Chapter 3. Technology in the Sierra.

3.1. The men from Bilbao I.
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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 Compañia 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.

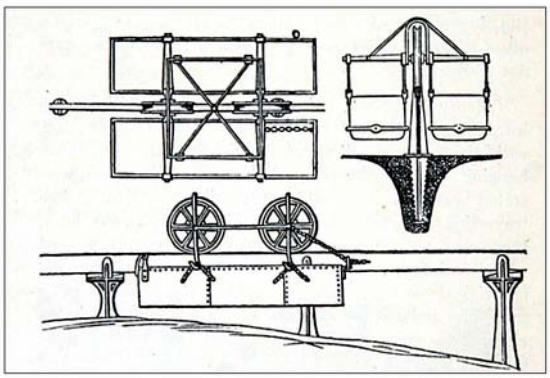
Transporting minerals to the sea had already been proposed in the 1850's when there were plans to use the drainage tunnel, the socavón Riqueza Positiva, which ran from the desagüe in the Jaroso to the Cala del Peñón Cortado. (*See Vol.1, Ch. 4.1, The Desagüe del Jaroso*) Although the socavón was constructed 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 Vincente Ferrer, Hermosa, Rescatada and Virgen del Carmen.

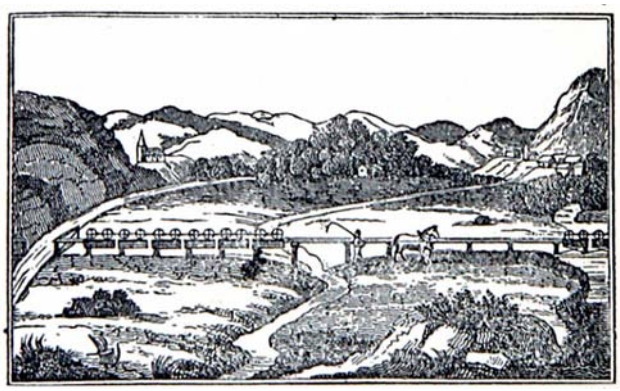
The railway linked these Uriate holdings at the head of the Jaroso Valley.

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

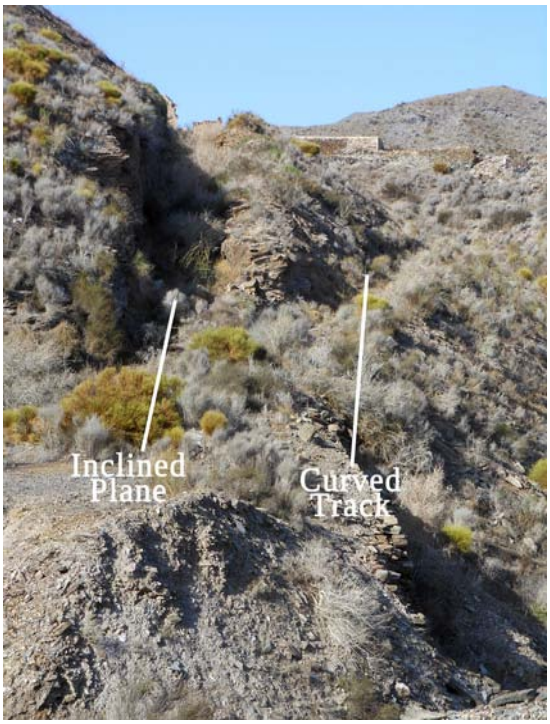


Palmer track was suited to rough terrain.

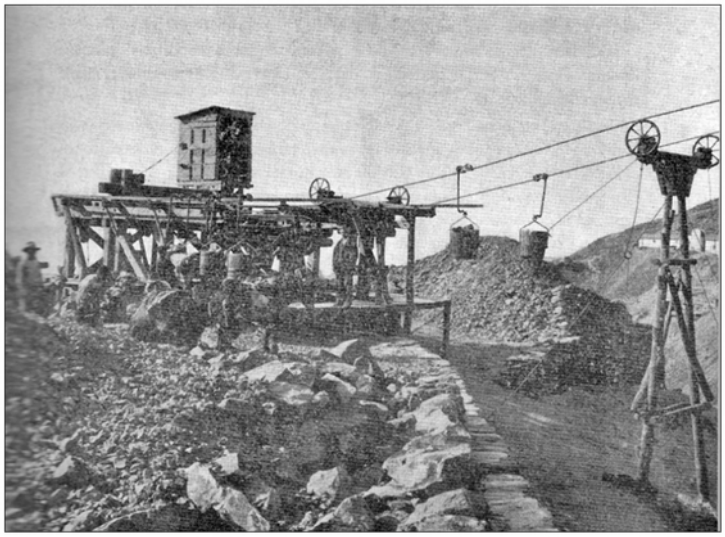
The inclined plane, from San Cayetano to the loading station was built on wooden piers of variable heights. In 1899, the local mining magazine described the inclined plane as having two rails “que se dispondrán, a manera de vía aérea” that is, arranged like those of an aero cable. This seemed to indicate 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.

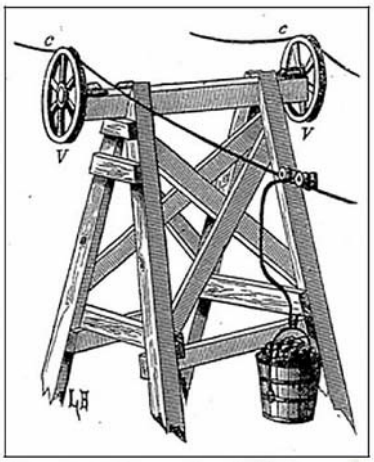
Un siglo de Historia Minera. Bolea.

The “tranvía aéreo” or aero cable was a mono-cable one, known as “el systeme 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.

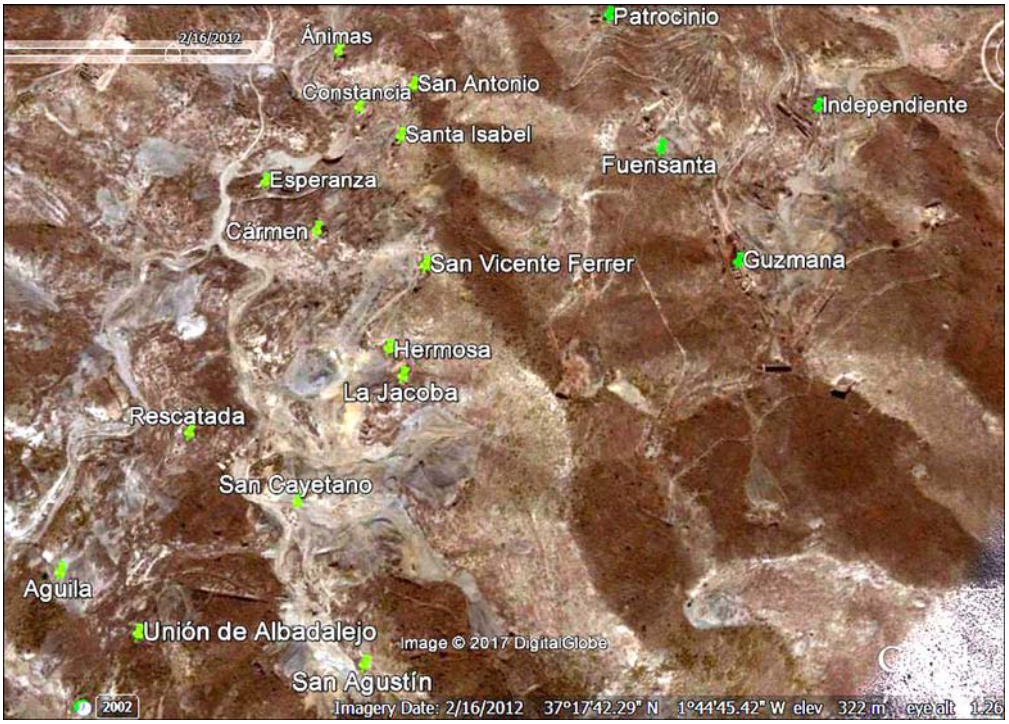
Aero cable similar to that at Cala de las Conchas.

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 Guzmana, 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 Jarosso. 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.

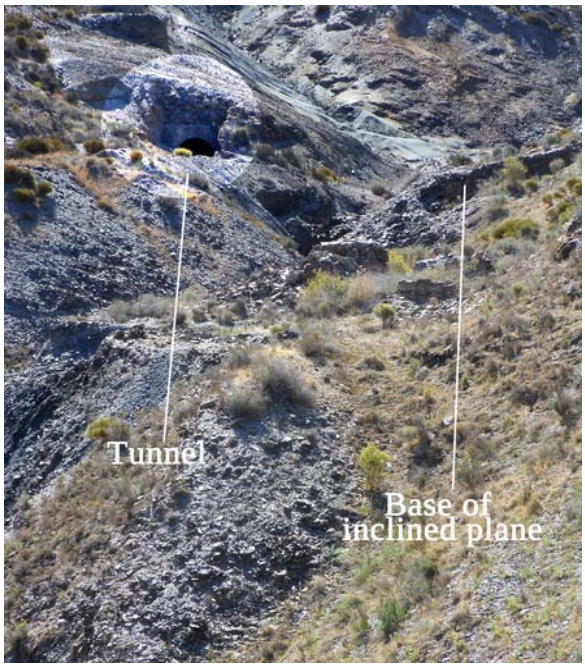
The aero cable was now proving inadequate for the volume of material that needed transporting so a new system was developed. This involved building a massive inclined plane on the seaward side of the mountain and linking it, by means of a tunnel, to the existing railway.

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.

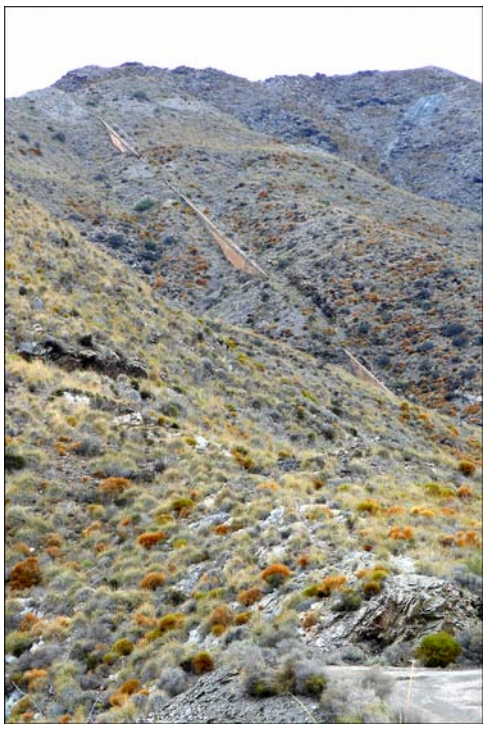
The tunnel exit on the seaward side of the Sierra.
mti blog.

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.

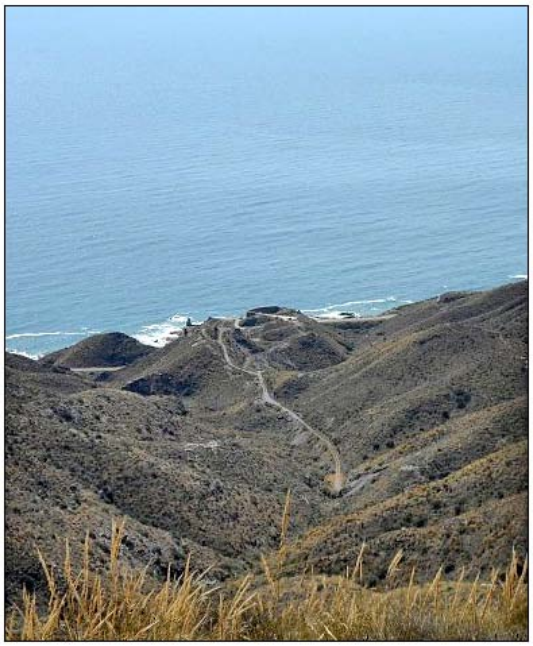


Remains of the inclined plane on the seaward side.

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.

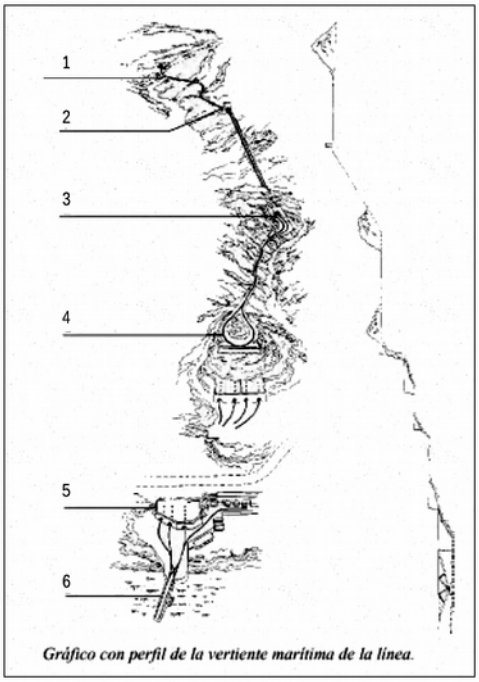


The inclined plane seen from the top of the Sierra. The lower railway line can be seen running from the plane and looping round the top of the hopper.

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.

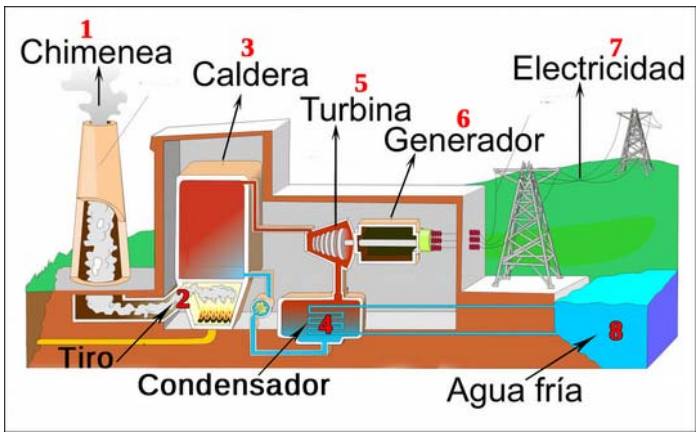
Detail of the moulding inside the chapel.

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 Argentífera 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 49.
This is part of what remains of it today.

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

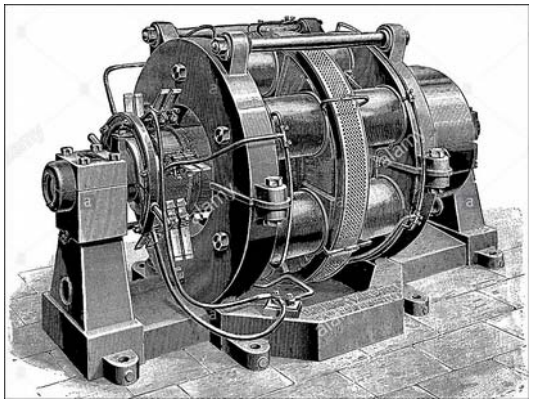
7 The transmission lines. Traces of the power line outlets can be seen on the walls.

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

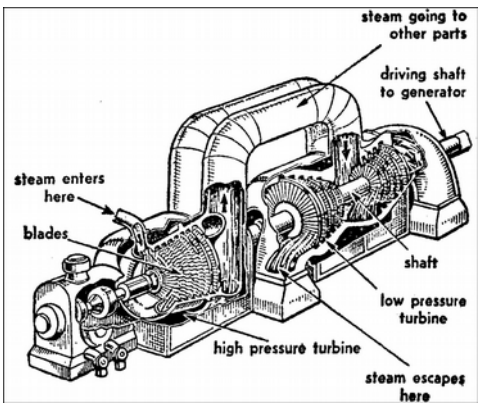
The water inlet pipe on the beach seen from the roadway in front of the plant.

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.



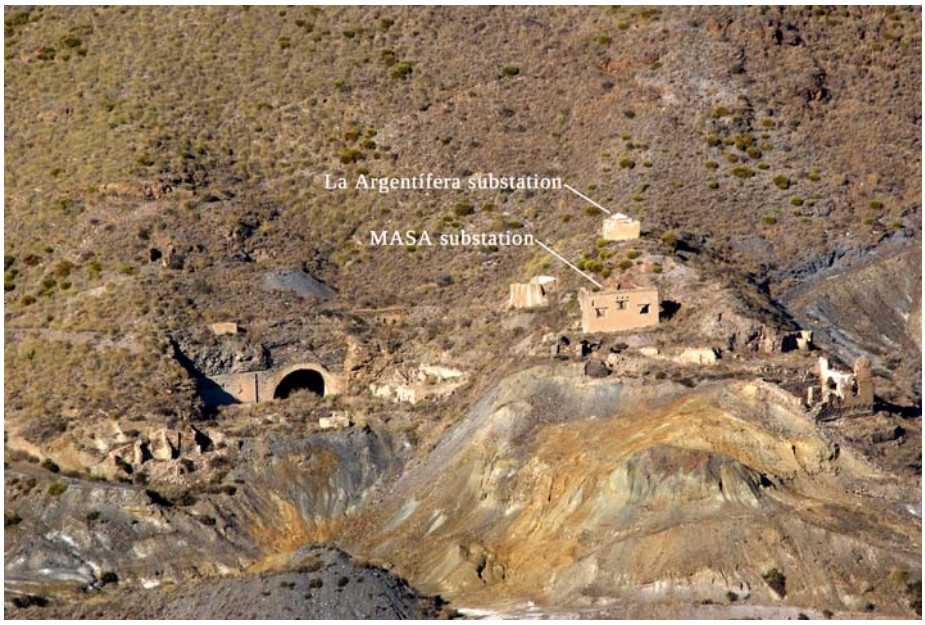
Early form of Siemens and Schuckert generator.



Steam Turbine diagram. *Alamystock.*

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, Guzmana's transformer.

Right, Republica's transformer.