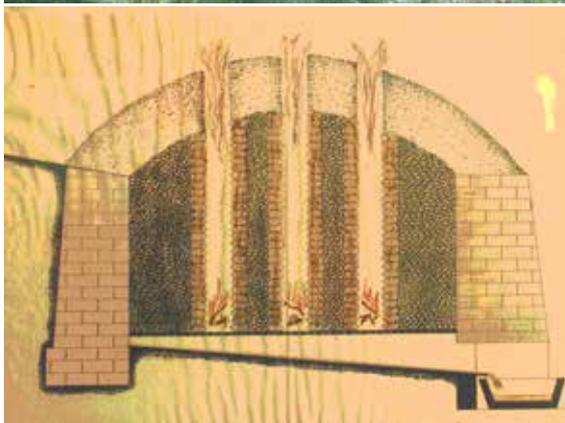


# *Medieval Gunpowder Research Group*



## *Sulphur from Sicily*

*A Galathea 3 Project*

*Report Number 7– April 2007*

*Middelaldercentret, Nykøbing, Denmark  
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## **Introduction**

We know from documentary evidence that Sicily was one of the main sources of sulphur from earliest times. Certainly the Romans were exploiting the vast deposits that were known to exist and the last mines were closed down in the 1960s though the industry had largely collapsed by the beginning of the 20th century. In the medieval period Sicily, together with Iceland, were the main suppliers of sulphur to Europe which was used for gunpowder making. In February 2007 members of the Ho Group visited Sicily to investigate and explore the industry in Sicily. The first site was at Villarosa in the centre of the island while the second was at Comitini near to Agrigento in the south west.

## **The sulphur deposits**

Unlike in Iceland, where the sulphur occurs on the surface and can just be dug up, the sulphur in Sicily occurs underground and mines have to be sunk to reach the deposits. The sulphur occurs not as in Iceland, in a fairly pure condition, but intricately bound up with the rock matrix. The miners, especially up to the 20th century, were frequently young men, youths and often, children. Unfortunately due to the fact that the sulphur was extracted from deep mines these were not accessible so that it was not possible to see the sulphur in situ. However through the assistance of Primo David we were able to collect some samples of the ore for analysis.



**The entrance to one of the mines at Villarosa**



**A piece of the sulphur ore**



**A mine at Comitini**



### **The refining of the ore**

Sulphur melts and boils at quite low temperatures – it melts at around 120oC and boils at 444°C. These very low melting and boiling temperatures mean that it can be quite simple to refine by heating the raw material, the ore - either to just above 120oC so that it melts and runs off from the impurities - which will melt at much higher temperatures - or to heat it to above 444oC and boil it away from its impurities. A number of different ways to carry out the melting process were devised depending on the nature of the sulphur ore. In Sicily, where the ore is mixed up with the rock minerals around it the sulphur was melted by setting light to a part of the sulphur, which burns very well, and letting the heat from the small amount of burning sulphur heat up and liquefy the remaining sulphur which could then be collected.

The simplest and crudest method was to put a huge mass of the ore in a hole in the ground and set light to it. After a time the heat melted a part of the sulphur which runs down to the bottom of the hole from where it was ladled out.



**Drawing showing how the sulphur was burnt in a large kiln called a calcarone**

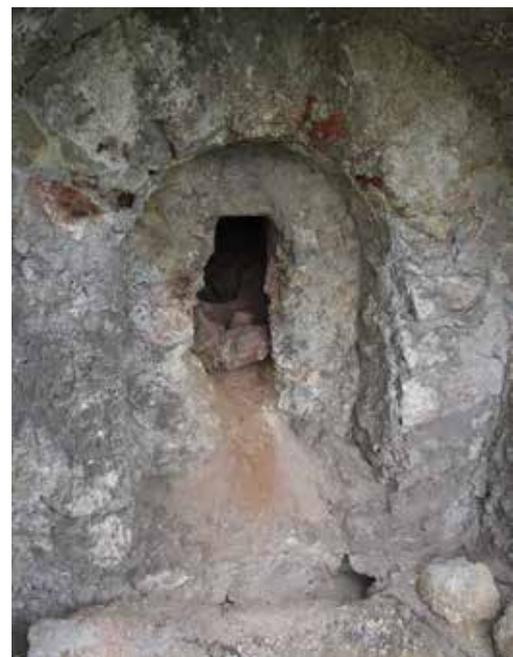
This exceptionally wasteful process, in which only perhaps one-third of the sulphur was recovered, was improved by conducting the heating in a sort of kiln. A semicircular or semi-elliptical pit, called in Sicily a calcarone, about 10 metres in diameter and 2.5 metres deep is dug into the slope of a hill, and the sides are faced with stone. The base, called the sole consists of two halves slanting against each other, the line of intersection forming a descending gutter which runs to the outlet. This outlet having been closed by small stones and sulphate of lime cement, the pit is filled with sulphur ore, which is heaped up considerably beyond the edge of the pit and covered with a layer of burnt-out ore. In building up the heap a number of narrow vertical passages are left to afford a draught for the fire. The ore is kindled from above and the fire so regulated by the combustion of the least sufficient quantity of sulphur, the rest is liquefied. The molten sulphur accumulates on the sole, whence it is from time to time run out into a square stone receptacle, from which it is ladled into damp moulds, of truncated cone shape and made of poplar, each cake weighing about 50 to 60 kg. A calcarone with a capacity of about 825 cubic metres burns for about two months, and yields about 200 tonnes of sulphur. The yield is about 50%.



**An early form of calcarone – just a simple pile of the sulphur ore enclosed with in a stone wall**



**The front of the calcarone showing where the molten sulphur collected and was run out into wooden moulds**



Later on this simple form of kiln was replaced by a type in which there were a number of individual chambers into which the sulphur ore was loaded from the top.



**A later form of calcarone in which the sulphur was packed into four chambers – the tops of which can be seen here**



**The side of the calcarone showing where the sulphur collected and was run out into moulds**



**The inside of one of the four chambers – left from the top, on the right from below, the hole at the base is where the liquid sulphur ran out**

### **Final remarks**

Compared to our visit to Iceland in 2006, where sulphur could be collected from the ground, that to Sicily was less fruitful. As the industry had undergone an enormous upsurge in production in the 19th century much of the medieval workings have been obliterated. Taking samples was very limited to those provided for us and some from the various calcarone which we investigated – though these will probably yield little information about the distant past – being more a product of the later periods. What was obvious though was that the industry had been very extensive in the early modern period and that it was situated on good trade routes and roads making access to the ports, primarily Catania, very easy.

Seeing the industry in Sicily was a fitting finale to the Group's investigations of the primary sources of sulphur in the medieval and early modern periods. It will enable us to compare the different sites, Iceland and Sicily, and the sulphur that each produced helping us to more fully understand the amazing material that is medieval gunpowder.



**Some of the 19th century remains of the industry**



**View towards the sulphur area of Villarosa showing the easy access by road – the new autostrada following the route of the old road to the coast**

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