The Sulphur Mining Industry in Sicily

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Abstract A brief history of the Sicilian sulphur industry from the mid-19th to the mid-20th centuries. Inhumane working conditions of "zolfatari" and "carusi". Machines for the extraction of ore. Trade and export of sulphur: French and British merchants. Systems for melting sulphur. The Herman Frasch process and the end of the Sicilian world sulphur monopoly. The Cozzo Disi sulphur mine in Casteltermini: project of restoring and transforming it into a "Museum Mine". The role of sulphur in the Italian Government's decision to colonize Libya. An adventurous Sicilian explorer: Ignazio Sanfilippo.

1 A Brief History of the Sicilian Sulphur Industry from the Mid-19th to the Mid-20th Centuries

Archaeological finds kept in Palermo and Agrigento museums show that sulphur was discovered in Sicily at an early date and that the native peoples (Sicanians, Sicels, Elymians) already used sulphur and exported it to Greece and Northern Africa from 900 BC. Moreover, studies indicate that, by the end of the 2nd century AD, a number of mines were active in Sicily employing slaves and criminals. Arab geographic literature from the 9th–11th centuries AD contains mentions of sulphur mines in Sicily where the high temperatures caused the loss of the miners' hair and nails (Barone 1989).

The Industrial Revolution and the need for gunpowder were the main reasons for the growth of sulphur mining in Sicily in the late 1700s. Sulphur was also used to manufacture matches, in wine growing and to produce fertilizers, but the greatest request for Sicilian sulphur was connected to its use in the production of sulphuric acid, used as a reagent in the French and British chemical industries.

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In this connection, Sicily emerged as the most important sulphur-producing area of the Industrial Age.

In the 19th century, the island was the world's primary commercial source of sulphur-bearing compounds and maintained its monopolistic position for over 150 years until the end of World War I.

A massive sulphur vein, in fact, the largest easily available sedimentary deposit of native sulphur in the world, called "Sicilian gold", extended principally into the provinces of Enna, Caltanissetta and Agrigento, where major mines were located (Fig. 1).

By 1832, there were already 190 mines operating in Sicily, mainly in the Caltanissetta and Agrigento areas, producing 90,000 tons of sulphur, 40,000 of which were exported (Squarzina 1963). In 1886, the number of mines had increased to 664, but only 373 of them were active, and in 1899, 733 mines were operating in Sicily with a total production of 537,093 tons of sulphur (Musco 1961).

Despite the rapid expansion, until after the unification of Italy in 1860, sulphur mining failed to transform that area into a significant industrial centre due to poor internal communications—there were hardly any railways in Sicily—backward technology, fragmentation of sulphur deposits into many small mines and lack of investment.

In most cases, the ownership of the mine and its operations were separate, because landlords rarely took an active part in the operations. The mines were managed by "gabelloti" through contracts that gave the landlords a fixed lease paid in kind called "estaglio" (generally, 15–20 % of the sulphur production). Other than that, all the economic benefits of production went to the "gabelloti", whose interest,

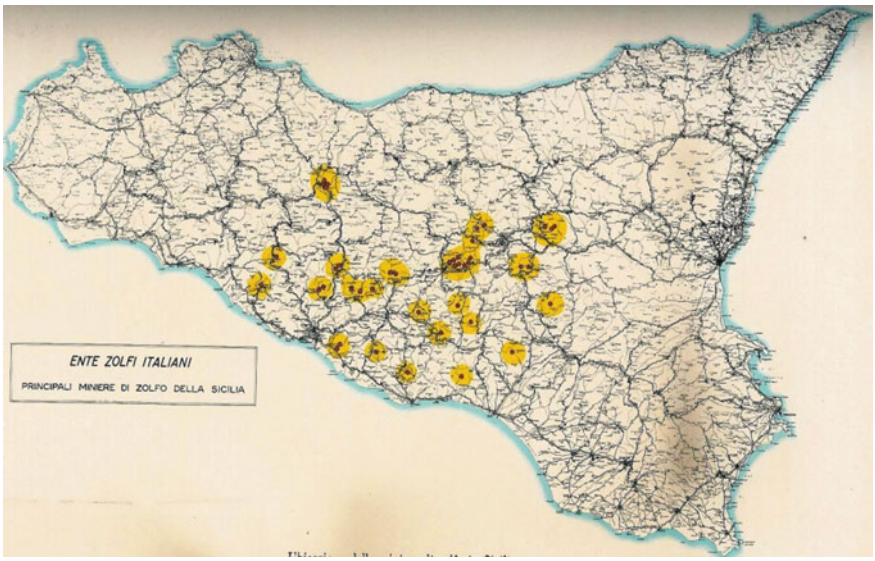

Fig. 1 Major sulphur mines in Sicily

therefore, was that of investing as little as possible in efficiency, safety and modernization of the plants and speculating as much as possible between the "estaglio" and the activity expenses.

Flooding and fires were the most common reasons for abandoning a mine, since it would have been too expensive to control water and fire.

As a result, the industry remained primitive until the beginning of the 20th century, when massive investments improved the efficiency of some of the largest mines. This was also required by the necessity to challenge a powerful competitor: low cost American sulphur.

2 Inhumane Working Conditions of the "Zolfatari" and "Carusi"

Originally, Sicilian sulphur was extracted from open-pit mines. Later, the mining was done below the surface of the earth: in 1850, the average depth of Sicilian mines was only 19 m, in 1870, 50 m, and by 1890, the average depth had increased to 80 m, with a maximum of 195 m in two of them. At the beginning of the 20th century, the expansion of mining activity and some increased mechanization had brought the average depth to 300 m (Squarzina 1963).

Working conditions in Sicilian sulphur mines were inhumane and dangerous. Mining was still largely unmechanized and labour-intensive, with "zolfatari" (miners) working naked in the dark depths of the earth at a temperature of over 40 °C in a poisonous atmosphere (Fig. 2).

Tunnels were poorly ventilated and the air breathed by workers was humid and unhealthy. The only source of light in the galleries was given off by acetylene lamps or by ceramic lamps filled with oil and a wick inserted and ignited. The flame was exposed to the air. Safety lamps were still unknown.

Since sulphur dust is combustible, the smallest spark could cause a fire. When ventilation was not good, sulphur dust and other flammable gases could easily cause explosions and fires that could last for years.

Fig. 2 "Zolfatari"

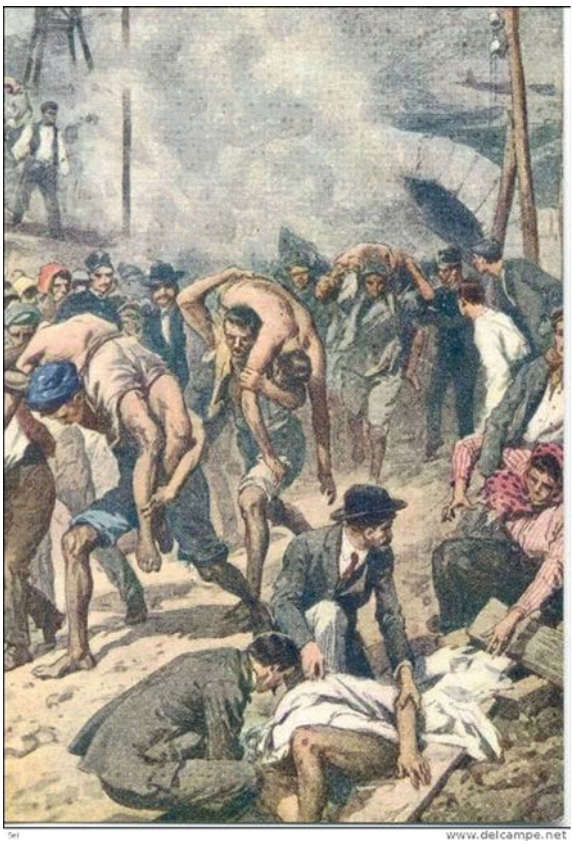

Fig. 3 1916 Cozzo Disi mine disaster

One of the worst disasters caused by an explosion of gas, followed by the collapse of several galleries and an uncontrollable fire, took place in 1916 at the Cozzo Disi mine located near the village of Casteltermini (Agrigento), when 89 miners were killed and 39 injured (Fig. 3). It took a couple of years before the fire was extinguished and the bodies of the miners could be recovered. The only way to put out an extended fire was to build walls in order to seal off the stretch of tunnel where the fire took place so that oxygen would not feed the fire. This expedient was taken at Cozzo Disi, and in 1918, when the mine was re-opened, the director said that it was like walking through a cemetery, since human remains were found everywhere in the tunnels (Ferrara 2012).

At one time, miners were allowed to dig wherever they found a sulphur vein without any geological study or preparatory plan and with no regard for the safety or the future of the mine. Galleries and inclined shafts were not reinforced. Once the vein was exhausted, the old galleries were abandoned empty and no measures were taken to reinforce the stability of the mine and prevent its collapse. Weak supports

made of pine beams could not protect the workers from falling rocks and landslides, which caused numerous accidents.

Until the mid-19th century, in most Sicilian mines—especially the smallest—the lack of financial means did not allow for the use of wells or pumps to free tunnels from water. Flooding was then another cause of disasters. For the same reason, there were hardly any machines in use for the extraction and carrying of ore to the surface. This job was mainly done by "carusi" (Fig. 4).

"Caruso" is the Sicilian dialect word for boy. "Carusi", aged from six to fourteen years old, were engaged by miners to carry the crude ore in straw baskets from the extraction gallery up to the surface, where it was melted and refined. On each trip, they climbed endless steep stairs carrying a weight of about 25/30 kg for the youngest up to 70/80 kg for the oldest.

Each miner engaged from one to six boys to work for him. The miner purchased the "caruso" from his poor family by paying the "soccorso morto" (dead help), a sum of money in the form of a loan, agreed upon according to the age and strength of the boy. Once this money was paid, as a matter of fact, the miner became the owner of the boy, who, from that moment, was his slave. The "caruso" could only obtain his freedom by repaying the "soccorso morto", but neither the poor parents nor the child would easily have found sufficient money for that, and so, many "carusi" remained slaves as adults.

This gruelling work caused frequent cases of curvature of the spine and deformation of the bones of the chest in the young boys. From 1881 to 1884, in the Sicilian mining district, among 3672 men submitted for medical examination, 1634 (44.5 %) were found unfit for soldiering (Squarzina 1963).

More than that, these children were frequently beaten and sexually abused by their masters, also as a result of week-long separations of husbands from wives (Fig. 5).

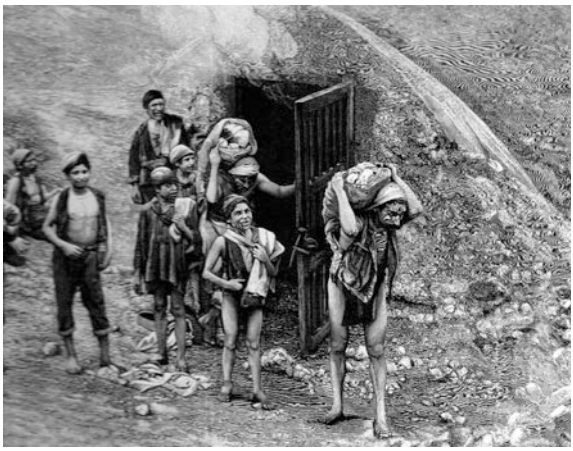

Fig. 4 "Carusi"

Fig. 5 "Carusi"

Salaries were very modest. According to official sources, in 1893, the daily wage of a "child caruso" was 0.60/0.95 Lira; that of an "adult caruso" was 1.70/2.00 Lira. A miner earned 2.00/2.70 Lira for 6/8 h of labour.

The payment of salaries was frequently late and it was often replaced by the "truck system", a practice introduced by British merchants consisting of paying part of the wage in highly-priced and poor quality goods (food, tools, etc.) sold in stores opened in the mine area and managed by the same "gabelloti".

As a result, their wages could suffer a reduction of about 25 %.

3 Machines for the Extraction of Ore

In small mines, carrying the ore to the surface by hand was profitable thanks to the "carusi's" poor salaries. On the other hand, in mines which had a depth of 150 m or more, the transportation by "carusi" was too slow and expensive. It was, in fact, calculated that, in 1873, the cost of manual transportation of the ore was about 3/3.50 Lira/ton, while the cost of mechanical extraction was about 1.50 Lira. A more careful management, therefore, required more rational and modern transportation techniques. However, the investments needed for this innovation could only be found for large mines, while the small ones still continued to employ "carusi".

The first primitive mechanical extraction systems adopted in the mid-19th century consisted of carrying the ore by hand to the collection gallery and unloading it onto wooden carriages (Fig. 6).

The carriage rails were simply flat iron bars fixed on wooden crossbeams and held by wedges. This system could only be used for a horizontal transportation anyway and took advantage of a slight slope existing between the piles already formed inside the gallery and outside. Loading and unloading was done by hand (Fig. 7).

Only in the second half of the 19th century did the largest mines begin to be equipped with properly inclined shafts. The most common ones had double rails, one for climbing carriages and one for descending ones. Heavily laden climbing

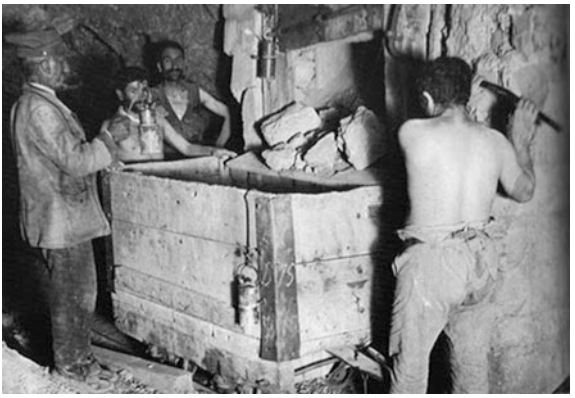

Fig. 6 Wooden carriages

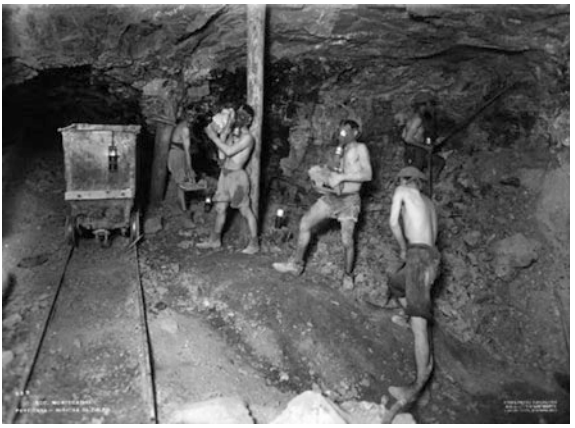

Fig. 7 Primitive mechanical extraction system

carriages were often operated by steam engines, while descending ones did not need an engine, but a brake.

In 1865, in 13 Sicilian mines, the extraction work done by "carusi" and mules had already been replaced by steam engines with a total power of 190 HP. Only a few years later, in 1872, 25 steam engines with a total power of 400 HP were in use in 21 mines. In the same period, the first extraction wells were installed in those Sicilian mines which could afford their high cost. Vertical wells, used for the ore transportation, as well as for the drainage of spring waters, reached an average depth of 60–120 m.

The first mechanized extraction system consisted of a masonry hoist tower installed over a well. At the top of the tower, pulleys connected to flat belts were operated by a steam winch in order to lift two elevators anchored to the well. The carriages full of ore were placed inside the elevator and hoisted to ground level.

The introduction of head frames, already experimented with in the coal mines of England, improved the extraction technique. Initially, they were made of wood:

four strong beams held together by horizontal or crossed wooden boards. They were 5–10 m high and had two revolving spools at the top operated by steam engines that made both of them spin simultaneously at the same speed but in opposite directions. In this way, while one spool wound the first rope pulling the full cage from the bottom, the other spool made the second empty cage descend.

A wooden or iron guide was fixed onto the sides of the well in order to direct the cage lifting and allow the elevators to be manoeuvred quickly while avoiding swinging and bumping.

After World War I, some head frames were built in reinforced concrete the structure of which did not differ from that of the wooden ones: the only difference was that the wooden beams and boards were replaced by walls in the form of a right-angled trapezium. Although they had the advantage of having a reduced cost, the continuous vibrations produced cracks in the cement coating protecting the metallic structure. This allowed infiltrations of rain water, which caused damage and, therefore, the life of the equipment was shortened (Cassetti 1989) (Fig. 8).

The most advanced head frames were built with iron or steel and could be up to 30 m high. They were also used as lifts for the workers and their tools. The special carriages elevated by these head frames could transfer the ore from the gallery all the way to the top of the head frame, where a collection container was placed. Conveyor belts then moved the carriages to a stock container from which the ore was automatically loaded onto trucks (Fig. 9).

A further technological improvement to mechanical extraction came in 1898, when the first system powered by electricity was installed in the Tallarita mine (Riesi).

At the end of the 19th century, all the large mines had extraction equipment and, therefore, more than 1/3 of the ore was carried to the surface mechanically (Squarzina 1963).

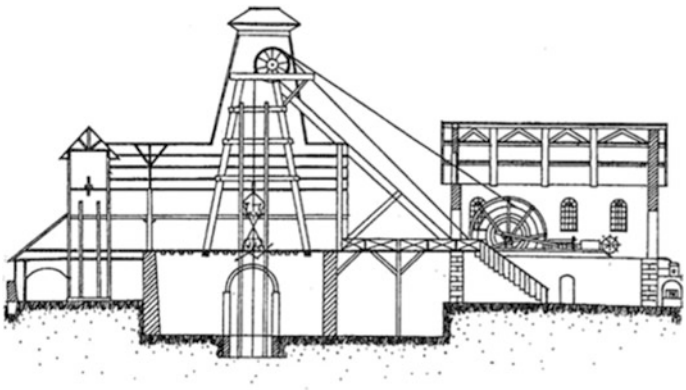

Fig. 8 Iuncio Testasecca mine: design of the extraction well

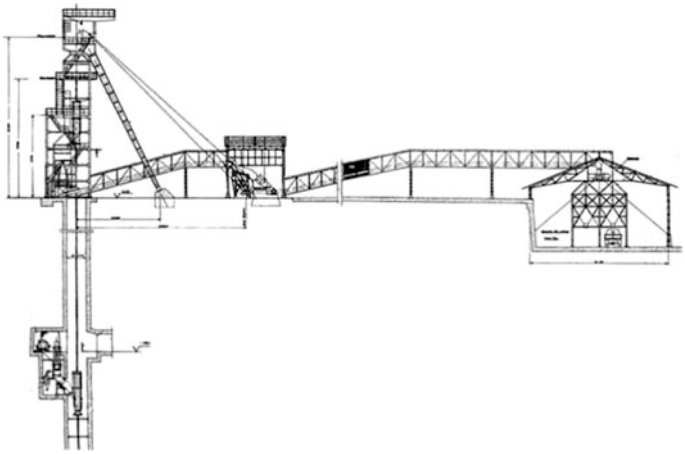

Fig. 9 Gessolungo mine: design of the extraction well

4 Trade and Export of Sulphur: French and British Merchants

Trading of Sicilian sulphur was developed in the early 18th century. It was first exported by sailing boats and later by steamboats. The mineral extracted from the mines located in the Caltanissetta and Enna provinces was mainly transferred to the port of Catania, while Licata and Porto Empedocle were the ports of embarkation to which the sulphur from all the mines in the Agrigento province was taken by mules or carriages. Once there, it was unloaded onto small boats by men who carried the sulphur on their backs, walking chest deep in the water. The small boats then transported the load to the vessels anchored in deep waters. This happened all year round, even in winter.

In the early 19th century, the most important sulphur refineries and sulphuric acid plants were located in Marseilles (Kutney 2007), and France was the major market for Sicilian sulphur. This state of affairs gradually changed with the growth of numerous Leblanc plants in England, which replaced France as the major customer for Sicilian sulphur. By 1830, the Sicilian sulphur trade was dominated by British merchants, already operating in Sicily in the wine trade business. In the first half of the 19th century, Britain and France purchased most of the Sicilian sulphur through exclusive contracts (Cassetti 1989). In the years between 1833 and 1838, Britain imported 49 % of the entire Sicilian sulphur production and France 43 % (Barone 1989).

In 1838, even though Britain was the major buyer of Sicilian sulphur and despite existing agreements with British merchants, the Neapolitan government granted a monopoly for the trade of most of the production to the French company "**Taix, Aycard et C**." This agreement took the business away from the British, causing a

diplomatic incident which produced a serious military escalation. The British Mediterranean fleet was made ready for war and sent to Naples. Fortunately, diplomacy prevailed and Taix, Aycard et C.'s monopoly was revoked by Ferdinand II against an expensive penalty paid to the French company.

A second attempt at commercial discipline on a voluntary basis started in 1896, when a Sicilian businessman, Ignazio Florio, formed a consortium for the control of the price and export of sulphur. The new joint-venture with British and French investors was named "**The Anglo-Sicilian Sulphur Company**". The company contracted the control of about two thirds of all Sicilian production through ten year sales contracts at a fixed guaranteed price. In this way, the Anglo-Sicilian managed to maintain price stability at a reasonable level during periods of price depression. This state of affairs might have gone on indefinitely had it not been for the entry of American-produced sulphur into the international chemical business. American competition caused a financial crisis for the Anglo-Sicilian, which had to fulfil their obligation to purchase most of the Sicilian sulphur production even though sales and export had considerably decreased.

In 1906, the Anglo-Sicilian was rescued by the Italian Government, which established the "**Consorzio Obbligatorio per l'Industria Zolfifera Siciliana**". This compulsory State consortium purchased the Anglo-Sicilian stock on hand, amounting to over 500,000 tons. A new law obliged the producers to store all their production in the new "Consorzio's" warehouses. They could receive immediate advances on their deposits, but the commerce and trade of sulphur was exclusively operated by the "Consorzio".

This consortium lasted until 1932, when it was replaced by "**Ufficio per la Vendita dello Zolfo Italiano**", in turn taken over by "**Ente Zolfi Italiani**" in 1940 (De Gregorio 1989). After World War II, the Sicilian sulphur industry was barely profitable. Mines survived only thanks to contributions granted by the Government, and Sicilian sulphur gradually became a Government social programme (Kutney 2007). In 1964, the few mines still operating were transferred to the Sicilian Regional Authority, "**Ente Minerario Siciliano**", which acknowledged that even the best mines were no longer competitive and started a gradual closing plan: the number of mines in activity declined from 24 in 1967 to 5 in 1975. In 1988, the last four mines were closed.

5 Systems for Melting Sulphur

The simplest method of sulphur purification was that of burning the ore and collecting the molten sulphur after eliminating contaminants.

The earliest system of melting adopted in Sicily was the "**calcarelle**". Until about 1850, it was the cheapest process employed to extract sulphur from rocks. This consisted simply of a circular stack of ore with a diameter of 1.50–2.00 m built in a sloped ditch with a depth of about 1.00 m at the back and 0.50 m at the front (Gatto 1928). The construction of the stack usually took two days and was left open

at the top. The mass, consisting of 3–4 m^3, was ignited at the summit. On the third day, the molten sulphur flowed out through an opening called the "morto" and was collected in wooden buckets ("gaviti"). By this method, two thirds of sulphur contained in the ore was wasted, since it burned vast quantities of sulphuric acid into the air, which caused terrible damage to the vegetation in the neighborhood and, as a consequence, long legal disputes with the landowners.

After 1850, most "calcarelle" were replaced by "**calcaroni**". These mainly differed from "calcarelle" in size: the diameter of "calcaroni" went from 5 to 30 m and the depth of the ditch was about 5 m at the back and 1 m at the front (Gatto 1928). The more advanced preparation, which included the addition of soil on top of the sulphur stack, and the more sophisticated piling technique allowed for a regulated combustion lasting 30/90 days. Once liquid, the sulphur could flow down the sloping hillside and be collected in the "gaviti", where, once solidified, it formed blocks ("pani") weighing 50/80 kg.

With the "calcaroni" process, 35/50 % of sulphur was still lost in the air (Fig. 10).

Better results were achieved with the **Gill's furnace** invented by Robert Gill, a British engineer, director of the Gibellini Sulphur Company. This furnace, entirely made of concrete, was experimented with for the first time in 1880 in the Gibellini mine (Racalmuto). Gill's process involved the use of a series of chambers (from a minimum of two to a maximum of six).

The main innovation of this furnace consisted in the possibility of recovering the combustion gas and using it again in the following chamber. Since the sulphur fumes produced by this furnace were very limited, the Gill's furnace could operate continuously all the year round. The most common Gill's furnace used in the Sicilian mines was the four-chamber one, which had a capacity of about 30 m^3 and a sulphur waste of only 7–10 %. Within a few years, this process was adopted in most Sicilian mines and became the most common method for melting sulphur. In 1890, the sulphur melted in Gill's furnaces was 12 % of the whole production and increased to 64 % in 1905 (De Gregorio 1989) (Fig. 11).

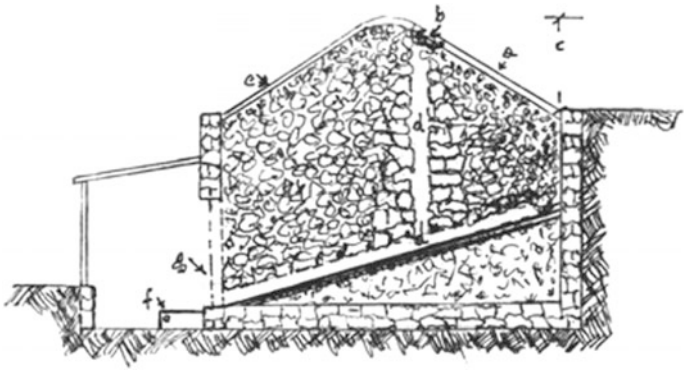

Fig. 10 Calcaroni

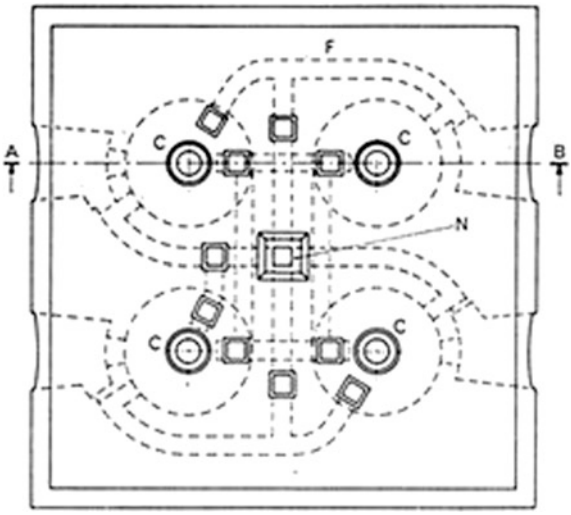

Fig. 11 Four-chamber Gill's furnace

Sanfilippo's ore roasting furnaces were invented by Ignazio Sanfilippo, owner of sulphur mines in Casteltermini and General Technical Director of all the mines of the Société Générale des Soufres, Ignazio Florio's company operating in the sulphur industry. Sanfilippo invented a new furnace in 1901 which was patented in 1902 (Fig. 12).

In 1903, Sanfilippo invented a second and more advanced type of filtering pipe furnace, which was tested and used in numerous Sicilian mines.

Sanfilippo's furnaces were suitable for any kind of sulphur metallurgical treatment, but its speciality was that of being the only one, at that time, which could melt the sulphur still contained in the industrial waste ("ginisi") after fusion had been performed in "calcaroni" and Gill's furnaces.

Furthermore, Sanfilippo's furnace could be used for melting without any special preparation of the sulphur contained in the minute crude ore ("sterri"), which could not be efficiently treated in Gill's furnaces (Fig. 13).

"Sterri" and "ginisi" were still rich in residual sulphur, but were considered industrial waste and piled up in massive mounds, up to 40 m high, having the form of cones with cut apexes. The new invention produced the great advantage of extracting the significant percentage of sulphur still contained in the huge piles of ore at no extraction cost, since it was already at ground level. In addition, the new invention reduced the big industrial problem of finding additional land on which to store the waste (Ferrara 2012).

Sanfilippo's furnaces were adopted in some of the largest Sicilian mines and became one of the most popular systems for melting sulphur. It was calculated that, in 1905, 52 Sanfilippo's fusion chambers were operating in Sicily, with a total production of 4304 tons of sulphur.

At the end of the 19th century, several mines adopted **Steam furnaces**, which had the advantages of reducing the high cost of the Gill's and Sanfilippo's furnaces,

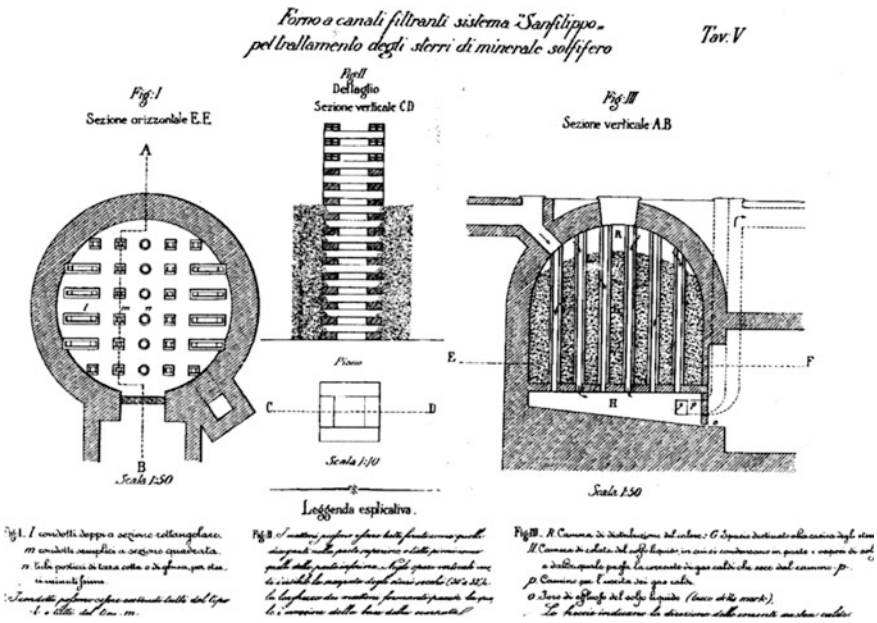

Fig. 12 Sanfilippo's filtering pipes furnace

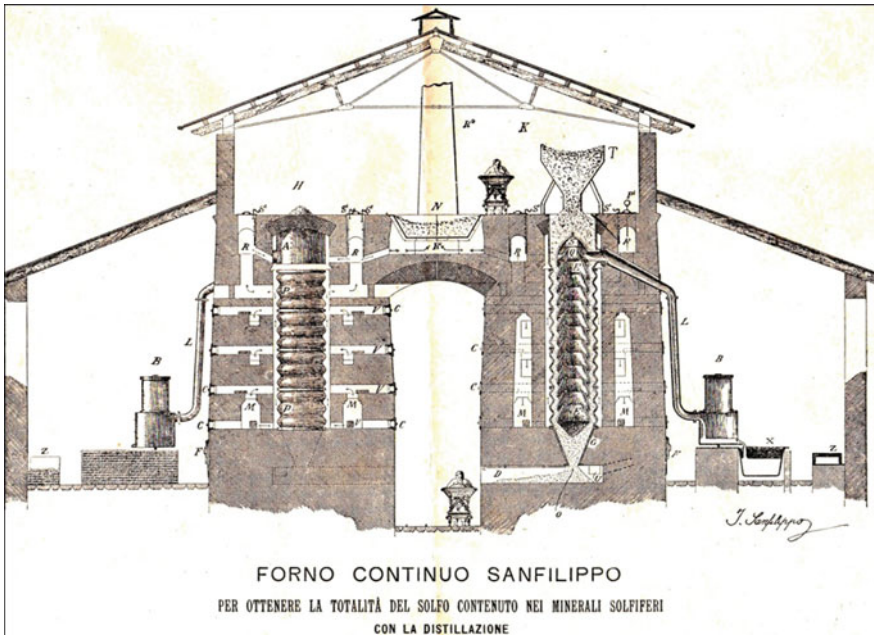

Fig. 13 Sanfilippo's ore roasting furnace

producing an excellent quality of sulphur, and having a very fast process. However, the disadvantage was the high loss of sulphur, calculated between 7 and 17 %, which made this device unsuitable for ore with a low content of sulphur.

After World War II, a higher grade of purity (99 %) of sulphur was obtained with the **Flotation process**, adopted only in a few large mines. But this attempt to modernize the industry came too late, when Sicilian sulphur was no longer competitive, and some mines never recovered from the high cost of this investment.

6 The Herman Frasch Process and the End of the Sicilian World Sulphur Monopoly

In December 1894, Herman Frasch, an American chemist of German origin, invented a new revolutionary technology for the extraction of sulphur from rich deposits in Louisiana and Texas. This process consisted of melting the sulphur while still deep in the ground by pumping in water heated to a temperature of above 119 °C, the fusion grade of sulphur, and then forcing the liquid sulphur up to the surface using compressed air (Fig. 14).

This hot-water sulphur mining process, after various attempts, was perfected and put into operation by the Union Sulphur Company—of which Herman Frasch was director—in 1906, in Louisiana and then in Texas.

For geological reasons, this new technology was not applicable to the Sicilian deposits. In 1898, Herman Frasch himself secretly tried his process in Porto Empedocle (AG). The attempt failed twice, confirming that his invention would have soon destroyed the Sicilian sulphur monopoly.

It goes without saying that the Frasch processed sulphur was produced at a very competitive cost and, in fact, it was sold at $7.72 (US) a ton, less than half the price of the best Sicilian sulphur. Furthermore, the American sulphur was 99.5 % pure, as the melting process removed all types of impurities. In 1904, when American-produced sulphur entered the European market, the Anglo-Sicilian Company decided not to renew its contracts, and over one hundred Sicilian mines had to close.

Hardly any Sicilian sulphur was exported to the U.S., whilst American sulphur started being exported to some North European countries. In this competitive context, the price of sulphur continued to decline. In order to normalize the market, Italian and American authorities reached an agreement stating that two-thirds of the European market had to be left to the Sicilian producers, while only the remaining third was assigned to the American companies. The U.S. market was left open to competition. By 1914, the U.S. sulphur industry was ranking first in world production, well above Sicily.

The Sicilian sulphur monopoly was definitely over.

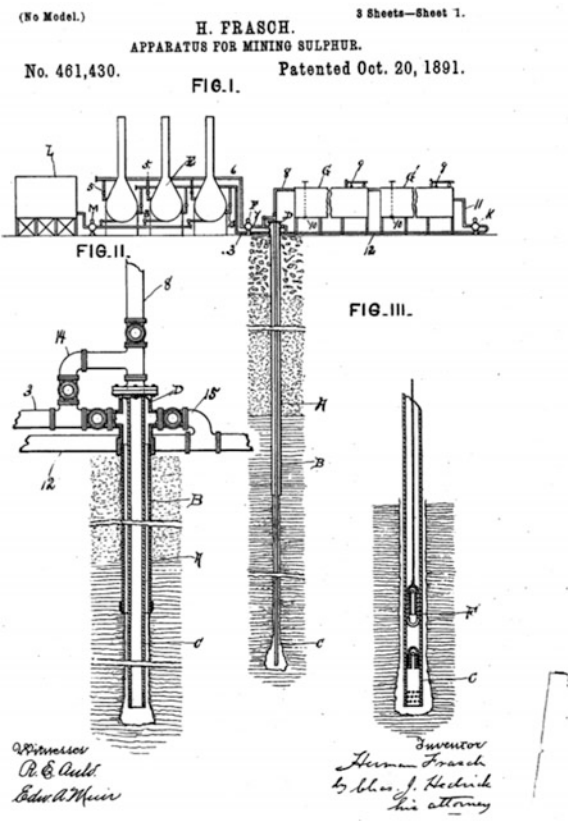

Fig. 14 Drawings of Herman Frasch's sulphur mining apparatus

7 The Cozzo Disi Sulphur Mine in Casteltermini: Project of Restoring and Transforming It into a "Museum Mine"

In order to fight the stiff competition from American sulphur, the largest Sicilian mine owners and "gabelloti" decided to invest the additional capital needed to modernize the production system and reduce its costs. One of the oldest sulphur mines was the Cozzo Disi located in Casteltermini.

There are records of open-air activity in this mine from the end of the 1700s and the first years of the 1800s, but proper underground extraction began in 1870 when the first galleries to the lower two levels were opened. The third level was opened in 1911 after upper levels were exhausted. From then on, extraction continued in deeper galleries, down to the 12th level. The total depth was of more than 300 m. At the beginning of the 20th century, the Cozzo Disi mine was the largest in Agrigento province and one of the most important in all of Sicily. This was due to the considerable extension of its deposits of sulphur, the purity of its ore, the absence of

underground waters and the proximity to the railway station of Campofranco. After World War II, Cozzo Disi became one of the most important sulphur mines in Europe thanks to the installation of a modern floating system plant, which improved production considerably. However, the American sulphur competition also hit Cozzo Disi which, despite government subsidies, became unprofitable and had to start reducing its activity and number of employees. The active mining production lasted until 1988, but the mine was kept in a state of potential activity until 1991, when it was transferred to the cultural department of the Sicilian Region as a "museum mine".

Since then, a long programme of restructuring and restoration has been ongoing with the participation of the MMS Historical Museum of the School of Engineering of Palermo University. This interesting site of industrial archaeology is expected to open to visitors in the near future (Figs. 15 and 16).

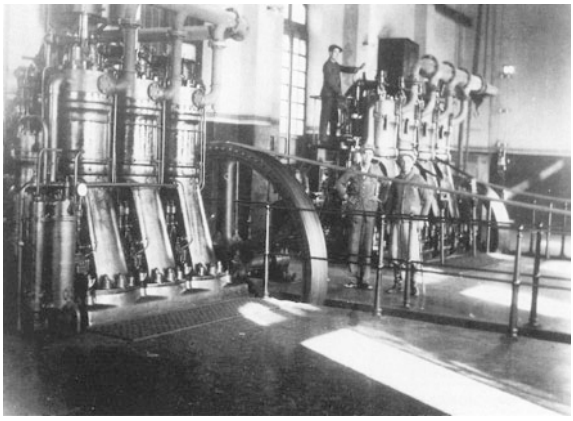

Fig. 15 Cozzo Disi mine: old power station

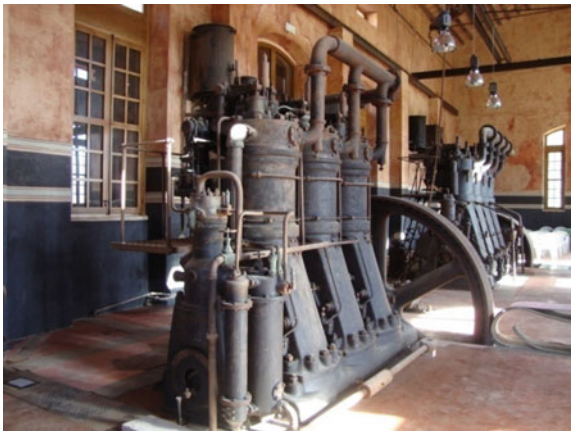

Fig. 16 Cozzo Disi mine: power station after restoration

8 The Role of Sulphur in the Italian Government's Decision to Colonize Libya. An Adventurous Sicilian Explorer: Ignazio Sanfilippo

In 1911, sulphur was so important for the economy of Sicily and of all Italy that the fear of losing the world monopoly, already threatened by the Americans, was one of the causes, though minor in scale, which generated the Italo-Turkish war.

At the beginning of the 20th century, most European powers had already established one or more colonies in Northern Africa, while Italy had assured its non-interference policy in exchange for the promise that Libya, one of the last North African territories still not occupied by European states, would have been left to Italy.

At that time, the provinces of Tripolitania and Cyrenaica, later known as Libya, were under the domination of the Ottoman Empire, but their position in the Mediterranean Sea made this land a target of strategic importance to Italy. While waiting for the right time for occupation, Italy promoted a policy of "peaceful penetration" through Banco di Roma, one of the largest Italian banks at that time. The aim was to take possession of Libya gradually without having to fight for it.

For this purpose, Banco di Roma performed financial and commercial operations in Libya, such as maritime transportation, the construction of mills and an ice factory, the export of cereals, an ostrich feather industry, a sponge factory and, above all, the acquisition of land at a very high price. These operations were clearly unprofitable and generated suspicion on the part of the Ottoman Authorities about the real role of the bank. In fact, Banco di Roma had been urged to play this role by the Italian Government and under its subsidy. In other words, this was a case of private investment used as a tool of diplomacy.

Some travellers on their return to Italy from Libya had reported having seen "vast sulphur deposits" on the surface during their excursions (Giannò 1905). Should these reports have been confirmed, occupation of Libya by another country and exploitation of its sulphur deposits at a very low labour cost would have caused serious damage to the Sicilian sulphur industry and to the Italian economy in general.

It was therefore necessary to verify the information by sending an expert in sulphur research and processing for a secret exploration. The manager of the Tripoli branch of Banco di Roma—who was actually a secret agent under cover and not at all a banker—urged the Italian Foreign Ministry to take prompt action. The search for the right person was obviously done in Sicily where the largest and most important sulphur enterprise at that time was "Société Générale des Soufres", a Sicilian-French company established in 1906 by Ignazio Florio in Paris to manage ten large mines located in the Enna, Caltanissetta and Agrigento provinces. The company employed about 7000 people and had an annual turnover of about 50,000 tons of sulphur.

The General Technical Director of the company was Ignazio Sanfilippo, co-owner and director of the sulphur mines in Casteltermini, expert in geology and

very well known in the sulphur industry, as well as for being the man behind several inventions. Ignazio Sanfilippo was then chosen to lead a dangerous secret expedition in order to verify the presence of sulphur and phosphate deposits in Tripolitania and Cyrenaica (Fig. 17).

The Sanfilippo Mission, made up of five Italians, left Tripoli on April 8, 1911, accompanied by a caravan of about seventy men and one hundred camels. The caravan included the Turkish military escort whose official task was to protect the Mission from attacks by Bedouin rebels (Ferrara 2012).

As a matter of fact, the Turkish Authorities were suspicious about the real purpose of the expedition and, therefore, the military escort had been ordered to control the Mission. For this reason, the Turkish Officer tried to impose significant restrictions on the Mission's operations, such as not allowing Sanfilippo to dig deeper than cm.20 for sample collection, limiting the length of excursions and impeding contacts with Arab chiefs. Turkish hostility and interference was partially solved by Sanfilippo, with the assistance of the Italian Consulate in Tripoli, by replacing the Turkish officer (Fig. 18).

In the meantime, diplomatic relations between Italy and Turkey had deteriorated and on September 28, 1911, the Italian Government sent the Turkish Sultan an ultimatum requesting the Ottoman Empire's consent to an Italian occupation of the Tripolitania and Cyrenaica provinces. Only 24 h later, on September 29, Italy declared war on Turkey (Del Boca 1993). The main claim contained in the ultimatum was the Ottomans' hostility to Italian enterprise in Libya, with a specific mention of the problems caused for the Italian Mineralogical Mission.

Fig. 17 Ignazio Sanfilippo

Fig. 18 Members of the caravan

Mysteriously, neither Banco di Roma nor the Italian Consulate promptly advised the Mission of the imminent conflict (Grange 1994). As a result, the five Italian explorers had no chance to return to Tripoli and leave the country in time. They were taken prisoner by the same Turkish soldiers that had been assigned to the Mission for protection and conducted to the south of Fezzan in the Libyan desert.

The unbearable imprisonment lasted 13 months, during which time they were moved from one desert prison to another. The Italian explorers were forced to live in small dirty cells in extreme temperatures and allowed outside only a few hours a day. The food provided was extremely poor and they often had to drink water that, even after boiling, remained dirty and muddy. Any contact with Italy or with any international authority—even the International Red Cross—was strictly forbidden. Therefore, since they could not receive letters, medicine or parcels, they were in need of everything and in the dark about the political and military situation.

The Turkish soldiers considered them spies and, for that reason, constantly kept them under the threat of execution.

After lengthy negotiations, a peace treaty between Italy and Turkey was signed at Ouchy, Switzerland, on October 18, 1912, and on November 11, 1912, the Mission was finally freed (Fig. 19).

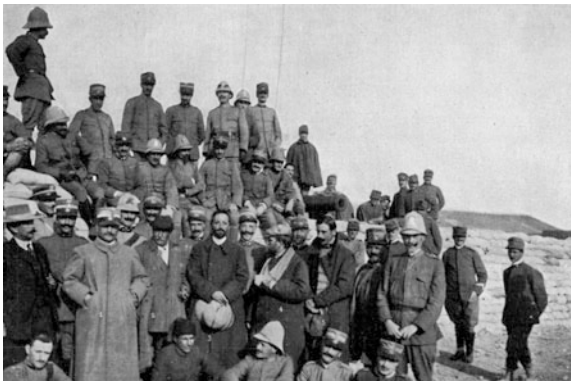

Fig. 19 Liberation of the "Missione Sanfilippo"

Ignazio Sanfilippo received several honours, including the title of “cavaliere” of the Crown of Italy, personally presented to him by King Vittorio Emanuele III (Ferrara 2012). As soon as he returned home, he asked to be sent to Libya again to complete the exploration interrupted by the war and the imprisonment, but in the meantime, Libyan resistance had made those territories dangerous.

During the period of Fascism, other explorations confirmed that no sulphur deposits of industrial importance existed in Libya, but by then, the golden era of sulphur was already over.

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