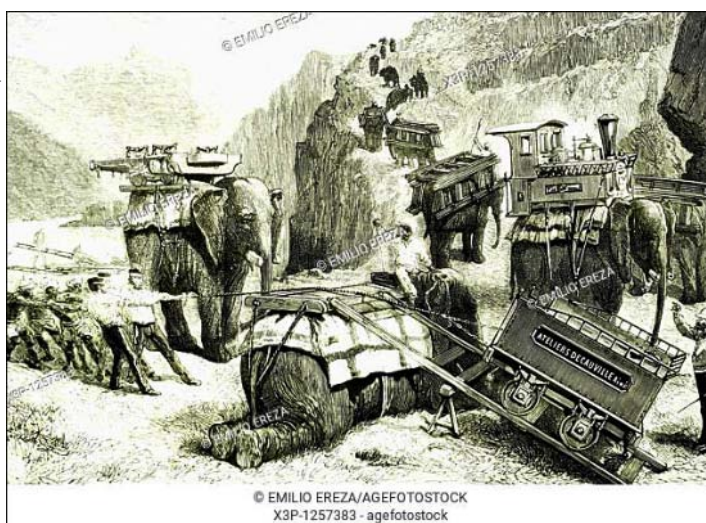
Coll. Pedro Perales Larios.

The Decauville system, because of its portability, was extensively used in the open cast areas of the Roza, the track was simply moved down to successive haul roads as the sides were excavated.



Decauville systems were employed extensively by both the French and British Armies in the trenches during the First World War, using either Decauville locomotives or horses.

This wondrous engraving of an entire system, engine and all, being taken up a mountain on the backs of elephants, gives some idea of the universality of Decauville.



2.8. Along the lines.

While Villaricos has worked so hard at obliterating its industrial heritage and re-inventing itself as a touristy “fishing village” there are still one or two glimpses of its past remaining.

While the section of the new promenade that was built over the loading pier boasts the title “el Mirador”, the real “mirador” or, look out point, is still alive and well as can be seen in these two pictures.

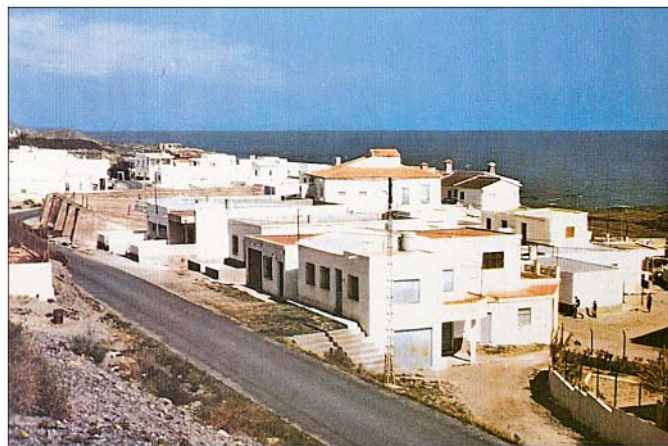
The sloping roof at the rear covers stairs leading to a belvedere with windows on three sides. It gave the Harbour Master a commanding view of the shipping entering and leaving the area. The new building on the right of the view from the front, stands on what was the Tío Borracho yard.



View from the back of the mirador



and from the front.



The ramp and belvedere, on the roof, can be clearly seen in the 1970's postcard (above). Before the sea front was developed it had a prominent position. The high wall which runs along the road and down towards the mirador enclosed the Tío Borracho yard.

To help you to get your bearings, the asphalt road is the main road into Villaricos, the unsurfaced road on the right is signed Calle Verde. The church is just out of the picture on the left, almost opposite the yard walls.

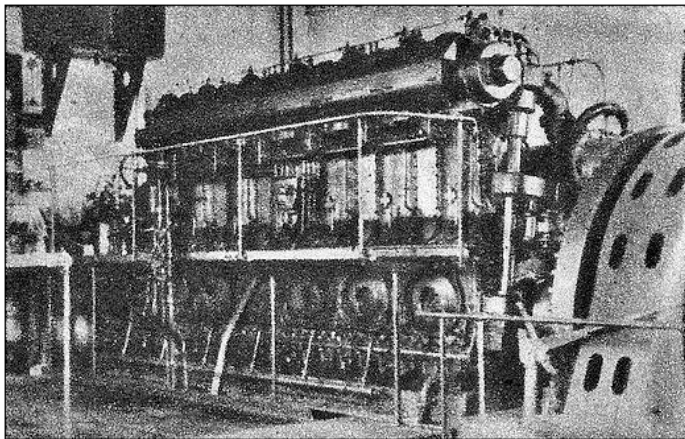
The hoppers and tunnel were in the road that runs in a straight line between the new mirador and the large, walled area that was the mineral yard. The road name plate reads Calle Las Torvas, which is odd because the Spanish word for hoppers is tolvas. Calle Las Torvas translates as the grim street. While I don't doubt that the passageway was grim, most place names in the area are far more prosaic, so I wonder if it was simply misspelled.



The Central Eléctrica, built in 1932 to power the pumps at El Arteal, is just round the corner on the left hand side of the road built on the line of the railway. I imagine that it also powered the loading pier from that date.

As can be seen from the photograph below is falling into disrepair. Ever prosaic, the name of the road in which it stands is Calle Central.

Central Eléctrica's collapsing roof.



The dynamo of the Villaricos power plant.

*Minas de Almagrera S.A. 1944-1958
Andrés Sánchez Picón and Isabel Garcia Jiménez.*

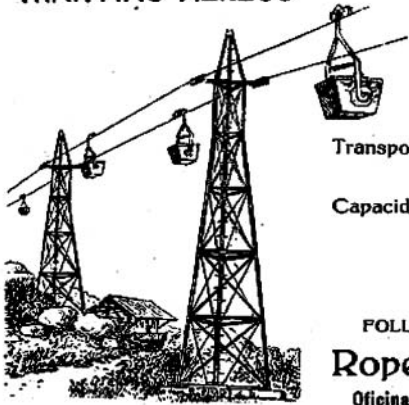
Even more prosaic is the name of the road leading off it to where the old Carmelita foundry used to be. This one is Calle El Escorial. Forget about any connection with the magnificent palace built by Philip II, this one translates to the address you do not want as your own - Slag Heap Street.



Calle El Escorial.

Chapter 3. Technology in the Sierra.

- 3.1. The men from Bilbao I.
- 3.2. The men from Bilbao II.
- 3.3. The men from Bilbao III.
- 3.4. The men from Bilbao IV.



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CASA CENTRAL EN LONDRES: **ELDON STREET**

3.1. The men from Bilbao I.

While Luis Siret was gaining the monopoly of iron ore exploitation in Las Herrerías, the Basque company Uriate y Compañía was gaining ground in the Sierra Almagrera, particularly in the area around Pico Tenerife. The greater volumes and lower value per tonne of iron ore made them look for alternatives to pack mules on dusty tracks as a means of transport. Siret had the advantage of operating on flat ground, at almost sea level, but the Basques were precariously perched 300m up, at the head of the Jaroso valley. Undeterred, they came up with a scheme to transport ore from their holdings on the landward side to the seaward side at Cala de las Conchas.

Transporting minerals to the sea had already been proposed in the 1850's when there were plans to use the drainage tunnel, the socavón Riqueza Positiva, which ran from the desagüe in the Jaroso to the Cala del Peñón Cortado. (See Vol.1, Ch. 4.1, *The Desagüe del Jaroso*) Although the socavón was constructed wide enough, it was never used for this purpose. There were too many companies with too little co-operation between them to make it work. The answer to the question of whose ore was in which truck would never have been agreed.

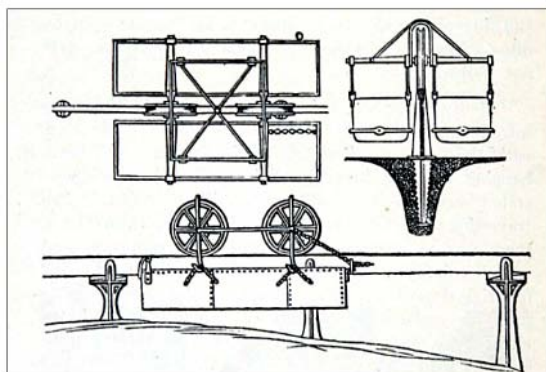
The Basques were transporting minerals from their own mines so there was no such disagreement. Their scheme was a complete package, transportation, processing and exportation using the expertise gained in the mines and foundries around Bilbao. 1898 saw work start on the first “tranvía aéreo” or aero cable in the Almagrera. Its loading station was above the San Cayetano mine and its terminal was at the calcination ovens constructed in Cala de las Conchas. The ore was raised to the loading station by means of a 100 metre long inclined plane from a transfer station at San Cayetano. This was the terminus for a narrow gauge, animal traction railway linking San Vincent Ferrer, Hermosa, Rescatada and Virgen del Carmen.



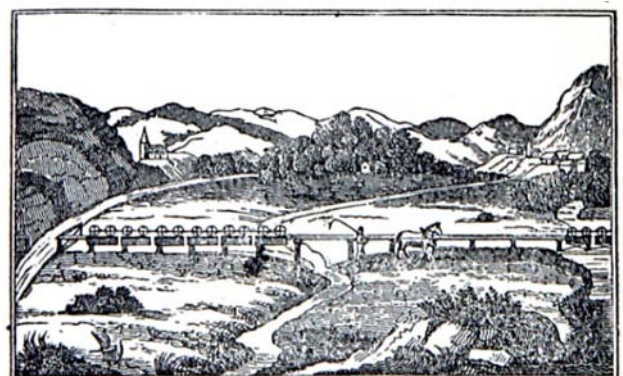
The railway linked these Uriate holdings at the head of the Jaroso Valley.

Much of the line of the railway has been lost beneath the spoil that dominates this part of the Sierra.

The Spanish railway web sites offer no clues as to the type of track or rolling stock and I thought originally that it was ‘Palmer’ track favoured by the Basque companies. This was a horse or mule drawn, suspended, monorail system that would have been particularly suited to the type of terrain of the Jaroso valley.



Suspending the wagons reduced friction



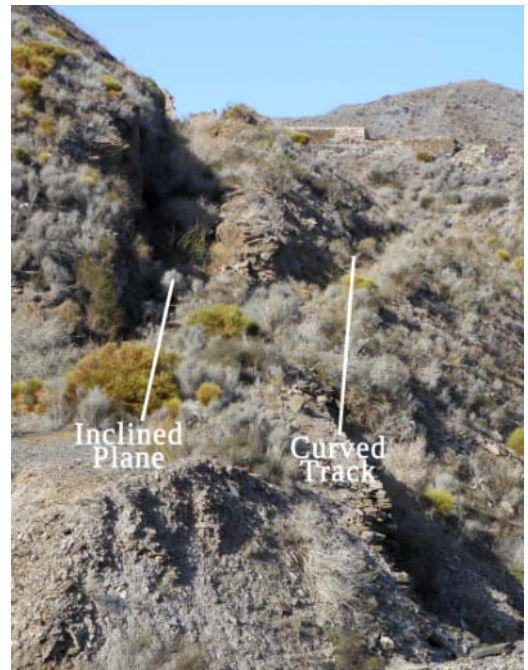
Palmer track was suited to rough terrain.

The inclined plane, from San Cayetano to the loading station was built on wooden piers of variable heights. In 1899, the local mining magazine described the inclined plane as having two rails “que se dispondrán, a manera de vía aérea” that is, arranged like those of an aero cable. This seemed to indicate that this was indeed an integrated rail/inclined plane Palmer system. I was, of course, mistaken. I have since found out that it was a Decauville system.

The inclined plane was the last part of the whole system to become operational. This was due to the late delivery of the motor which was to provide traction for the cable used to raise the full wagons. For a time, pack mules were used to take the ore up to the aero cable, trekking up and down the gentler, curved side of the strange looking inclined plane.



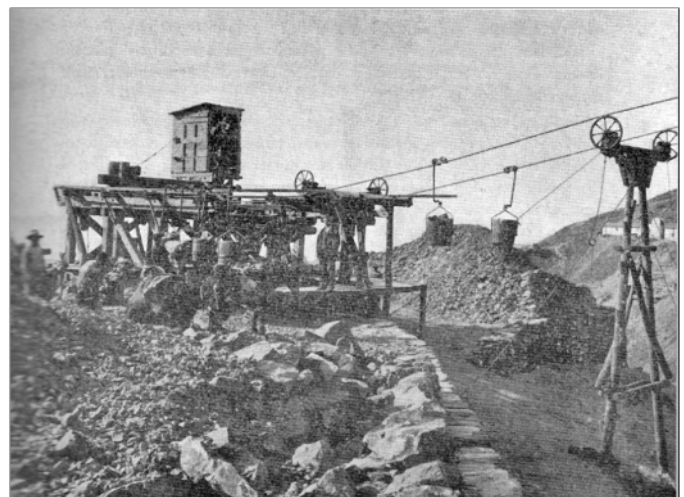
The strange looking curved track.



Inclined plane seen from the bottom with loading station at the top.

*The loading station for the aero cable.
The inclined plane was not yet operational
and mules had to bring the ore up the curved
track from San Cayetano.*

Un siglo de Historia Minera. Bolea.



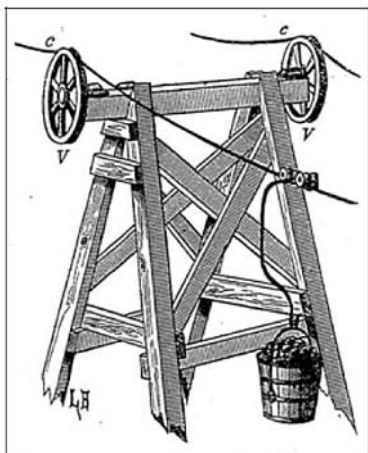
The “tranvía aéreo” or aero cable was a mono-cable one, known as “el sistema inglés” or Hodgson. It had a single, continuous cable which served as both the tractor and carrier line. This endless steel rope ran over roller supports, mounted on the wooden stanchions, and round the sheaves of a pulley connected to the drive motor, situated in the loading station. This pulley, mounted on a vertical axle, was of a sufficiently large diameter to afford the cable enough grip to prevent it from sliding.



*The pulley had a wooden friction brake.
The picture shows a brake detached from
the pulley.*

A second pulley was positioned in the terminal station, and was equipped with machinery to tighten the cable to keep it properly stretched. The carriers were wooden buckets, hung on the cable at 45 metre intervals, by means of metal brackets, known as saddles.

Within these metal brackets, pieces of wood were inserted to give the necessary adherence for the bucket to remain in position. The stanchions and bucket hangers were shaped to allow the free passage of the latter past the former.



There were several teething troubles with the aero cable. The buckets frequently became detached from the cable and the cable tension couldn't be maintained, there were troughs and peaks along its length. An engineer from Bilbao, an expert in the field of aero-cables came to the rescue. The saddles were replaced with a type patented by a Bilbao company. These provided better grip and prevented "jumpers".

The sagging cable was due to the placement of the stanchions. Over the barrancos Los Ángeles and Cala de Cristal the distance between the supports was far too great. Very tall stanchions were needed, positioned on the slopes of both barrancos in order to support the cable.

The line covered a distance of 1,606 metres between the loading and the terminal stations. It was supported by 29 stanchions, whose height varied between 14 and 27m. They were positioned at variable distances depending on the terrain. The greatest distance was 200m where the line was 65m above a valley floor. The gradient varied between 13% and 20%. The buckets were each capable of carrying 200 kilograms of ore, at a speed of two metres a second.



Aero cable similar to that at Cala de las Conchas.

As soon as the line was operational, the calcination ovens at Cala de las Conchas were fired up and the ore was ready for shipment. Its success attracted the attention of other Basque companies and mergers and takeovers were on the horizon.

3.2. The men from Bilbao II.

In 1901, Uriate and a Bilbao company, Sociedad General de Minería, merged to form a new company, Cala de las Conchas. The holdings of this company were widespread. They included, Troya and Casualidad in the Barranco del Arteal, Manchego and Rosetón in the Barranco de las Palomas, and El Boletín, along with Paquita and Garibaldi in the Barranco Chico de la Torre. In addition, Águila de Romero and Unión de Albadalejo were added to the holdings in the Jaroso. An impressive portfolio that ensured that the installations at Cala de las Conchas were fully utilised.

In the same year, the Sociedad Argentífera de Almagrera was formed in Bilbao. The proposed aim of this company was the exploitation of both lead and iron ore extracted from various mines, owned and leased, in the Sierra. It rapidly became a massive corporation, taking over the Cala de las Conchas company in 1903. Basques now dominated the Sierra.



The Argentífera holdings in the Barranco Jaroso and Barranco Hospital de Tierra.

Since the Argentífera were exploiting both lead and iron ore, the next thing to be addressed was the exorbitant cost of the crushing, washing and manual sorting of minerals at individual pit heads. They built a big, mechanised, washing and processing plant at Cala de las Conchas. Sea water was pumped up for the washing process. Centralisation had arrived in the Sierra Almagrera.

According to Bolea, in 1907, the mines Guzman, Rosario, Independiente, Patrocinio and Fuensanta all situated in the Barranco Hospital de Tierra were linked by rail to the existing line, built by Uriate, in the Jaroso. However, the general consensus is that this was a proposal, and that an overground line was never actually built. It is probable that the mines were linked by rail, but underground, using existing workings.

The acquisition of the mines Santa Isabel and San Antonio and then Constancia and Ánimas in 1908, led to the construction of an inclined plane from this lower part of the valley up to the existing railway.

The line of this inclined plane from Constancia to Santa Isabel can just be seen in the picture overleaf.



Rob Vernon. From Notes about the Lead Mines of the Sierra Almagrera.

Because of the way that sunlight falls it is frequently impossible to see any trace of it. I happened to see it because it was a cloudy day. I later found Rob Vernon's picture, from a very similar angle and noticed what looks like a second inclined plane down from the upper track to the level of the railway line. When Rob's picture was taken, there were still three pillars of the Jaroso pumping station standing.

Due to the cloud, I also noticed the entrance to one of the two railway tunnels at the top of the plane, on the section of the line between San Isabel and San Vicente Ferrer. Previously, I had only seen the tunnel exits.



One of the tunnel exits viewed from the top of the Sierra. Any other trace of the railway lies under the moonscape.



Both tunnel exits can be seen from San Cayetano. The second tunnel is highlighted.

No more mules up and down the dusty tracks for the Basques!

3.3. The men from Bilbao III.

The aero cable was now proving inadequate for the volume of material that needed transporting so a new system was developed. This involved building a massive inclined plane on the seaward side of the mountain and linking it, by means of a tunnel, to the existing railway.

The Argentífera had acquired the mine San Agustín situated above San Cayetano right at the top of the Jaroso valley. They tunnelled from one side to the other of the mountain and extended the railway line through it.



San Agustín tunnel entrance.

*The tunnel exit on the seaward side of the Sierra.
mti blog.*



The mines Águila and Unión de Albadalejo and possibly Templanza and Venus Amante, were then linked to the railway by reversing the direction of travel of the original inclined plane up to the, now defunct, aéreo cable. The base of the plane is within a stone's throw of the San Agustín tunnel entrance.

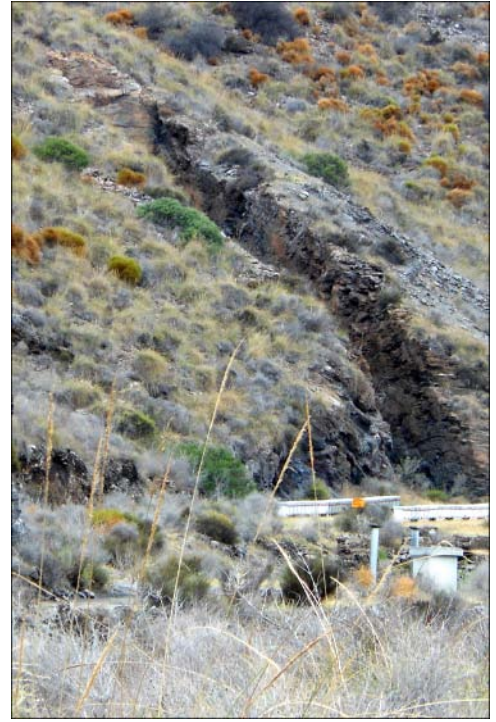


San Agustín tunnel. The base of the reversed inclined plane is on the right of the picture.

On the seaward side, the line snaked a short way round to the top of a 200m long inclined plane that plummeted down the mountain. Like the aero cable that it superseded, the plane also had its teething troubles. On one of its trial runs, testing its braking system, the cable couplings failed, precipitating the wagons down the steep slope to their destruction.



*Remains of the inclined plane
on the seaward side.*



*The cutting for the tunnel to the base of
the inclined plane. Note the bee-hives!*

A second railway line linked the bottom of the plane to a massive hopper. It passed through a short tunnel and then looped round a rocky outcrop to discharge the ore, before returning back up to the base of the plane. (Accessing this tunnel is not recommended unless one is wearing protective clothing. The path has bee-hives on both sides!)



The line looped around this outcrop. The wagons tipped on the way round.



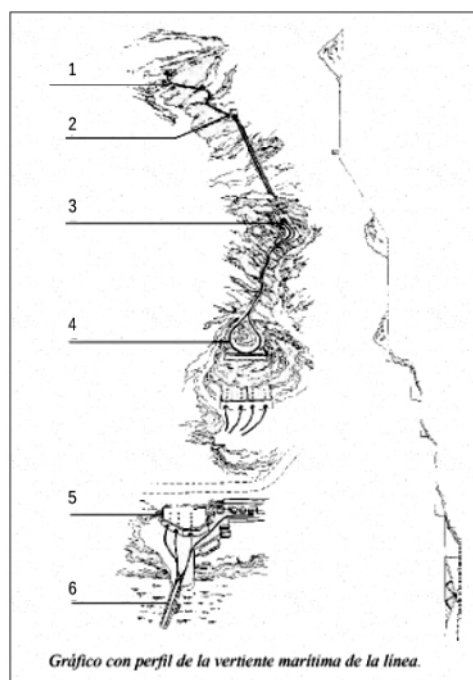
*The inclined plane seen from the top of the Sierra.
The lower railway line can be seen running from
the plane and looping round the top of the hopper.*

*Diagram of the ore transportation system
on the seaward side.*

Key:

- 1. Exit of the tunnel through the Sierra.*
- 2. Start of the inclined plane.*
- 3. Tunnel at the start of the railway.*
- 4. Loop around the first hopper.*
- 5. Loading hopper next to the calcination
ovens.*
- 6. Loading pier out to sea.*

Almedian.org



Below the loop where the wagons were tipped, is the first hopper. I think that there was some initial sorting of the various ores in this area. The hopper openings in the floor, through which the ore was passed into the waiting trucks in the loading tunnels below, are relatively small. There was ample room to sort any galena from from any iron ore at this point. It could then have been loaded via separate tunnels for further processing. The galena going first to the lavadero and the iron to the calcination ovens.

There was an inclined plane from the upper hopper to the beach area, but it was destroyed when the coast road was built.



*The upper hopper.
The wagons tipped from the top of the wall.*



Apertures in the floor of the hopper.



Loading tunnels.



View of lower hopper, cargadero and calcination ovens.



Calcination ovens.

Once processed, the ore was then passed to the second hopper. Here, the apertures to the loading tunnels beneath, and the tunnels themselves, are much larger, as can be seen in the picture.



Apertures in the lower hopper.

View inside the loading tunnels.





General view of lower hopper from below.

From the lower hopper, the wagons laden with ore were pushed by hand along this 87m long, cantilevered, cargadero. Completed in 1912, this loading pier stood 14m above sea level. The minerals were tipped via the chutes, down into the holds of the steamers bound for Bilbao.



The loading pier

The remains of the land and sea pier supports today.



The remains of the installations are very impressive and well worth a trip along the coast. The wall above the top hopper is almost impossible to miss on the left hand side on the road to San Juan.

3.4. The men from Bilbao IV.

The men from Bilbao had their headquarters between the Invencible foundry and the old Guardia Civil barracks on the coast road just outside Villaricos. The remains of this fine old building with its turret, together with the ruins of its chapel are well worth a visit.



The Argentífera's headquarters in 1912.

F. de Blain



The remains of the ornamental turret.



Detail of the moulding inside the chapel.

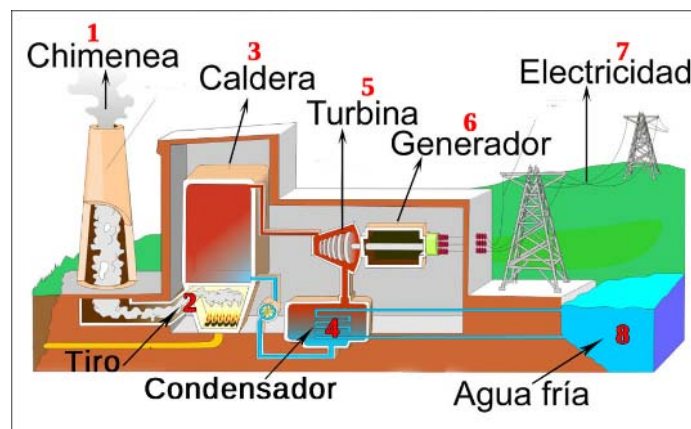
The 1912 picture postcard is titled *Instalaciones de la S. Argentífera-Villaricos*, and makes no reference to the all important building on the lower right. This building, built for them in 1902 by the German company, Ahlemeyer, housed the single, most important 20th century development in the area. It was the Sierra's first electricity generating plant where three steam engines powered dynamos, each capable of generating 275,000 watts. Sea water was pumped up in order to cool the condensers.

The massive boilers were shipped by steamer from Germany to Cartagena. They were then caulked, put into the sea and towed by smaller vessels to Villaricos. When they reached the site of the power station they were beached using chains.



The scene today. The flue arches of the Invencible, the headquarters and chapel. In the foreground is all that remains of the electricity generating plant.

The Argentiñera plant followed the typical basic layout of an early 20th century Spanish power plant as shown in the diagram below.



Working from left to right.

1 The chimney. All that remains of the chimney stack is a small pile of bricks. I suspect that it was dynamited for the bricks in the same way as was the one at El Arteal.



2 The flue. The chimney stood on the hill above this flue opening.



3 The boilers. The boilers were housed in the area between the two walls on either side of the author in this photograph.

4 The condenser. The condenser cistern serving the dynamos also acted as a water feed for the boilers.



5 The turbines. The hot water feed lines from the turbines can be seen in the walls next to the cistern.

The wall seen from the other side.



6 The generators. The generators were housed in the area between the facade and the turbines. The full facade can be seen in the 1912 photograph on page 55. This is part of what remains of it today.



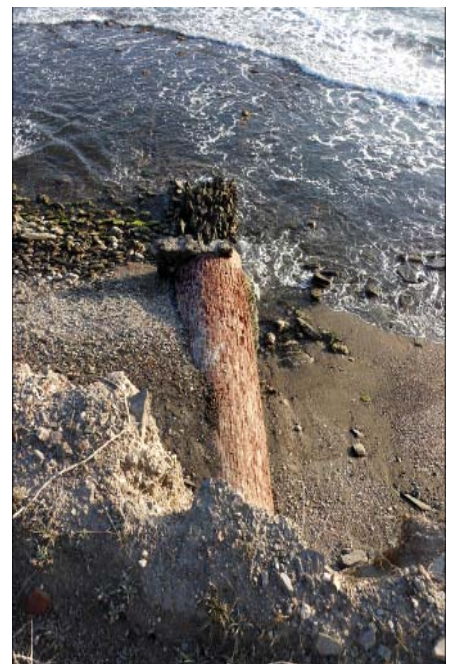
Beneath the rubble and vegetation, the anchor points for the generators can be seen.

7 The transmission lines. Traces of the power line outlets can be seen on the walls.



8 The cold water inlet. Sea water was pumped up from the sea through the inlet on the beach to feed the turbine condensers.

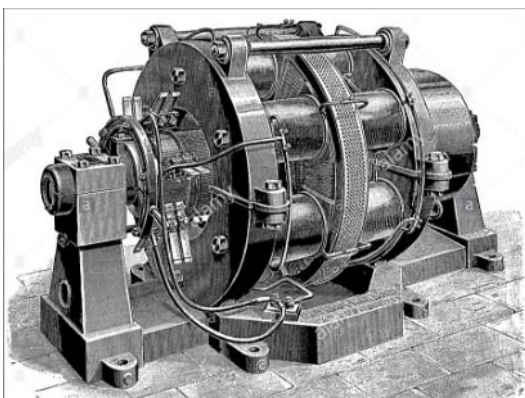
The water inlet pipe on the beach seen from the roadway in front of the plant.



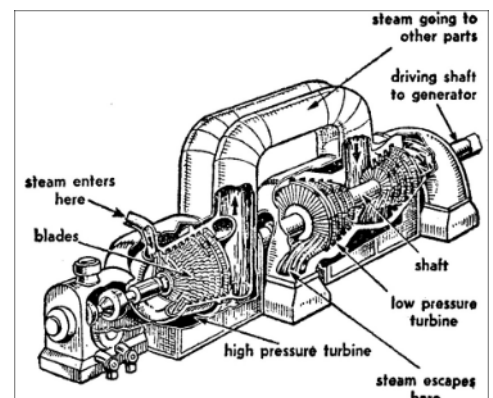
A general view of the plant can be had from these two pictures. The one taken from above looking over the boiler room, with the cistern on the left hand side, to the facade at the end overlooking the sea. The other, the view from the side which gives some idea of the scale of this building.



Ahlemeyer were associated with Siemens and Schuckert so the generators in the plant probably looked like the one shown below.



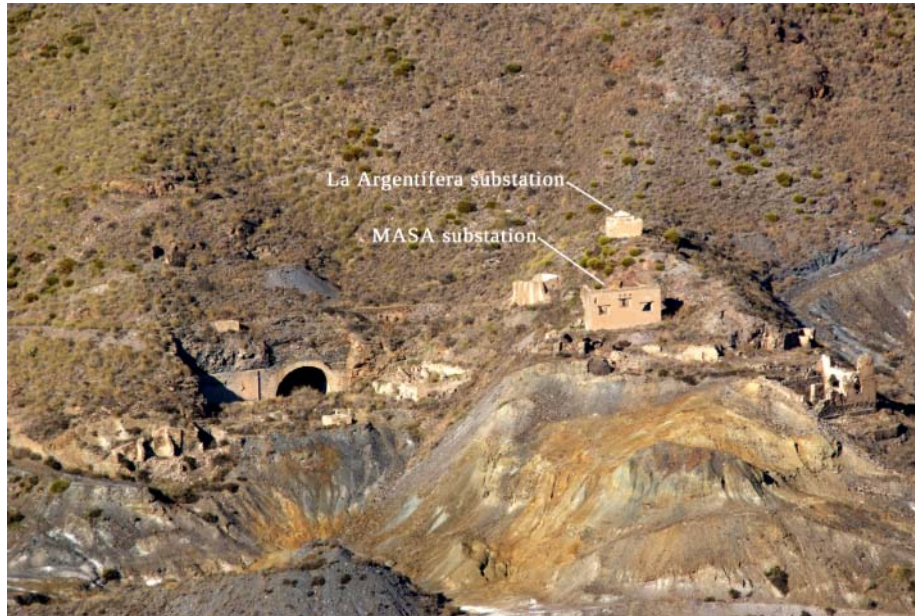
*Early form of Siemens and Schuckert generator.
Alamystock.*



Steam Turbine diagram.

Aerial power cables supplied electricity to the Sierra and, for a short time, Las Herrerías. (Luis Siret built his own, similar generating station in 1905.)

Three separate lines carried current to the Sierra, where secondary lines from substations distributed it to a wider area. The mine Jacoba in the Jaroso, owned by the Argentífera, was the first to install electrically powered winding gear. San Cayetano quickly followed suit. The ruins of the Argentífera's substation are just above those of MASA's, which was built in the 1950's.



MASA built their substation just metres away from the ruins of the Argentífera's.

A G Jódar

These transformers also date from MASA's time.



Above, Guzman's transformer.



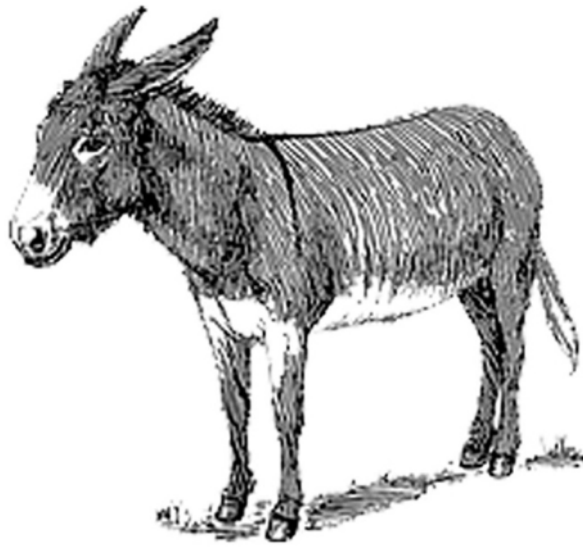
Right, Republica's transformer.

Chapter 4. The Donkeys' Decline.

4.1. Rise over run.

4.2. Aero cables.

4.3. Aero cables. The technology.



Why is this chapter called The Donkeys' Decline?

The technological innovations in the sections that follow are about the mechanics of the inclined planes and aero cables that replaced the donkeys or, more correctly, mules.

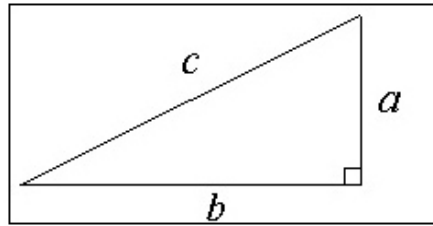
Although no longer used as beasts of burden they continued to be used as the locomotive force of the railways. They were still pulling lines of ore trucks from El Arteal to Villaricos up to the 1959's.



4.1. Inclined planes.

Inclined planes have been described as the most beautiful machine and the mechanics behind them have been understood for millennia. Using a ramp reduces the force needed to overcome gravity when moving objects up or down. By extending the distance travelled, the run, (c), to achieve the required elevation, the rise, (a), makes it easier to move loads to the same height. A gradient is the ratio of the rise to the run.

$$\text{Gradient} = \frac{\text{Rise}}{\text{Run}}$$

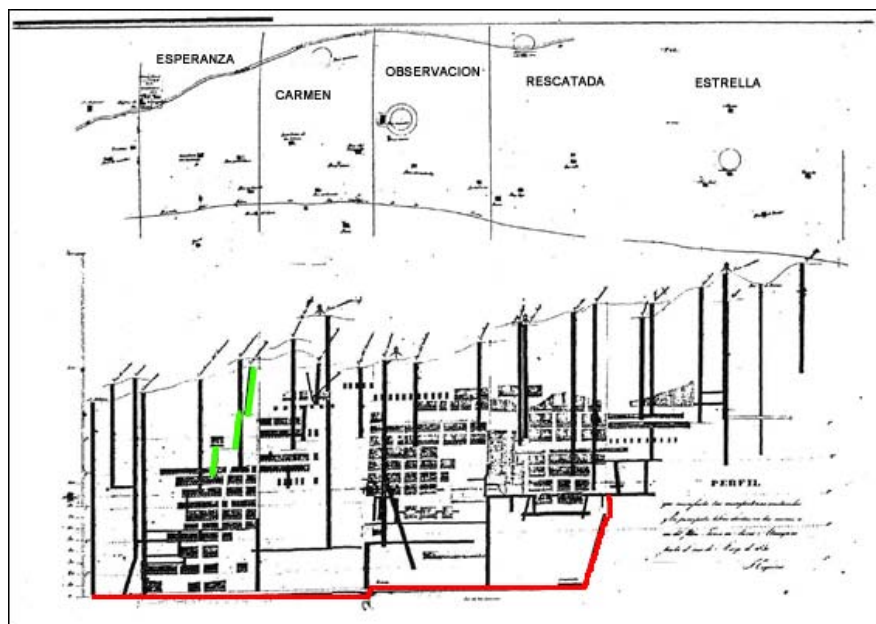


The tracks in the mountains are themselves inclined planes of between 15 and 20% gradient, the optimum for the mules to ascend and descend. Any slopes steeper than the tracks are either cuttings to allow aero cable buckets to circulate, or, the remains of cable railways. The most basic inclined planes in the Sierra were simply ropes attached to trolleys pulled up a sloping shaft.

A basic inclined plane.



Although not very popular in the Sierra, the mines Esperanza and Carmen both had inclined shafts. This was probably due to the fact that they had “Saxon” i.e. German engineers, who favoured their use. They were extraction shafts rather than access shafts and the kibbles laden with ore were winched up manually. These shafts were known in the area as Mequínez which has no English translation but is a city in North Africa. How, or why, the shafts should be called this is something of a mystery.

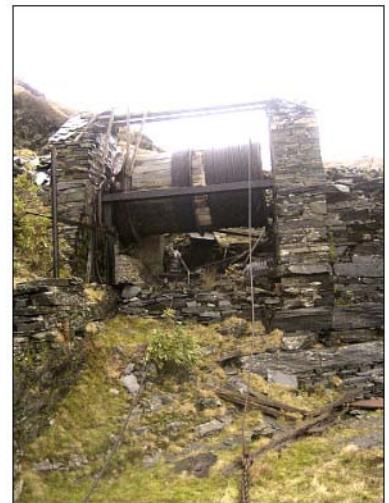


Detail from shaft plan. The inclined shafts in the Esperanza mine are highlighted in green.

The development of better, motorised, winches led to far more sophisticated inclined planes or cable railways, capable of operating at gradients of up to 80%.

Typically, inclined planes for lowering materials consisted of a pulley or winding drum, situated at the top of the incline, and two lots of wagons, running on rails laid on the slope, attached to a cable which ran round the drum. As one set of wagons were raised the other was lowered. The cable was wound several times around the drum providing sufficient friction to stop cable slippage when a brake was applied. The weight of the loaded descending wagons was used to lift the ascending empties.

A winding drum similar to those used in the Sierra.

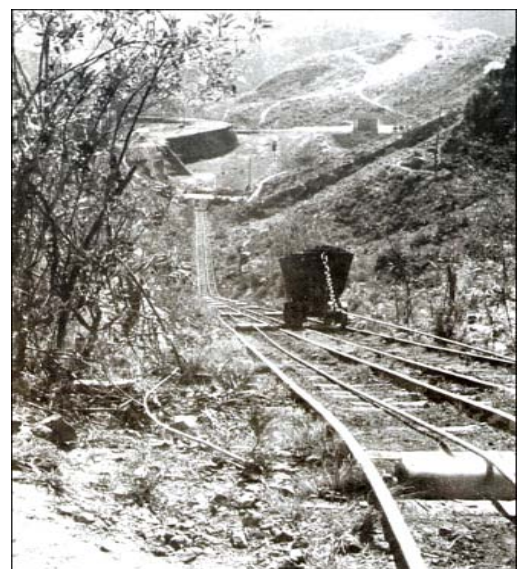


Empty and full trucks on a simple inclined plane.

On the incline, the cable was recessed and guided by wooden rollers to prevent it crossing the rails and being damaged by the wagons' wheels. Because this gravity balanced type of plane could be operated without external power it could be used in the Sierra where the necessary water for steam engines was in short supply. The disadvantage was that it required two rails throughout its length so a wide ramp was needed.

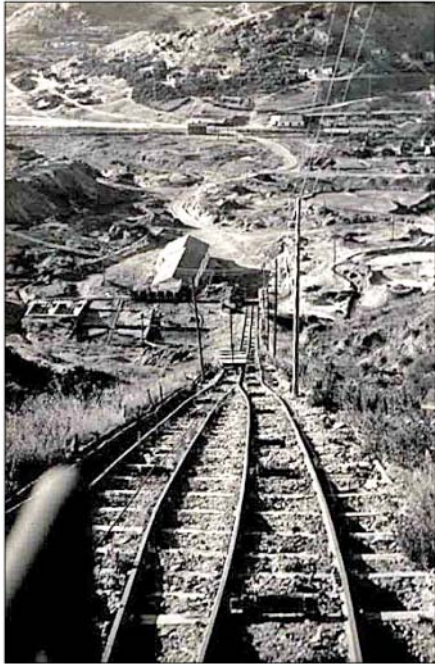
The rollers can clearly be seen in this 1950's photo of an inclined plane at Bédar.

Faro de Bédar. com



Raising loads required a motorised drum. Often, a ballast counter weight was added, running on an auxiliary rail that passed under the descending wagons to assist the lifting of the loaded wagons. The counterweight is known in Spanish as “un mono” meaning monkey, which is also how it’s referred to in English. The Welsh term for it is a “mochyn”, or pig.

I don't think that the more complex type of cable railways, those with gauntlet, or interlaced, tracks, were used in the Sierra. This type was used where there was a need to restrict the width of land needed. The track was shared by both the ascending and descending wagons for most of the length. At the centre of the run, a refuge, or lay-by track allowed the wagons to pass each other. Gauntlet track inclined planes are generally much longer than those found in the Sierra.



The passing point on a Gauntlet track.



The intriguing curved inclined plane.

When I first saw the cuttings in the above photograph I was mystified by them. It looked liked a double inclined plane. Were there such things as curved inclined planes? Had it been an ascending or descending system?

Then, when researching the Palmer monorail system on a Basque website, I came across the term “cadena flotante” or floating chain. I entered the term into the search box and there, among the pictures of floating necklace chains, was a line of wagons on a curved inclined plane attached to a raised chain rather than a cable. Such a system could have been used on a Palmer monorail.



An artist's impression of a “cadena flotante” or “floating chain” curved inclined plane.

I later realized that I had been barking up the wrong tree about both the Palmer monorail and the curved inclined plane. The straight run was the line of a normal inclined plane and the curve was a lower gradient path up to the top. As mentioned earlier, this plane had a useful working life. Built initially to carry ore up to the aero cable, it was later used to carry ore down to the tunnel leading to the massive inclined plane on the other side of the mountain.

Luis Siret's inclined planes in Las Rozas were what is known as the tank type. The fixed, angled platforms on which the wagons rode, can be seen in the picture. The incline isn't operating, so there are no wagons riding on them.

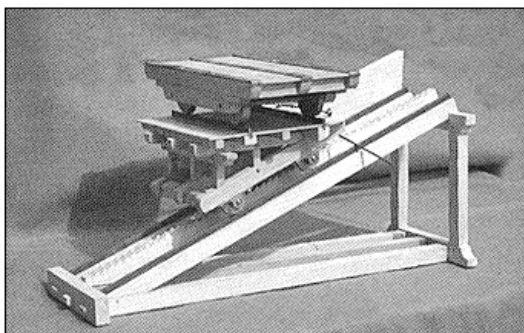
The inclined plane can be seen on the right of the picture.

Also note the curved and straight track that feeds the inclined plane.

The tiny black dots on the plane are trucs.



The Decauville name for these fixed platforms was “trucs” which from modern French translates as “thingys” or “whatsits”, i.e., those things that we temporarily forget the name of.



Model of a Decauville truc.

Since the load was being raised on the Las Rozas planes, there would have been a powered winding drum. I don't know what the motive power was initially, but would have been electrically powered after 1905. Given the steep gradient of the Argentífera's massive inclined plane down to Cala de las Conchas it would have been a tank incline. As the railway was a Decauville system, the plane was most likely a Decauville system too.

There are the remains of an inclined plane at República Romana. I had assumed that it only carried ore down from Luna II which is situated just above it. Antonio Jódar informed me that it also carried ore from El Boletín where it had been calcined in an oven built into the mountain. This information explained the mystery of the remains of some rail track that can be seen there.



Above left, remains of the inclined plane at República Romana.

Above right, the mine Luna II.

Left, the entrance to the calcination oven at El Boletín.

Above, the last remnants of the rail track.

Another of the Argentífera's holdings, the mine Centinela in the Barranco Chico de la Torre, has an oven of a very similar design to that at El Boletín. Calcined ore from Centinela was also taken to República Romana by rail. In this case, a cutting for the track was made from the mine into the neighbouring Barranco de la Torre de Tierra, and from here the line would have followed the contours of the hillside. There is no trace of it today, so I'm not sure whether it ran to the inclined plane or took a lower route and ended at the circular structure at the base of the plane. Ore was passed into a tunnel leading from the circular structure, where it was raised to the loading platform of an aero cable.



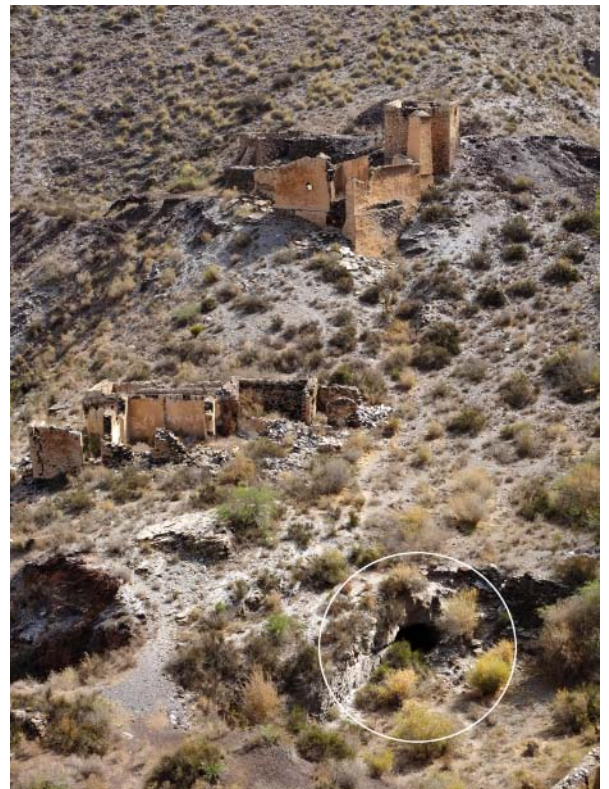
Above, the oven at Centinela. The entrance is above the wall and the top of the oven can just be seen (highlighted) at the top right of the photo.



Right, the cutting between the Barrancos Chico de la Torre and de la Torre de Tierra.



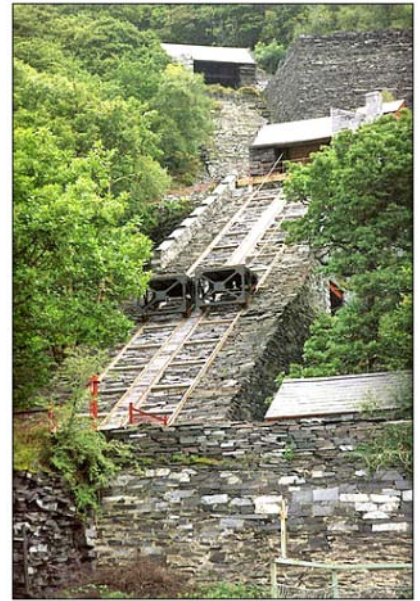
Above, the tunnel entrance in the circular structure.



Right, the ore passed via the tunnel (highlighted) to the loading station.

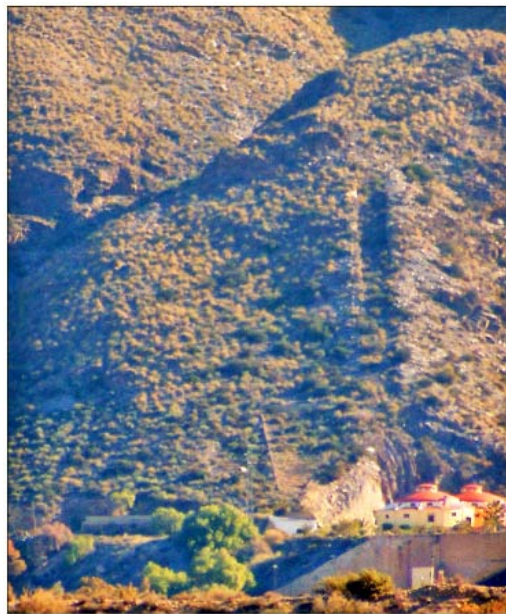
This poses the question, if the ore was calcined and taken by aero-cable to the coast, then why is there a blast furnace at República Romana? Presumably, one system predates the other, but which way round?

There is a short, steep plane at El Arteal, most likely a tank incline, possibly built before the civil war, but I don't know what it was used for. I think that there may have been a lavadero at the base of it as this area is frequently wet.



The steep inclined plane in El Arteal would probably have looked like this restored one in the Dinorwic Quarry

What looks like an inclined plane above the bath houses in the picture below, is actually a cutting to give clearance for the buckets on the aero cable running down from Manchego.



4.2. Aero cables.

While the Jaroso to Cala de las Conchas line was the first aero cable in the Sierra, others followed as technology finally came to the Sierra. One was installed in 1903, at the República Romana mine in the Barranco del Torre. Known as the Violeta cable, it served to carry the iron ore from the adjacent mines to a loading station in the Cala de las Picotas, a distance of more than 2 kilometres. It was constructed by the engineer, Karl Bahlsen and was an Otto system, an early type of tri-cable, powered by a steam engine. The cutting which allowed the passage of the buckets through the top of the Sierra can be seen from the Cuevas-Los Lobos road.



The remains of the Violeta loading station at República Romana.

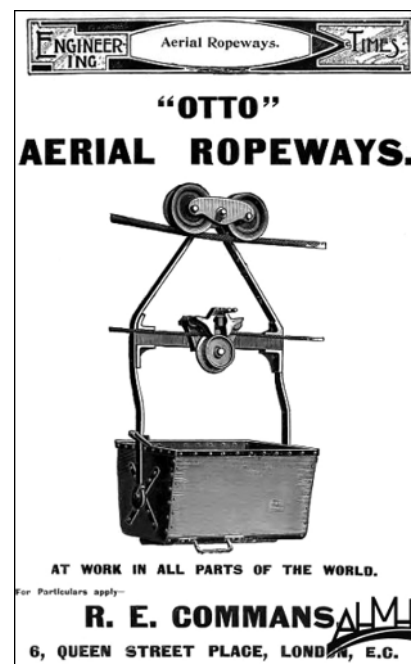


The cutting made for the buckets to clear the summit



Above, remains of the Violeta terminal at Cala de las Picotas.

Right, the Otto bucket.



Less than 200 metres from the terminal station of La Violeta is the terminal station for another aero cable. This one didn't originate in the Sierra Almagrera but passed over it, a mere 170 metres from the Violeta cutting. This one ran from the mine Los Tres Pacos in the Sierra Almagro, near Cuevas, and was 13.5 kilometres long. It wasn't a Man from Bilbao but a Woman from Bilbao, the widow of one Pedro Gandarias, who headed the company responsible for it. Constructed in 1912, it was a Bleichert-Otto tri-cable system, with a motor powered by steam generated electricity. It was in operation until the Civil War. When it was dismantled, the cables were cut into small sections and sold as souvenirs.

*The line of the Los Tres Pacos
aero cable.*



*A tri-cable system similar to the
type used on Los Tres Pacos line.*
Adurcal.com

*The building in the foreground is the
loading station at Los Tres Pacos.*





The cutting on the right was made for the Los Tres Pacos cable, the one on the left was for the railway line from Centinela.

The Violeta terminal is on the right and the Los Tres Pacos terminal is on the left.

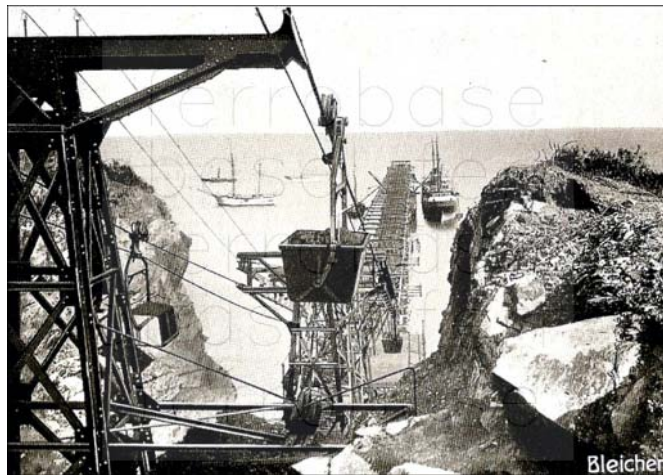


Cala de las Picotas seen from the top of the Sierra. A cutting for the Violeta cable can be seen on the left. The los Tres Pacos terminal can be seen on the right.



The remains of the terminal at Cala de las Picotas.

I think that this building, pictured above, housed the tensioning mechanism. I haven't found any details of the loading jetty. As it was a Bleichert-Otto tri-cable system it is possible that the cable extended out over the jetty and that the buckets emptied directly into the ships' holds as illustrated by the picture below.



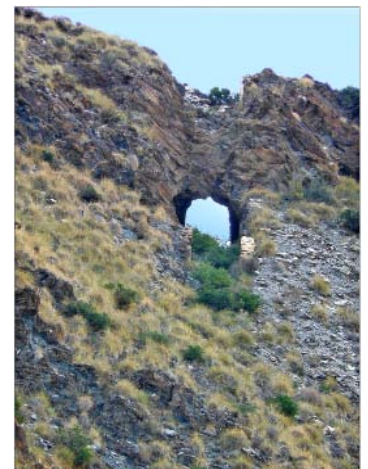
Loading the ships.

Bleichert Lib.

Two other aero cables intrigue me, obviously constructed at a later date and of a completely different design to the earlier cables. One was from the mine El Boletín and the other from the mine Manchego both owned, in 1903, by the Argentífera. The supports resemble those of pit head winding gear, that is, a pair of brick built, triangular structures. The one from Manchego passed over the Barranco de las Palomas to above the big hole in the rock above El Arteal, and from there down to El Arteal.



The cable supports on both sides of the hole in the mountain above El Arteal.



Obviously, the buckets must have been carried between the supports but I have failed to find out just how they worked. I do know that this one was operational, because there are the remains of a metal bucket which had “jumped” the line somewhere between Manchego and the aljibe, or water cistern, in the barranco.

The recently unearthed remains of a bucket that “jumped” the cable.



The cable from El Boletín was a real mystery because ore from there previously went to República Romana and the Violeta cable. This cable from El Boletín, crossed the Barranco Chico del Torre to the mine Garibaldi, and from there down what is known as “Television Hill”, the track parallel to the pine forest. I could not find out where it went to from the bottom of “Television Hill”, whether it went through the gap in the small hills and down to La Muleria, or, veered south down to El Arteal.



The loading station built at el Boletín.

The Eureka moment was when the web site 'MTI minas andalucia' posted pictures of the mine Garibaldi. One of the photos showed the supports and the caption was to the effect that the aero cable had never been operational. Hence its abrupt end.

My theory is that both lines date from the 1930's when Luis Siret negotiated, on behalf of the Consorcio de Almagrera, the licence to carry ore from the Sierra on the El Arteal - Las Rozas - Villaricos railway. Whether the Argentífera still owned those mines or had sold them to the Consorcio I don't know but, if anyone knows the answer, please let me know.



Left, the aero-cable supports on “Television Hill”



Right, the sight-line from Garibaldi to the top of “Television Hill” looking towards Las Herrerías.



Line of the cable from El Boletín.



Line of the cable from Manchego.

The picture below that mtiblog posted in 2017 fascinated me. It shows an aero cable passing over Garrucha beach in the 1960's.



I knew there had been an aero cable there in the early part of the century. It was part of an elaborate, integrated system of linked cables for the transport of iron ore from the Sierra de Bédar to the coast. It was also far more sophisticated than the one in the above picture, being an Otto tri-cable system.

The tensioning station of the old Garrucha aero cable. El Obrero Consciente.

M. I Ruiz Garcia.

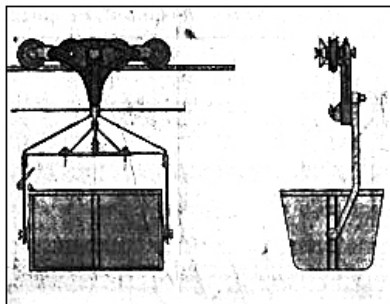


Further research revealed that the one in the 1960's picture belonged to a company called Hierros de Garrucha S.A. and was built in 1953. Like the renaissance of El Arteal, this was another post Civil War reactivation of workings paralysed in the 1930's. Ore was brought into Garrucha by lorry and off-loaded into big hoppers. The cable ran for 700m from the hoppers to the quay of the harbour. It closed in 1970.

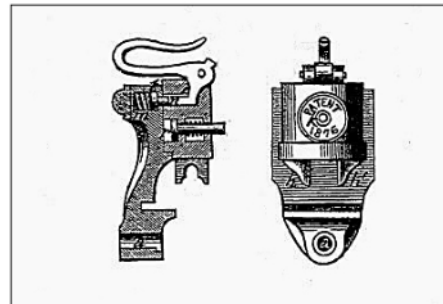
You have to hand it to the people on the beach, sunning themselves under a somewhat primitive mono cable. Rather than me!

4.3. Aero cables. The technology.

The Bleichert-Otto tri-cable system, like the one at Bédar and Los Tres Pacos, used two fixed steel ropes, one for the ascent and the other for the descent. These carried the buckets, while the third was a continuous tractor cable providing the movement. The buckets were fitted with grooved wheels that sat on the fixed cable, and were attached to the tractor cable using special couplings.



Note the grooved wheels on the bucket arms.
adurcal.com



Bleichert couplings used to attach the buckets.
Km130 tranvia aéreo

This system allowed the buckets to pass over the stanchions.

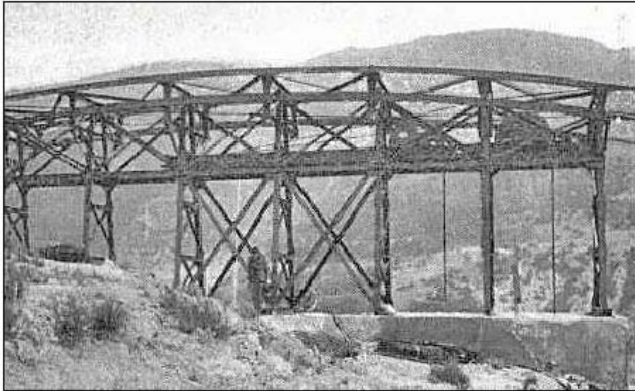
The fixing mechanism between the bucket and the fixed cable was the target of young thieves who used them as roller skates.

The newspaper article, from March 1933, reports the theft of the cable fixing mechanisms by children from Dúrcal who used them as roller-skates! The Guardia recovered 63 sets. Forty-four children, 15 of whom were under 7 years old, appeared before the courts. Which poor child had only one skate?

do.
—El encargado de la estación del cable de Dúrcal denunció a aquella Guardia civil que muchos niños de varios pueblos tenían patines hechos con ejinetes sustraídos del mencionado cable.
En virtud de la expresada denuncia, la Guardia civil ha practicado gestiones para la recogida de dichos ejinetes, y ha rescatado en Dúrcal 63 que tenían 29 niños, y 48 en Talá a 15 infantes.
Los niños extraían los cojinetes de las vagonetas que hacen el recorrido del cable.
Han sido denunciados todos estos 44 niños a los correspondientes Juzgados.

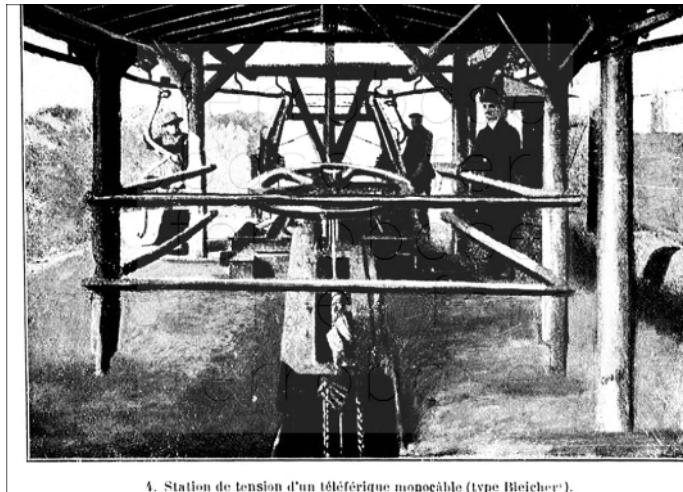
The fixed cables were anchored at one end and kept tight by a tensioning device at the other.

The overhead cables were kept taut by suspending blocks of concrete which were in pits below ground level. The picture shows the cables from which the blocks were hung.



Aero cable tensioning station.
adurcal.com

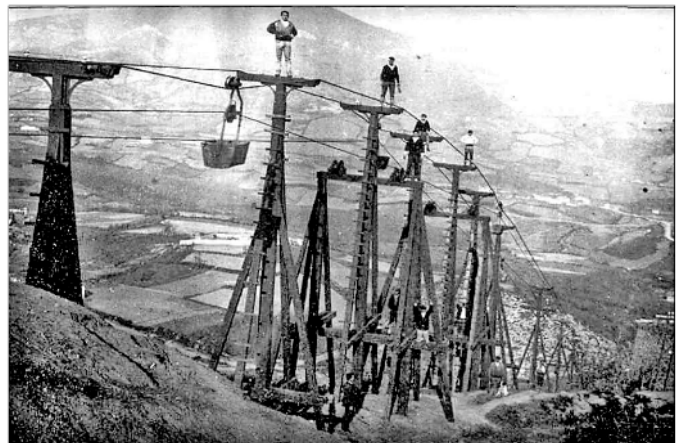
The same system was used on mono cables to maintain the tension of the single cable.



4. Station de tension d'un téléphérique monocâble (type Bleicher).

Mono cable tension station. *Bleicher Lib.*

Maintenance was relatively simple, the carrier wheels on the stanchions required greasing weekly with a mixture of oil and grease. Men climbed up to do this wearing spiked shoes, but no safety harness. Climbing a 27m high, wooden pylon situated half way up a windswept mountain isn't my idea of fun. They were, however, in relative terms quite well paid. (If short lived.) Apparently, it was possible to detect potential problems with the system by ear. Daily inspections were carried out with the men listening to the buckets passing over the supports.



An aero cable maintenance team.

One question that I asked myself was “How did they get the miles of cable into position on the mountain?”. Well, now I know. Strings of mules were laden with 115kg of coiled wire, with a 5m to 7m slack section between each animal. The slack section was held by a man, in order to prevent it from trailing on the ground. As simple as that! However, it must be said that this system was not without dangers. Since the mules were linked together by the cable, if one fell over a precipice the others followed. The constructor of a 2 mile long aero-cable in Mexico recorded the details of one such accident:

"During the conveyance of the section of rope to the upper terminal an accident occurred which was productive of very considerable delay, and demonstrated the difficulties attendant upon the operation. The head mule, at a point where a rise immediately followed a steep descent, started to take the rise with a rush until checked by the rope, which threw him backwards over the bank, he taking two other mules with him, and had not the last of these caught on a tree, the rest of the train would have followed."

Extract from an article in Lowtechmagazine.com.

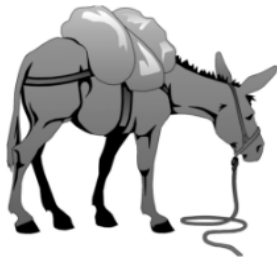


Packing Traction Rope over a Mountain Trail.

The mule train in action.

Lowtechmagazine.com.

The donkey was used for its own demise!



Acknowledgements.

I am indebted to Antonio Jódar for answering my questions and for the gentle way that he corrects my errors. Rob Vernon is equally patient and his background in mining engineering makes me feel inadequate, but I hope that you, the reader, understand what I have written.

Bibliography.

My copy of “Sierra Almagrera y Herrerías. Un siglo de historia minera” by Enrique Fernández Bolea is now falling apart. His “Memoria Visual del Siglo XX. (1901-2000) La tarjeta postal ilustrada en Cuevas del Almanzora” isn't fairing much better. The book, Tiempos de Plata y Plomo, also by E F Bolea, in conjunction with J G Rodríguez and P P Laríos is still in relatively good condition. (All three books are available from the book shop in Cuevas.)

The e-book, Aerial or Wire Ropeways by A.J. Wallis-Taylor provided a good deal of information about aero cables.

Information about the Las Rozas to Palomares line was found at asafal.es and vidamaritima.com.

Acedemia.edu/292618 Intervención arqueológica preventiva en Calle Playazo describes the excavation of the Tío Borracho site before the building of the “edifice” that has been erected on it and gives the information about the railway and loading pier in Villaricos.

The information about the Decauville rail system was found in ruedeslumieres.morkitu.org Transport Pierre IV.

Information about the Palmer rail system was found in Thomas Tredgold's book, ‘A Practical Treatise on Railroads and Carriages’. The workings of the floating cable on a curved incline plane were provided in the Basque Centro de Interpretación Peñas Negras.

The Basques really do celebrate their mining history and the following websites have provided me with a wealth of technical information about aero cables and incline planes.

ingurumena.ejgv.eus

morkitu.org

meatzaldea.eus

Oficiostadicionales.net

ezagutubarakaldo.net

adurcal.com

Closer to home, farodebedar.com is a fantastic source of information.

Also,

km-130blogspot.co.uk

and

almadeherrero.blogspot.co.uk

despite their .co.uk address both are in Spanish but worth the effort.

Lowtechmagazine.com /aerial ropeways, explained to me how the cable for an aero-cable was transported.

In addition,

Mtiblog.com

mining-andaluz

almediam.org

and

agjodar.blogspot.co.uk

are standard reference sites for any one interested in the area.

And, where would we be without Wikipedia?