

Ancient Mining Techniques

By Chris Mundigler

Ancient mining techniques go well back into our history – well back into our prehistory, in fact. As we progressed through the Stone Age, with more and more sophisticated tools and weapons being designed and developed, so too, our need for more and better raw materials for these implements. Stone and flint led to copper, then bronze, gold, silver, iron... all in the name of progress, war, technology, vanity or greed. In fact, it's ironic (pun intended) that the substance prized and even mined by our ancient ancestors for some of the earliest stone tools and weapons – flint – was later a hindrance encountered by Classical miners – who were in many cases also Classical minors – in gold mining galleries described by Pliny the Elder in the 1st century AD as “thought to be the hardest thing that exists, except greed for gold, which is the most stubborn of all things.” (Natural History, 33.21.74).

Pliny also describes some of the perils of ancient mining techniques as whole masses of flint (or by some translations, quartzite) are “burst asunder by fire and vinegar” which produce suffocating heat and smoke and the veins of flint (quartzite?) themselves were often prone to collapse on the miners. So unstable was the surrounding flint, and so precious was the gold being sought, that “the mere hope of obtaining their coveted object was a sufficient inducement for encountering such great dangers and expenses.” (Natural History 33.21.78)

This was the world of deep mining in Greek and Roman times and such was the life of peril and suffering the unfortunate slaves, criminals and workmen who risked (or were forced to risk) life and limb for the glory, pleasure and extravagance of power and ruler. Whether it was copper, silver or gold – especially in Spain – there are numerous ancient accounts of the unfortunates slaving away (pun intended) in the depths of the earth, sometimes for their whole lives, to retrieve a profit they would never enjoy. As Pliny again tells us, “the mountains are mined by the light of lamps – the spells of work are also measured by lamps, and the miners do not see daylight for many months.” (Natural History 33.21.70). But it's Diodorus, in his “History” of the 1st century BC, that gives us the despair that was felt by the miners working away day and night for the wealth of their masters: “compelled beneath blows of the overseers to endure the severity of their plight, they lose their lives in this wretched manner... indeed, death in their eyes is more to be desired than life, because of the magnitude of the hardships they must bear...” (History, 5.37-38)

The harsh working conditions, which often included little or no proper ventilation for the miners, saw no real improvements from Greek to Roman times and the technical innovations for these mining operations were few and far between as

well. Two of the best examples we have of well-established underground mining techniques come from the Laurion silver mines south of Athens in Greece – especially important in the 5th century BC – and the Roman Rio Tinto silver mines in Spain, both using mining technology only slightly improved upon from their earlier Bronze Age predecessors who worked these same mines as early as 3000 BC. The basic process of driving shafts and galleries into the ground, to roof supports and inadequate ventilation, continued into the Greek and Roman mines with the latter only really improving the operation once they started digging below the water table – the Laurion mines near Athens never really having to worry about drainage to any large extent because they stopped above sea level. Some of the early operations at Laurion were simply trenches dug into the surface of the ground to extract the rich silver deposits there. Later, the lower levels at Laurion – reached only by shafts dug deep into the Attic landscape – yielded such rich deposits of silver for the Greeks, in fact, that Themistocles was able to build an entire fleet of ships he needed to destroy the Persians in the 480s BC.

It wasn't until such large-scale mining operations as the Rio Tinto in southwestern Spain, that the Romans had the need to develop drainage techniques for their mines, which in most cases simply incorporated earlier technologies they had improved upon, such as the Archimedean screw and the water-wheel (note: earlier issues of *Labyrinth* presented a series of articles on ancient hydraulics which contain more details on these mechanical devices). When they started to use water power in the form of aqueducts, water-tunnels and sluices to drive their mining machines and clean out shafts and over-burden, the Romans were really able to take advantage of all the wealth under the earth in a mass-produced way.

While the Archimedean screw is limited by the angle in which it can be used, Diodorus describes the amazing quantity of water that was pumped out of the Spanish mines using it (V.37.3-4). Strabo, in the 1st century BC – 1st century AD, also tells us that, “as regards the streams that meet [the miners] in the shafts, oftentimes they draw them off with the Egyptian screw” (Geography, 3.2.9) – by which he meant the Archimedean screw. From most accounts, though, it seems that the tympanum, or drum water wheel, was the method of choice by most large-scale mining operations – often two parallel wheels raising the water from deep within a mine to a higher level, where another pair of wheels then raised it to a higher level and so on to ground level. Eight pairs of such water wheels were used at the Rio Tinto mines by the Romans to raise the mine water more than 30m. Even these wheels, though, were manned by slave labour, probably full-time just to keep up with the underground water flow.

Animals could not really be used in any way as an effective power source for the mine equipment as it would have been almost impossible to get them down into the vertical mine shafts, let alone have the space to house and feed them down there – after all, not only did a good draught animal eat more than a slave, it also

cost more! So it was up to human power to drive the machinery as well as haul out all the ore and spoil earth on their shoulders from deep within the mines.

Nature was often used by the Romans, though, to help with the mining operations. Whole rivers were sometimes either diverted directly into the mines, or to reservoirs first, then to the mines, to wash out mine spoils or collapses directly from the shafts – an ingenious as well as time- and labour-saving technique.

In the next issue of *Labyrinth*, we'll look at what happened to all this raw material that made its way out of the mines and into the pockets the rich and powerful.