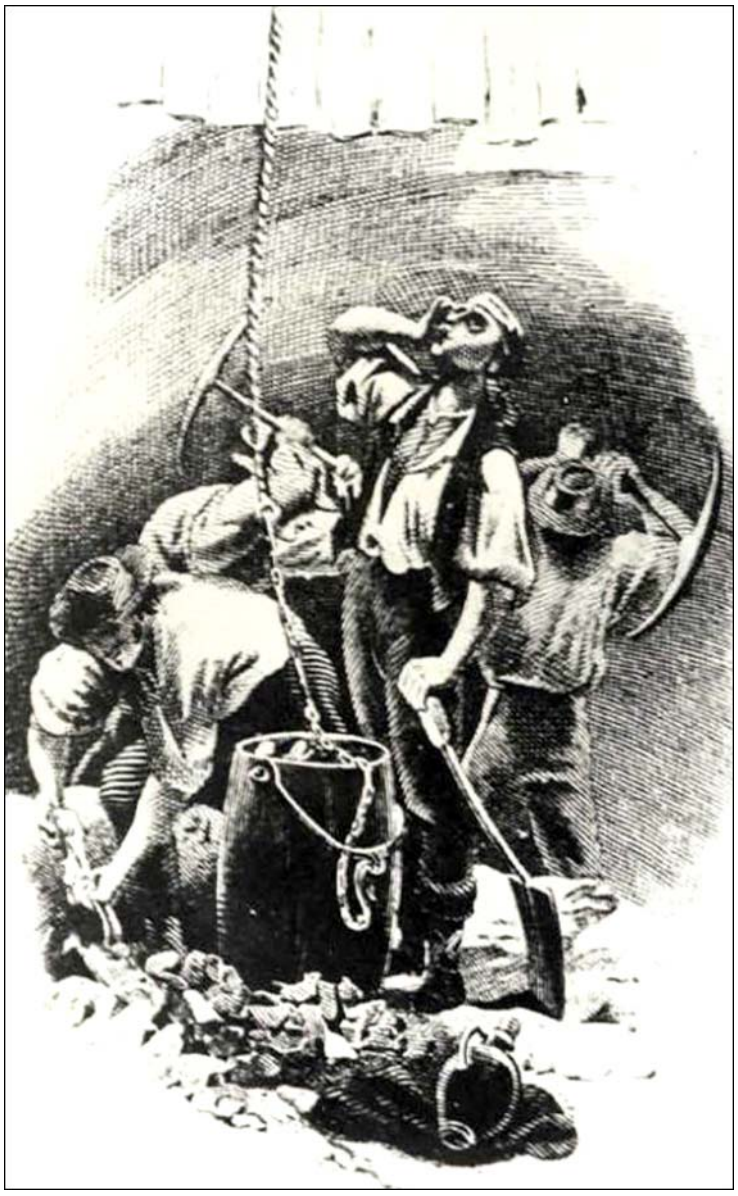
Chapter 4. The Dead Workers' Work.



In a mine, unlike extraction, excavation or development work that is not productive is known as dead work. This covers shaft sinking and level driving, and it was customary throughout Europe to contract out excavation work and, although the terms of the contracts varied little from country to country, the rewards for the men actually doing the work varied considerably. The Cornish model was of small co-operatives of "tut" workers who shared the rewards equably, as was the North Pennine "bargain" system. However, the Spanish model seems to be along the lines of a contractor acting as a gang master. In "Untrodden Spain and her Black Country", Hugh James Rose writes about the contractor keeping the lion's share of the money and paying the workers piteous amounts.

Joaquín Ezquerra del Bayo in "Datos y Observaciones Sobre la Industria Minera" doesn't mention how the payment in the Sierra Almagrera was distributed but does go into great detail about the costs to the mine owner of dead work.

There were two main types of contract. One was where the mine owner bore the cost of bringing the broken country rock (deads) and any ore to the surface and the other, more usual type, where the contractor undertook to clear the site of any broken rock. Payment to the contractor was per vara (about 0.80 metres) linear in both shafts and levels. The mine Observación had a slight variation to the usual payments. The 100 to 150 vara section was paid at 30 reales rather than the usual 50 reales, but the owner provided the gunpowder and oil for the lamps and sharpened the contractor's tools. In addition, the contractor only lifted the deads up as far as the next level and the owner then bore the cost of raising them to the surface. At depths greater than 150 varas, the owner provided the labourers with their food as well, but the payment per vara was only 59 reales as opposed to 64 reales.

The remains of this winch (pictured below), recently found in a long abandoned shaft was a staging winch used to lift material up a level.

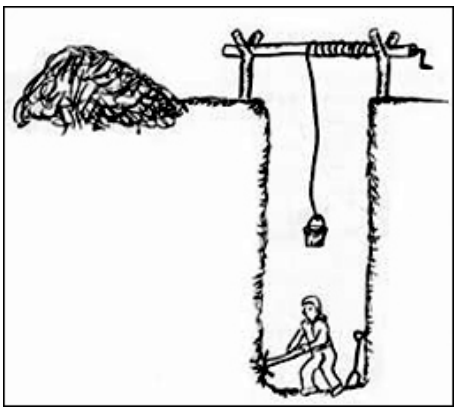
The remains of a torno de albardilla

Fran Mulero.

A stage winch in use.

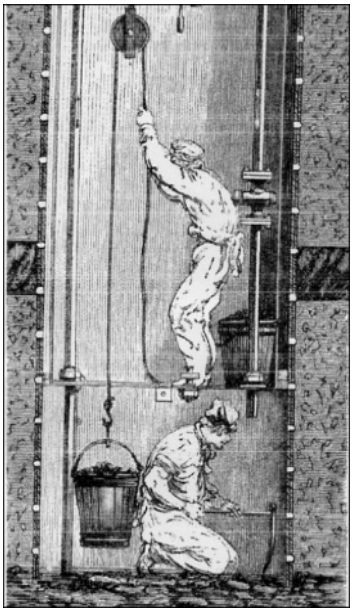
In shafts, the payment increased every 50 varas (just over 40 metres) of depth, with a higher payment for a narrower shaft. At first glance it seems nonsensical that the payment per cubic vara differed from shaft to shaft, with the excavation of a narrow shaft costing more than that of a wide shaft. However, this cost

difference is still apparent in modern mining and is due to the problems of shaft driving in a confined space.



Digging the shaft …

Lupton.



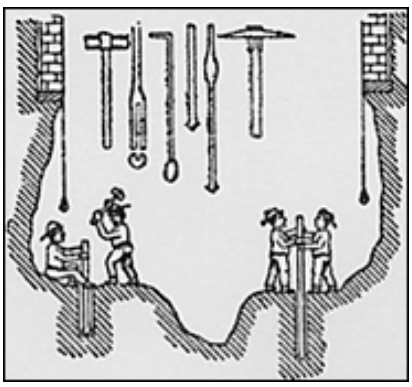
Working in a confined space.

Simonin.

To drive a shaft, shot holes, known as sumpers, were bored in either a circular or a square pattern, depending on the stability and density of the rock, at the centre of shaft's desired position. The holes were bored downward at an angle so that a wedge of rock could be blasted out to form a sump. Once this blasted rock had been broken sufficiently to load it into the baskets or tubs, it was winched to the surface. Then, another set of shot holes could be bored, again downward, and fired. As broken rock occupies 40% more space than unbroken rock, the sump was needed to accommodate the debris. Once that waste had been broken and removed, the next set of holes could either be bored downward, or, bored horizontally towards the proposed walls of the shaft. The men were able to stand and work in the already excavated space. In a shaft measuring a mere 1.25 x1.25 metres there was hardly room to swing a cat never mind a pick. These narrow shafts had to be drilled by single handed jacking, where the worker wielded a 1.80kg hammer and held his own drill rod or jack. This was inefficient, costly and painfully slow, with a single 20 centimetre hole, into which explosives were packed, taking an hour to be drilled.

Single handed jacking.

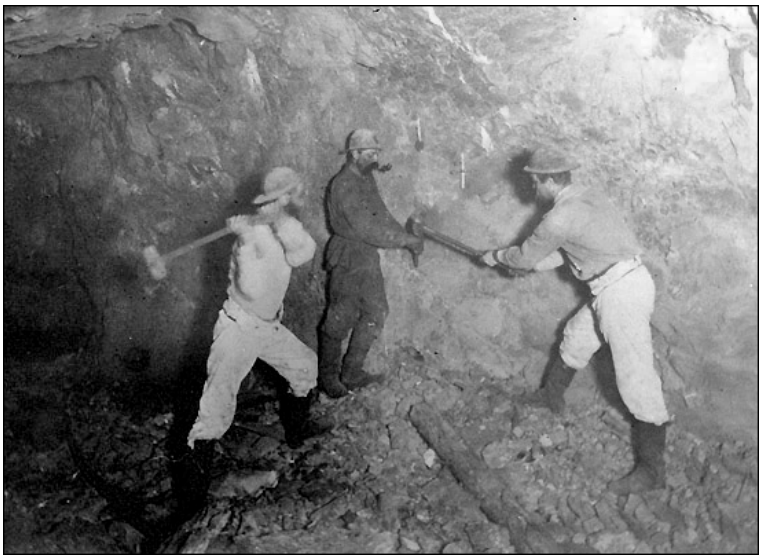
The wider the shaft, the more cubic metres of excavation can be effected in less time and therefore at a lesser cost to the mine owner. With more space available, two teams of drillers using a double-jack technique could, just about, work simultaneously. In double-jacking, one man would swing a 4kg hammer while his partner held the drill and rotated it in the hole. This was more efficient than single jacking as a 60 centimetre hole could be bored in an hour. It took 30 to 60 holes to be able to blast away sufficient rock to advance a shaft half a metre.



Sketch showing 2 teams sinking a shaft. The sump has been cleared and is ready for the debris of the next round of blasting.

Lupton

In wider shafts, a third man could be added, also with a 4kg hammer, in order to increase the drilling speed. While this looked impressive, with the drill being hit rhythmically by the two men, the addition of a third man didn't increase the speed sufficiently to generally warrant the practice.



Two handed jacking like this looked and sounded impressive, but the resulting saving in time and money were insufficient to make it a common practice.

Boring and blasting weren't the only things which took a long time. Breaking the rock into pieces small enough to be loaded into the tubs or baskets ready for hauling up to the surface was time consuming. So too was the actual raising of the debris which was hand-winched in shafts up to 50 metres deep.

In shaft sinking, raising the debris posed a threat to the sinkers as there was nowhere to shelter from the possibility of falling chunks of rock. Even though a torno de albardilla or saddle winch was used in the Sierra Almagrera, which centred the containers in the shaft, the risk of them colliding as they passed one another was quite high. Also, if the supports of the winch weren't high enough there was the risk of the tubs hitting the collar of the shaft as they were brought over to be emptied and of rock falling down the shaft onto the men below. The Northern expression for raising material to the surface was 'to bank' and the Cornish was 'to grass'.

The term used in the Sierra Almagrera was, unsurprisingly, 'al sol', to the sun.

'Mucking off' or clearing the debris.

Emptying the tubs at the pit bank posed a threat to the shaft drivers.

Buck O'Donnell.

The greater load capacity of the horse whim buckets speeded up the process of mucking off in a wider shaft where there was the man-power to fill the containers. The dangers to the men in the shaft of raising the debris were less but were still ever present. 200 metres was about the maximum depth that could be mucked off using a horse whim. Anything below this depth required powered winding gear.

Shafts required ventilation below a certain depth. If there was no other shaft twinned, the shaft being driven needed a brattice or boarded channel up the side of it to create an upcast and a downcast of air. In the Sierra Almagrera, where wood was in short supply, brattices were fashioned out of brushwood and plaster in the manner of wattle and daub.

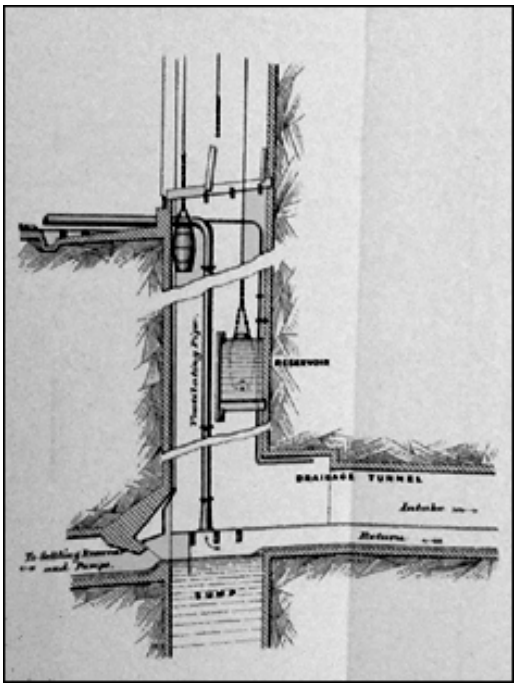
The ventilation channel, which would have been boarded, can be seen to right the of the shaft. The rings round the shaft give some indication of how much progress was made by each round of blasting.

Photo. A.G.Jódar.

In the 1840's, at the start of the Almagrera mining boom, only 3 to 4 metres of shaft per month could be driven. By the 1900's this had risen threefold to between10 and 12 metres a month. The figure had reached 30 to 40 metres by 1940. The reasons for the dramatic improvements were, firstly, the transition from manual to horse, and then, from steam to electrical powered lifting. Secondly, improvements in the type of explosives used from gunpowder to dynamite, and thirdly, at a later date, the introduction of the pneumatic drill. However the basic principle of drilling and excavating a central core and then working out towards the sides, remained the same.

When the El Arteal pumping station was constructed in 1898, the five associated shafts were excavated by experienced local workers. The site engineer, Gustave Reinhold, gave a detailed account of the work in a paper presented to the Institution of Civil Engineers. The men involved in the shaft excavation worked three 8 hour shifts, while those working at the surface worked two 12 hour shifts. By this time the sunrise to sunset shift pattern was being challenged in the Sierra Almagrera.

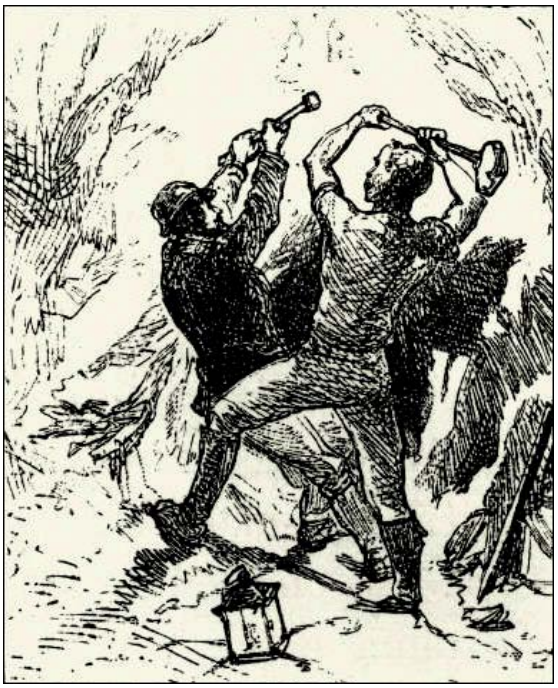
The five, circular and elliptical shafts were excavated in the traditional manner, using a borer, or bar drill, and hammer to make the bore-holes for the explosive charge. Health and Safety was considered on this site. When the kibbles containing the broken rock were raised, a trap-door was lowered over the shaft before the kibbles were emptied, protecting the men beneath. The use of traditional methods, rather than mechanical methods, to excavate the shafts at the pumping station was due to the nature of the terrain being bored and the dimensions of the shafts.



The water and ore kibbles in the main shaft, Encarnación.

Contractors were also used to drive the main levels, or galleries, to access the ore veins. The same drilling procedure was used for this. First a central core was blasted and then the rock above, with the debris falling into the space formed by the first round of blasts. Finally the lower section was drilled downwards and blasted. This lifted the broken rock up to from the floor level from where it could be cleared.

Payment for driving levels was also by the cubic vara and depended on the depth at which the level connected with the extraction shaft, and was higher than that for shaft sinking being as much as 150 reales per cubic vara. The elevated cost was mainly due to the need for an additional labourer to convey the deads along the tunnel to the main shaft. Again, there was a difference in the costs between low roofed and higher roofed workings, however, in the Sierra Almagrera, it was the reverse of what one would expect, with the more spacious area costing more. Bayo has an interesting explanation for this anomaly, according to him, it was because the local workforce, influenced by the practices of the miners from the Alpujarros, preferred to work seated rather than kneeling or standing. With wood to make work platforms in short supply, they were in the habit of filling baskets with broken rock and sitting on them to work, rather than kneeling on one knee or standing when driving higher roofed levels. Bayo considered this practice abhorrent and against the “art” of mining.

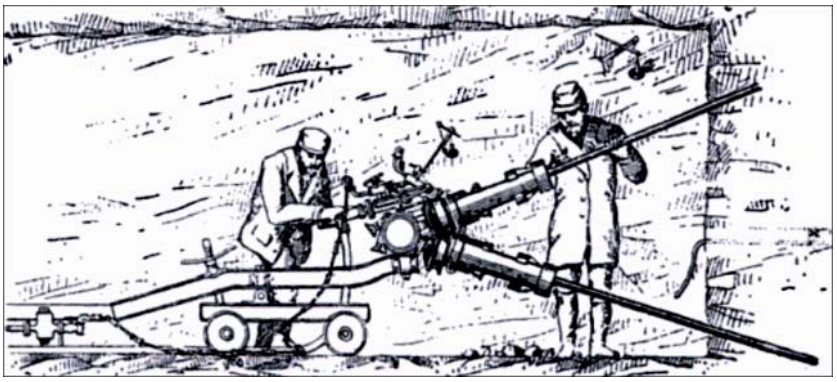


Driving a tunnel.

The local workers preferred to sit rather than kneel like this when working.

Buck O'Donnell.

When the galleries into the slate of the mountain were driven at the el Arteal pumping station Brandt hydraulic rock drills were used which was the first time that such type of machinery had been employed in the Almagrera. Unlike pneumatic drills, Brandt's drill was powered by water under pressure from a force pump at the surface. Steel sectioned pipes could be uncoupled when the drills were drawn back into refuges during blasting. The sequence and position of the bore holes still followed the usual pattern. Reinhold speaks of the men learning quickly how to handle the drills, spurred on by generous bonuses. Hydraulic drills were an option at el Arteal because water was piped in from the Almanzora river.



Brandt hydraulic drill.

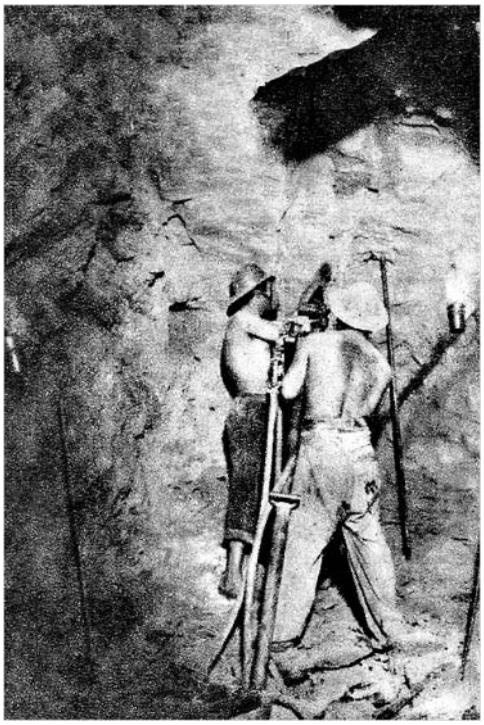
At what point pneumatic drills drills made an appearance in the area I don't know. It is probable that the Basque companies employed them from the turn of the century, given their willingness to embrace new technologies, but I haven't found any documentary evidence of it. However, it is unlikely that workers here never encountered the notorious widow maker or single line drills. These, in contrast to Brandt's hydraulic drill, created massive amounts of injurious dust, which coupled with the increased use of dynamite, caused the frequent disabling and death of thousands of miners due to pneumosilicosis, in as little as 8 years. Portable compressors mounted on small trailers, pulled up my mule would probably have supplied the air for the pneumatic drills. The website, farodebedar.com in the article Minería de Bédar: los compresores de Hierros de Garrucha speculates in detail about the type of machinery used during this undocumented period.

Single line pneumatic drill, known as a widow maker.

Shropshiremines.org.uk

When the Santa Bárbara tunnel was driven along the spine of the Sierra Almagrera, unusually for 1940's Spain, double line jack drills, possibly of the make ASTRA, were used and dust masks were provided. The use of an air and a water line helping to limit the dust present in the atmosphere. No such considerations were afforded to the prisoners of war forced to excavate Franco's mausoleum, many of whom were dead even before it was completed.

While this photograph, published by MASA, shows best practice, it was possibly a bit of a publicity exercise. Some local elderly residents, whose fathers worked at el Arteal, saw them suffer and die of silicosis. Given the short time that operations here lasted, this raises questions about the safety of their working conditions. To my untutored eye, the clothing of the miners pictured looks remarkably dry considering that they were, in theory, operating a twin line drill.



Using a twin line jack hammer in the Santa Bárbara tunnel.

An advertisement for an Astra drill.