
The Medici Silver Mines (1542-1592)

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Shortly after the territory of Pietrasanta had passed under the domain of the Florentine Republic, in March of 1512 the Lords of the Balia,

« having been given to understand that some people would willingly set themselves to search for gold, silver, copper, iron, tin, allum, vitriol, sulphur and other metals and similar substances, if some advantage were offered to them . . . and knowing that such are found in other countries, therefore desiring that an attempt be made, as that which can be had at home need not be looked for abroad . . . decided that by virtue of the present provision each man be allowed to appear before the *Ufficiali del Monte* and have noted and written down how he wishes to look for such mines and substances ».¹

The belief that some areas of Tuscany were rich in mineral resources, and in particular silver, must have been widespread, for an anonymous memoir of the 16th century recalls that, « the Pisans possessed silver mines in Sardinia and in 1320 the inhabitants of certain places worked more in the silver mines than on the land . . . (above all) they had them in Versilia, in the territory of Pietrasanta ».²

From the 13th century onwards new seams were intensively mined in the high Cecina, the valley of the Merse, in Montieri Gerfalco, in Travale, Frosini — that is in the entire area from Massa to Volterra, a development which was related to the growing needs of the Tuscan markets.³ In the

¹ Archivio di Stato di Firenze (A.S.F.), Archivio della Repubblica, Balie, c. 140.

² A.S.F., Miscellanea Medicea, 27, fasc. V, ins. 1.

³ cf. N. RODOLICO, *Toscana Marinara e Toscana Mineraria*, in « Nuova Antologia », 1938, pp. 183-185.

present state of research the reasons why these mines were gradually abandoned are unknown, although it probably followed the fall of the ancient Counts of Versilia.⁴

The provision of 1512 referred to the regulation which governed these ancient mines when it stated that « each man can mine and have mined as freely as he wishes or thinks fit and as he pleases . . . », so confirming previous legislation which had sanctioned every citizen's right to excavate in any part of the territory of Massa « *absque contradicitione personae vel loci* ».⁵

The initial bounties offered by the Florentine Republic were not, however, limited exclusively to the discovery of veins of minerals and the appropriation of mines but also covered the mining itself. In fact « all that which (the miner) mines or has mined in the first ten years after the registration of names and places is to be his own and freely belongs to him so that no part of it does he owe to the public or to any private persons ».⁶

The first request for permission to mine, which is preserved in the archives of the Republic, dates from 1522, the year in which Francesco d'Andrea Carnesecchi applied to the competent authority to « be permitted to search and excavate, or have searches made, for gold and silver in the countryside, the district and territory of Pietrasanta ».⁷

In fact other similar requests have probably been lost, for the decree of the Council of the Hundred shortly after stated that, « many people have been saying that they have places assigned to them (for mining) ».⁸

Because of lack of documentation few details are known about attempts made by private individuals to exploit these mines at the beginning of the 16th century. However we may assume that for the most part they did not go beyond the strictly exploratory phase, for in 1525 the public authority fixed a final date for the beginning of excavations and added that, (until then) nothing has been searched for or mined because of the cost or for some other reason ».⁹

The opinion expressed by the members of the Council of the Hundred, was correct for the initial cost of reopening mines which had been abandoned for more than a century, required the investment of enormous amounts of capital in an enterprise the results of which were extremely uncertain.

⁴ *Ibidem.*

⁵ The statute was published for the first time by F. BONAINI in « Archivio Storico Italiano », XLII, 1853.

⁶ A.S.F., Archivio della Repubblica, Balie, loc. cit.

⁷ A.S.F., Archivio della Repubblica, Consigli della Repubblica, Provvisioni, Registro 205, c. 62.

⁸ A.S.F., Archivio della Repubblica, Consigli della Repubblica, Consiglio dei Cento, Protocolli, 4, c. 138.

⁹ A.S.F., Archivio della Repubblica, Consigli della Repubblica, cit.

When the Grand Duke came to power, however, the authorities assumed the initiative which been left to private individuals in the republican period.

In the 19th century, Campana stated in his brief history of the captainship of Pietrasanta that, « it is not known how long these mines remained open; we only know that Cosimo I was the first to reopen them, and that he perhaps also rediscovered the silver mine known as the Bottino ».¹⁰

In fact, the accounts of Camarlingo for the Pietrasanta mines show that mining began at Bottino, which was almost certainly the richest mine in the area, and it was subsequently extended to the Monte dell'Argentera, Boddaiò and Campiglia.¹¹

The reopening of the mines began in 1539 and developed in three phases; the actual reopening of the mine, the construction of workshops and the building of the « *casa della fabbrica* » where the permanent workers lived. Not all these operations received equal attention however.

When the first German workers arrived in the summer of 1542, the *cavature* (excavation) of the basic ore was already proceeding with some regularity, while the work of constructing the workshops was still incomplete.¹² It was probably these same master smelters, all of whom were Germans, who provided invaluable advice about the choice of materials for the furnaces, their positioning, etc.¹³

Our sources give no indication as to the whereabouts of the workshops, but it is almost certain that they were situated near Ruosina, for an 18th century memoir recalls that « the silver from the Bottina mine was kept in store, and then it was taken to the silver works at Ruosina ». Most of the indigenous workforce (smiths, apprentices, etc.) came from this town.¹⁴

Initially, therefore, the Grand Duke's superintendents intended to begin operating the mine as soon as possible and to accumulate the *fondizioni* (ore for smelting) until it could be processed. The problem of finding lodgings for the German masters must have been of secondary importance. First they were lodged at the local inn and later they were transferred to lodgings near the workings at Bottino.

In 1546 Antonio Baldovinetti, the Superintendent of the Grand Duke had the bedding and cooking utensils for the miners' house delivered to Cristofano d'Egler, and described them as « 4 mattresses filled with good wool remade; 1 mattress filled with good hair and 1 straw mattress;

¹⁰ A.S.F., Manoscritti, 711, F. CAMPANA, *Analisi istorica, politica, economica del Capitanato di Pietrasanta con alcune riflessioni e discorsi relativi*, parte II, pp. 277-294.

¹¹ A.S.F., Miniere Medicee, 1, c. 1 e seg.

¹² A.S.F., Miniere Medicee, 1, c. 3.

¹³ Giorgio Agricola dedicated a whole paragraph of his chapter on the "fondizioni" to the construction and positioning of the smelting furnaces: cf. G. AGRICOLA, *Dell'arte di far metalli*, Basle, 1556, book VII.

¹⁴ A.S.F., Manoscritti, 711.

2 feather beds; 2 large pillows: one filled with wool, one with feathers; 9 miners' bed covers; 1 red cloth bed cover; 1 red and green woollen cloak; several linen tablecloths, including one god table-cloth; 1 pair of worn sheets; 1 pair of very good sheets; 2 pans for frying and cooking chestnuts; 1 pan and ladle and skewer; 1 tripod for a pan; 2 large knives and 4 iron forks; 1 cooking pot; 8 floor cloths, some good, some poor ».

This equipment would have covered the basic necessities of a small community, and in fact, Camerlingo's account makes several references to « eleven miners from Germany ».

We know little about the first groups of German miners to settle in Pietrasanta, apart from their names which were often distorted and italianized in the account books and sometimes qualified with "smelter" or "refiner". But where did Burghardo Par, Bolfo Simon, or Giglio Neghman come from and how they been recruited?

It was probably Master Cristofano d'Egler himself who recruited them. He was often cited in documents as the Grand Duke's Superintendent of Mines, who went to Germany to choose the workers and bring them together in Nuremberg, which served as a centre for recruitment. In fact, one document records that « Giglio Neghmann, German, a new miner arrived from Germany, must deliver on 15 April 1549, 29 lire and 5 soldi, together with eleven others bought from Germany by order of our master Cristofano d'Egler; this money is the change from the eighty gold scudi which he received in Nuremberg from the Torrigiani, acting for His Excellency ».¹⁵

The immigration of German workers was to assume considerable proportions with the years. By 1551 a new group of immigrants which was to work in the mines of Pietrasanta had been recruited and paid in Trent, and in 1559 more than twenty German miners were working every week in the mines of Bottino and Argentera.¹⁶

The number of workers was very small compared with « over 200 » who Biringuccio saw at work in one German mine, but the number was certainly not insignificant in relation to the more limited production of the mines of Pietrasanta.

Because of the extremely high degree of specialization which they had attained in their country, German miners were employed in all the silver mines of Peru, Mexico and Europe throughout the whole of 16th century. But while they were mainly employed in the American mines as supervisors and managers, in Pietrasanta they were employed in quite different capacities. In the mines of Zacatecas, or Potosì the excavating, the heaviest work, was left to local workers, who were paid at a very low rate, and to a lesser

¹⁵ A.S.F., *Miniere Medicee*, 7, c. 27.

¹⁶ A.S.F., *Miniere Medicee*, 20 and 21.

¹⁷ BIRINGUCCIO, *Protechnia*, Vinegia, 1550, pp. 1 and sgg.

degree to black slaves. In the Tuscan mines, on the other hand, there were few indigenous workers at all. In the week 10 to 15 July 1559, only six of the twenty-three miners employed in the mine of Bottino were Italians, and the proportion of Italians to Germans did not on the whole change with time.¹⁸ If local skilled workers took a limited part in the working of the mines, quite a different situation arose in the smelting and refining of the ore for the technical monopoly of the German masters was such that, as a note of 4 July 1560 illustrates, « Smelting was stopped because of lack of smelters, and the Germans left ».¹⁹

It is true that names of Italians are found amongst the workers in the workshops, like Pier Voltolino "our stoker", or Erchole of Ruosina "smith", and also among the small group of drivers, apprentices, and servants who supplied the wood and coal, transported the crude ore from the mines to the warehouse, or repaired the mining equipment.

Not long after the Grand Duke's mines were re-opened women's names began to appear in the lists of workers. The women, who were mainly the wives and sisters of the German workers, were also paid wages, and were probably employed in cooking for the workers and looking after their lodgings. There were women in all the mines: in 1559 there were two at the mine of the Ascensione, one at San Cristofano, and two at Campiglia. In little more than ten years this isolated group of immigrants had grown into a small but largely self-sufficient community.

As in the mines of central South America, it was the German workers who provided the inspiration for the technical advances in mining and smelting which were introduced at Pietrasanta in the 16th century. The great local tradition of mining and working metals had disappeared when the ancient Tuscan mines were abandoned.

The technical problems which arose when the workings at Pietrasanta were reopened must have been considerable: on the one hand, there were no specialized workers on the spot, and on the other, the miners and metal workers from Germany found it difficult to start the process of production again, for it had been interrupted for too long. Ten years after the opening of the works the technique of refining the ore was still at a virtually experimental stage; the Superintendent of Mines noted in a margin of one of the refinery ledgers, « that they had set out to refine all the smelted lead . . . and it did not come out well because the tools were out of order, and so lead and silver were left mixed together ».²⁰

The best source of information on the way in which the metals were worked are the notes which are frequently to be found in the yearly records

¹⁸ A.S.F., *Miniere Medicee*, 20, cit.

¹⁹ A.S.F., *ibidem*, c. 17.

²⁰ A.S.F., *Miniere Medicee*, 5, c. 172.

of a refinery. Without them it would be impossible to reconstruct the different phases of the process, and the production of silver, lead and other by-products, especially since the method used varied according to the type of vein.

We can say with some certainty that the seam must have been "hard", that is « that which is formed from medium - hard stone which is generally reducible in fire... lead stone is of this kind... ».²¹ A scholar of the 18th century observed that « the silver mined at Bottino is a mixture of silver, lead and antimony ».²² The seams of Pietrasanta were less rich in silver but very similar to those of the other central European mines, and in particular those of Saxony, and the method used to extract the ore « from deep shafts » was similar.

The ore extracted in this way, « they put in very hard stone pots where they break it up, and although the pestles are only wooden they are well covered with iron plates ».²³

The product thus obtained was ready for "smelting", which Agricola defined as « separation of those things which before were mixed with the metal ».

Different methods of smelting were in use in the 16th century and Agricola proposed several without favouring any in particular.²⁴ The criterion for the choice of method must obviously have depended on the nature of the material « because some melt in the fire more quickly than others ».²⁵

In the case of the Bottino and Argentera deposits the choice of one or another method of smelting was of fundamental importance. According to Dr. Targioni the chemical composition of the deposits was « mixed with arsenical substances... which when put in the foundry fire disappear leaving nothing but scum and very little silver mixed with it... which disappoints the hopes of those who work it... ».²⁶

The smelting operation was in fact crucial and was the most complex and delicate in the whole production process. Smelting, « which has a good result » made all the successive operations easier, above all the separation of silver from the other substances. But if the smelting was not or technically satisfactory the process of refining the silver often had to be repeated several times, which resulted in an obvious increase in costs.

It was not only a question of deciding whether the smelting should be done « outside the furnace or inside; if inside the furnace, whether the

²¹ G. AGRICOLA, *op. cit.*, libro V.

²² Cf. E. REPETTI, *Dizionario geografico, fisico, storico della Toscana*, Firenze, 1833, vol. IV, pp. 234-235.

²³ A.S.F., Carte Stroziane, I serie, 308, « Descrizione della valle Joachima et delle miniere d'argento della Sassonia », cc. 73-74.

²⁴ G. AGRICOLA, *op. cit.*, libro IX.

²⁵ *Ibidem.*

²⁶ Cf. F. CAMPANA, *Notizie sul Capitanato di Pietrasanta*, cit., c. 276.

aperture should be open for a certain time or always closed . . . if outside whether in pots or in troughs »; it was also necessary to chose the most suitable chemicals for easy smelting, mixing different ores, etc.²⁷

These problems must have been considerable, for the advice given by the German masters and workers was not always sufficient, and more than once samples of ore were sent to Germany so that experts at the German mines could give their opinion. As a result, by the end of the period under discussion considerable technical experience had been acquired, the main consequence of which was that production costs were stabilized at levels that were relatively low compared to those of the first period of activity. But beyond this no other significant result was achieved.

Production costs were stabilized but did not decrease and the quality of silver obtained remained the same as before. Only the discovery of a new technique which would significantly lower the still excessive production costs could have given a vital boost to the whole production process.

In fact, it was when the Medici mines were in their most active phase that the technique which was destined to revolutionize the silver mining industry was first applied in the mountains of Potosí. The method involved using an amalgam of mercury and greatly reduced the time taken to process the metal, so permitting a great saving of fuel and a consequent reduction in costs.²⁸ A. von Humboldt referred to the extreme simplicity of this "patio" method, which required only the use of mules to break up the ore, wood for fuel, and water and mercury for the amalgamating process.²⁹

The failure to apply this method in the Grand Duke's mines would imply that one of these elements was in short supply, as was once the case in America when a sudden fall in imports of mercury from Almadén was enough to cut silver production drastically.³⁰

The first problem, then, could be overcome by ensuring relatively constant imports of mercury, or else by the discovery of "quick silver" within the country. Toward the middle of the 16th century several mercury mines were opened on the Grand Duke's orders in the immediate vicinity of the silver mines. It is difficult to believe that this came about purely by chance, for it is much more likely that, at a time when the production

²⁷ Cf. G. AGRICOLA, *op. cit.*, libro IX.

²⁸ The mercury amalgam was introduced in the "vetas" of Potosí and Zacatecas in the spring of 1549, but was definitively adopted only after the visit of the viceroy Francisco of Toledo, one of the great organizers of the Spanish colonies. Cf. P. VILAR, *Oro e moneta nella Storia*, Bari, 1971, pp. 157-165.

²⁹ A. VON HUMBOLDT, *Ensayo político sobre el reino de la Nueva España*, Mexico edit. in 1966, libro IV, cap. II, pp. 381-383.

³⁰ According to the studies of Vilar this depression took place between 1560 and 1570. After 1574 the mercury yielded by Huancavelica brought about an inversion of this tendency cf. P. VILAR, *op. cit.*, pp. 159-160.

of mercury in Europe was relatively small, the government was looking for « what could he had at home ».³¹

Study of the technical problems of silver mining not only makes it possible to reconstruct the production cycle in some detail but also plays a major part in the analysis of production costs. Fortunately the account books of the Grand Duke's Superintendent of Mines throw useful light on this. An almost complete series of these books was originally kept in the Archives of the *Monte Comune* and was later transferred to the State Archives in Florence.³² Although they are extremely detailed, it is possible to extract the essential data on the production of silver and lead and the relative costs. These ledgers record, year by year, not only the consignments of goods from the workshop, but also the money paid out by Camarlingo in workers' wages and all other payments made in connection with the mines.³³

Table 1 gives the figures for the costs of the entire production cycle in the years under consideration. The data drawn from the Superintendent's accounts can be divided between mining and manufacturing expenses. Under the first heading come all the expenses covering the excavation work, while the second covers the cost of transporting both the materials for smelting, and the ore from the mine to the factory, the cost of the fuel itself and the "smelting materials".

Table 1 shows that the miners' wages accounted for the majority of the expenditure, and this is confirmed by more detailed examination of the sources. For the first quarter of the year 1551-1552 (January 1551-March 1552), for example, the workers' wages represented as much as 54.37% of the total expenditure. Payments for transport and fuel accounted for 10.56%, the salaries of supervisory staff 14.29% and all expenses for the maintenance of the plant, and the purchase and repair of tools only 20.37%.

Since the sources are fragmentary and extremely general, it has not always been possible to make such a detailed examination of costs in all

³¹ Very little is known about the mercury mines in the charge of Superintendent Giuliano Chivavacci. There are absolutely no data on production though some information about expenditure can be obtained from the accounts and annual reports.

Apart from the Superintendent no more than two people were employed, which leads us to believe that the activity was not very extensive. It must be added however that the chemical composition of the ore, which contained both antimony and lead, would have made the use of the amalgam method impossible, as was demonstrated by later experiments made in the New World. Cf. P.J. BAKEWELL, *Silver mining and society in colonial Mexico, Zacatecas - 1546-1700*, Cambridge, 1971, p. 130.

³² It is likely that the move to its present home occurred very late, because in the 19th century Campana still records that, « in the Archive of Monte Comune of Florence are kept 28 books of Camarlingo concerning the mines from 1539 to 1593 ». Cf. A.S.F., Manuscripts, 711, cit., p. 278.

³³ Sometimes the account books are also accompanied by the annual accounts.

PRODUCTION COSTS OF PIETRASANTA SILVER
(PER QUARTER 1546-1592)

TABLE 1

Years	Expenses: mining + manufacture				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total
1546	3,268	3,719	4,895	4,666	16,548
1547	4,777	5,465	4,889	5,357	20,488
1548	6,585	8,232	6,837	7,321	28,975
1549	6,689	6,700	6,239	7,108	26,736
1550	6,689	6,555	4,366	4,484	20,928
1551	—	—	—	—	—
1552	987 2,111	1,348 2,226	619 1,825	1,388 2,179	12,683
1553	—	—	—	—	—
1554	5,204	4,790	4,443	5,442	19,879
1555	—	—	—	—	—
1556	—	—	—	—	—
1557	—	—	—	—	—
1558	—	—	—	—	—
1559	(801)	(1,043)	(915)	(2,196)	22,083
1560	1,772 2,670	1,497 4,307	1,460 3,766	2,230 4,715	22,417
1561	2,615	786 4,514	1,253 4,059	1,656 4,180	19,084
1562	1,491 3,507	1,467 4,307	1,460 3,766	2,230 4,715	22,417
1563	1,516 3,642	1,205 3,457	434 408	430 807	23,798
1564	1,215 2,653	1,530 2,638	1,122 4,166	2,166 5,385	20,875
1565	1,021 3,741	953 4,739	1,140 4,948	1,064 5,815	23,421
1566	1,041 3,000	1,715 5,165	1,633 4,708	1,236 6,503	25,001
1567	661 3,606	1,170 4,747	1,075 4,757	1,632 6,992	24,640
1568	1,807 3,903	1,440 5,283	1,429 5,219	1,577 6,339	26,997
1569	1,193 3,503	1,923 4,208	1,177 5,058	1,323 5,594	23,979
1570	995 2,815	1,540 5,235	1,326 5,115	1,297 6,784	23,979
1571	—	—	—	—	—
1572	5,242	5,895	6,465	7,636	25,238
1573	5,594	5,594	5,918	6,595	24,101
1574	—	—	—	—	—
1575	(4,613)	—	—	—	—
1576	—	—	—	—	—
1577	5,342	6,765	6,350	7,984	26,441
1578	5,894	7,556	—	—	—
1579	5,788	5,630	6,052	8,522	25,992
1580	5,192	6,010	6,846	8,152	26,200
1581	5,758	6,427	6,973	9,193	28,351
1582	4,607	6,265	5,646	8,187	24,705
1583	4,848	5,631	5,865	9,588	25,932
1584	715 4,273	846 6,273	5,980	9,138	27,225
1585	4,893	6,932	6,528	8,054	27,916
1586	5,430	7,433	6,179	8,549	27,558
1587	5,791	4,682	6,659	9,129	25,952
1588	6,273	7,612	5,124	8,549	27,558
1589	(4,949)	—	—	—	—
1590	—	—	—	—	—
1591	—	—	—	—	—
1592	5,417	5,818	5,515	7,731	24,481

the various areas of production, although it seems that the costs of production tended to rise steadily. Taking the five-year period 1559-1563 as a base of 100, the index had reached though less pronounced increase to between 1584-88 there was a further though less pronounced increase to 125.89. It is extremely difficult to state the reasons for such a rise in production costs. On the basis of the data one could assume that an absolute increase in costs followed an increase in the rhythm of production, which would have involved a larger work force and greater consumption of fuel. Had this been so, however, the unit cost of the silver should have decreased. This assumption is clearly contradicted by Table 2, which shows the unit cost of a pound of silver for the years 1548-1588.

While the unit cost tended to decrease during the five years from 1559 to 1563 compared with the figure for the initial period between 1548 and 1552, it tended to stabilize at a relatively higher average between 1564 and 1583, and rose yet again between 1584 and 1588.

The gradual increase in production costs in the Medici mines can be understood in the context of a wider process which affected the entire mining industry at the end of the 16th century. Recent studies have shown that this was due to a sudden rise in the price of factors of production;

TABLE 2

UNIT COST OF PRODUCTION OF ONE POUND OF SILVER
1548-1588

Year	Cost	Year	Cost
1548	252.71	1569	119.89
1549	67.17	1570	166.25
1550	102.08	1571	—
1551	—	1572	153.89
1552	86.27	1573	140.12
1553	—	1574	—
1554	138.04	1575	—
1555	—	1576	—
1556	—	1577	—
1557	—	1578	—
1558	—	1579	148.52
1559	108.78	1580	169.03
1560	111.52	1581	218.08
1561	190.84	1582	123.52
1562	70.53	1583	116.28
1563	184.48	1584	109.33
1564	170.95	1585	136.11
1565	153.49	1586	—
1566	135.87	1587	201.15
1567	138.42	1588	308.95
1568	141.60		

the cost of the wood and charcoal used in smelting of metals is indicative.³⁴

The development of metallurgy and the consequent increase in consumption brought about a crisis in the German mines due to a fuel shortage. The same problem occurred in the Pietrasanta mines although on a less alarming scale.

On 29 November 1590 the General Council of Pietrasanta prohibited the cutting down of trees within two miles of the *Monte della Argentera*, but Bianchi, the historian of Camaiore, commenting on this decree, tells us that a process of indiscriminate deforestation had already begun with the cutting down of the forests of the Culla in 1582. If, on the one hand, the fuel needed for the mines was becoming scarce, on the other the price of other raw materials used in the works was also rising.³⁵

These factors probably played a relatively minor part in the increase in costs.

Ruggiero Romano has recently shown that in the American mines the price of precious metals was largely determined by the cost of labour since throughout the 16th century this type of mining industry did not require large amounts of fixed capital for expenses of a technical nature.³⁶ This is further confirmed by examination of our data for the period up to 1570: as we have seen, at Pietrasanta the main expenditure for the whole of this period was on miners' wages.

The increase in costs between 1570 and 1580, then, though not excessive, was probably brought about by an increase in workers' pay, even though the sources do not provide us with a definitive answer to the question. Of the workers « *Quaderni di opere et richordi* » in which the workers' wages were recorded, week by week, only those covering three years (1559, 1560, 1561) survive, and it is obviously impossible to draw any conclusions as to overall development of the workers' pay on this basis, especially as they do not reveal any outstanding variations. The task is made more difficult by the fact that the wages varied a great in any case, since differences in pay reflected the different degrees of responsibility borne by individual workers.

The highest wages were paid to the Master refiner, to the "Soprastanti" (overseers) and the Master smelters (Table 3). This scale has many features in common with the one operating in the same period in the Tudor silver mines in Southwark and Bristol where the highest wages were paid to

³⁴ On the timber shortage cf. C.M. CIPOLLA, *Storia economica dell'Europa pre-industriale*, Bologna, 1974, pp. 284-287.

³⁵ Thus, for example, the oil used by miners to light the mines or the leather needed for the making of the bellows used by the smelters.

³⁶ Cf. R. ROMANO, *I conquistadores: meccanismi di una conquista coloniale*, Milano, 1974, p. 105.

WEEKLY WAGES BETWEEN 1559 AND 1561

	Wages (in lire)		Wages (in lire)
Supervisor	13	Smith	5-6
Master	8	Attendant	7-10
Refiner	15	Driver	7
Smelter	10	Female employee	2.10

the "finers" and "blanchers", while the "labourers" worked for very much less.³⁷

At Pietrasanta a superintendent's pay was about 2 *lire* a day, that of the miners and smiths exactly half, and the apprentices and women workers received almost a quarter. It is therefore of dubious value to talk of an average wage when the pay was so highly differentiated; and much better to refer, as we have done, to the overall costs of production.

It is difficult to agree with Campana that, « Cosimo (and his successors) dallied about and spent a great deal on mining for silver without any profit, and rather to his own loss, (and) this commitment dragged on for many years without earning him anything ».³⁸

In what did the "profit" consist? The mineral deposits of Pietrasanta were probably very low in metal content compared with the Saxon mines. Giorgio Agricola bears witness to the fact that in Germany « they found a piece of silver so big that the prince who owned the place had a square table made of it in the German manner » while the calculations made by Biringuccio of Siena indicate that some German mines « were good because they obtained more than three and a half ounces of silver for every hundred of ore ». The Pietrasanta vein on the other hand contained, as we have already said, high percentages of lead and antimony.³⁹

In a letter of January 1582, Giovambattista Carnesecchi, the Grand Duke's minister in Pietrasanta, reported that « from 20 November to 24 December last, twenty-two pounds of silver have been made and refined in the said time, 2,255 pounds of good lead, and that was taken from 15,000 lbs. of *bottino* ore, and, in the said refining, 665 lbs. of poor lead was obtained ».⁴⁰

This careful and scrupulous observer, the trusted servant of the house of Medici, gives in a few lines a complete picture of how much the

³⁷ Cf. C.E. CHALLIS, *Southwark Mint 1545-1551*, in « British Numismatic Journal », 1964, p. 135.

³⁸ A.S.F., 711, cit., p. 278.

³⁹ This comment is quoted from BIRINGUCCIO, *Pirrotechnia*, cit., ch. II.

⁴⁰ A.S.F., Medocce, 6052, c. 17.

mineral deposits produced, and in the years following 1582 the situation would not have changed radically. We may conclude with Carnesecchi that, « deposits have been richer in silver and poorer in lead than at other times ».⁴¹ In fact in 1582 the ratio between the quantity of ore and silver extracted from it was about 681:1, and in 1590, it reached more than 725:1. The mineral deposits probably declined progressively in the last decade. Table 4, which gives the quantity of ore per mine, shows that in these years mining became centred mainly around Bottino, after the Argentera mine began to show unmistakable signs of exhaustion.

Perhaps because a further decline in production at Argentera and Bottino was foreseen, new mines were opened in 1556-57, at Boddaiio and San Cristofano another, larger one at Campiglia, and a small group of deposits which are only named in the documents (Canal Buio, Valdicastello, Santa Barbera etc.). But the new seams were not rich enough to improve the level of productivity, which from an initial quota of 283, had sunk to a more or less constant level of about 507 for the 20 years from 1550 to 1570, and diminished even further in the last decade of the period under consideration.

TABLE 4

DISTRIBUTION OF ORES REACHING PIETRASANTA
IDENTIFIED BY MINE OF ORIGIN (1542-1592)

Years	Argentera (pounds)	Bottino (pounds)	Boddaiio (pounds)	Campiglia (pounds)	S. Cristofano (pounds)
1542-1551	143,455	12,800	—	—	—
1552-1561	181,626	174,893	—	35,100	—
1572-1581	84,009	195,424	36,107	—	—
1581-1592	28,450	226,880	—	—	29,950

From the point of view of productivity the opening of new mines undoubtedly had a positive effect; in that it became possible to keep the quantity of silver produced at a sufficiently stable level.

It is not possible to make a proper evaluation on the basis of the data showing annual production (Table 5), which show an extremely high degree of variability. For example, in 1558 the works produced 101.4 pounds, then double that quantity in the next years, only to sink back to a hundred pounds in 1561. For a more accurate evaluation it is therefore preferable to use Table 6, in which the averages for five-year periods are listed.

⁴¹ *Ibidem.*

⁴² A.S.F., Miniere Medicee, 5, c. 170.

TABLE 5

ANNUAL SILVER PRODUCTION (1548-1593)

Years	1st Quarter (pounds)	2nd Quarter (pounds)	3rd Quarter (pounds)	4th Quarter (pounds)	Total
1548	—	26.8	30.10	25.11	83.5
1549	26.8	106.6	150.3	114.6	397.11
1550	40.2	35.2	62.7	67	204.11
1551	29.3	32.9	53.10	24	139.10
1552	38.10	32.9	37.5	37.7	146.7
1553	—	—	—	—	—
1554	18	36.6	36.4	53.1	143.11
1555	15	13.8	—	41.9	70.5
1556	—	—	—	—	—
1557	—	—	—	—	—
1558	—	39.10	19.8	34.8	101.4
1559	—	94	—	109.3	203.3
1560	20.9	69.4	111.8	—	201.9
1561	—	—	67	33.6	100.6
1562	98.10	72.3	—	111.5	282.6
1563	—	55	—	73.11	128.11
1564	62.9	35.6	—	205.1	240.7
1565	28.8	—	89	19	136.8
1566	37	28.9	37	81.3	184
1567	33	44.8	53.6	46.6	177.8
1568	17	52.4	87.8	16.8	173.8
1569	57.4	58.11	40.8	43.6	200.5
1570	17	57.1	39.6	37.7	151.2
1571	—	—	—	—	—
1572	31.3	41.2	37.8	53.7	163.8
1573	33.4	44.5	26.9	57.3	171.9
1574	34.3	53.4	38.10	49.7	176
1575	48.5	53.4	56.4	52.5	210.6
1576	—	—	—	—	—
1577	50.2	52.3	33.1	69.8	205
1578	33.11	56.4	43.3	52.3	185.9
1579	41.6	35.3	46.1	52.2	175
1580	32.9	50.7	29.11	41.6	154.9
1581	24.10	25.6	32.3	47	129.7
1582	30.5	71.3	41.6	57	200.2
1583	33.6	83.5	33.3	73.3	223.5
1584	54.10	72.5	57.10	64.2	249.3
1585	41.1	53.10	52.5	46.8	194
1586	27.7	48.9	54.2	56.2	186.8
1587	36	47.2	27.5	53.5	137
1588	28.11	42	—	13.8	84
1589	64.6	17.8	58.8	17.6	158
1590	38	71	43.9	51.1	203.1
1591	—	—	—	—	—
1592	36	35.2	59.5	49.5	180
1593	17.3	27	20	—	64.3

TABLE 6

SILVER PRODUCTION IN FIVE-YEAR PERIODS 1548-1593

Years	Total production (pounds)	Average annual production (pounds)
1548-1552	972.8	194.5
1553-1557	214.4	107
1558-1562	889.4	177.8
1563-1567	868.4	137.8
1568-1572	689	173.8
1573-1577	764	152.8
1578-1582	845.8	169
1583-1587	990.4	198
1588-1593	671	134.2

The picture we draw from this table is one of relatively stable production which reached its highest levels at the beginning (1548-52) and at the end (1583-87), though the causes of these rises in output seem to have been different. The high yield of the first five years is probably due to an accumulation of raw materials before the opening of the workshops. Between 1548 and 1552 not only was the mineral which was excavated daily kept in the warehouses but also that which had been accumulated during the excavations begun by the first German miners in the summer of 1542. After this initial peak, production suddenly appears to have fallen off.

Nevertheless the sources for these years are too fragmentary to permit any positive conclusion as to the causes of the partial arrest in production in 1556-57, which was however certainly short-lived. As early as 1558 production rose once again to fairly high levels and the situation remained almost unchanged for 30 years, with only a slight drop in 1563-65, 1570-71 and 1580-81.

This is the period of full activity in which the results of technological advancement were combined with the discovery of new deposits, and the peak of a trend was reached in which the production of silver attained and surpassed the levels for 1548-1553.

The activity of the factory of Pietrasanta was not however limited to the production of silver. This was obviously the main aim of the Grand Duke's initiative, but the possibility of exploiting the resources of the mines to the full was never neglected. This essentially involved the recovery and use of all the residual material left after refining the silver.

Only rarely was the mine « shining like stone: all or almost all of silver »; it was more usual to find « very heavy seams mixed with lead ».⁴³

⁴³ BIRINGUCCIO, *op. cit.*, ch. II.

The main product derived from the separation of the silver was in fact "poor" lead, that is lead without dross or "stage" of silver. Although this was the mineral used for purposes secondary to the productive cycle of the silver, we have shown in Table 7 the data concerning the production of "rich lead" and "poor" and "rich ash", which were minerals resulting from intermediate phases in the working of the ore.⁴⁴

The pattern of lead production resembles that of silver only in the central period. In the first two five-year periods, as in the last two, the quantity of silver produced reached its peak levels, while the production of poor lead fell off suddenly and markedly (Table 7).

This arises from the fact that it was closely dependent on the mineral content of the seam: where the quantity of silver in the vein was greater, the proportion of lead liberated in the smelting process was lower.

This is evident above all in the early years, when the high silver yields of the Argentera and Bottino mines corresponded to the very lowest levels of lead production. The features of the 30 years from 1558 to 1587 are rather different. Though the new deposits made it possible to maintain silver production at constant levels, they were much poorer than the first seams discovered in Pietrasanta, which led to a relative increase in the quantity of lead obtained in the refining process.

Silver and lead were weighed and worked together, and records kept in the same account books, but once outside the Pietrasanta workshops, their paths separated. The first destination of the silver — the documents constantly repeat — was the Wardrobe of the Medici Palace in Florence.

« 21 June 1587... (we have delivered) five big silver ingots and three small ones of 78 pounds and 1 ounce in weight to the wardrobe of S.A.S. in Florence; Gabriello da Prato, the driver, took them... 78 pounds 0.3 den. 2 of silver returned to Florence, with a receipt from ministers of the Wardrobe ».⁴⁵

But our sources give us no other information apart from the name of the driver and the weight and date of the consignment.

How was the silver used? Was it sold to private individuals, and therefore destined for personal use, or, as is more likely, was it kept for minting coin?

⁴⁴ "Rich" lead is derived from the first phase of refinement of the ore and is an amalgam of lead and silver, while the "ceneraccio" (poor ash) is the final residue of the molten material containing ashes, waste, lead dross and sometimes "granaglie" (granules) of silver. If the "ceneraccio" is "poor", that is if it contains no silver, it is further refined and its end product is lead; if it is "rich", it could be melted down.

Finally litharge is a protoxide of lead obtained by heating the lead in air until it melts and letting it solidify. It is a red and white coloured dust also used in smelting. Cf. G. AGRICOLA, *op. cit.*, ch. VII.

⁴⁵ A.S.F., Miniere Medicee, 88, c. 1.

TABLE 7

LEAD PRODUCTION: RAW MATERIAL AND BY-PRODUCTS
(1548-1593)

Years	Crude ore (pounds)	Rich lead (pounds)	Poor lead (pounds)	Ash (rich) (pounds)	Ash (poor) (pounds)	Litharge (pounds)
1548	—	—	6,573	—	4,766	5,740
1549	113,005	36,352	3,717	5,305	16,169	31,844
1550	90,320	25,591	2,157	6,332	14,887	8,864
1551	86,553	30,053	6,186	1,178	9,906	6,436
1552	67,635	—	4,909	4,062	6,763	3,409
1553	—	29,841	8,247	7,849	13,387	6,371
1554	—	16,570	5,689	4,062	775	3,719
1555	—	33,119	17,601	11,063	16,359	4,471
1556	—	—	—	—	—	—
1557	—	3,088	1,466	—	—	—
1558	—	14,653	2,456	278	4,543	—
1559	—	7,231	10,787	660	5,991	4,753
1560	—	44,389	17,270	8,078	24,514	2,460
1561	—	21,521	—	1,760	10,680	2,300
1562	—	—	—	—	—	—
1563	—	7,598	—	—	—	—
1564	—	14,390	—	—	—	—
1565	—	16,761	—	—	—	—
1566	—	37,381	24,402	18,381	8,468	5,272
1567	—	18,768	—	—	—	—
1568	—	22,123	—	—	—	—
1569	89,030	43,639	21,252	11,895	46,278	6,672
1570	—	18,292	—	—	—	—
1571	55,532	20,723	7,592	7,398	10,635	1,836
1572	—	—	15,009	—	—	—
1573	88,978	26,737	11,004	7,080	19,420	3,142
1574	102,837	32,369	12,912	8,922	24,142	3,642
1575	115,631	29,272	12,159	9,156	21,462	—
1576	—	—	—	—	—	2,642
1577	—	—	11,777	—	—	—
1578	—	—	8,542	—	—	—
1579	—	—	5,954	—	—	—
1580	56,425	23,143	6,135	3,500	5,226	—
1581	96,623	21,768	6,205	6,845	14,170	—
1582	—	—	8,642	—	—	—
1583	—	—	8,454	—	—	—
1584	—	—	8,253	—	—	—
1585	—	—	10,157	—	—	—
1586	43,980	12,714	4,520	6,200	6,750	—
1587	84,038	—	—	—	—	—
1588	—	—	—	—	—	—
1589	—	16,055	8,674	8,180	8,100	—
1590	147,320	30,649	5,845	11,100	9,510	—
1591	—	—	—	—	—	—
1592	143,358	23,203	1917	7,500	7,200	—
1593	90,750	8,711	2,723	4,100	4,700	—

The record books for « purchases of gold and silver » in the Archives of the Florentine Mint do not mention the provenance of the metals used in minting so it is impossible to tell whether or not silver from Pietrasanta was used.⁴⁶ Nevertheless this is most likely, and one memoir in fact records, « that there exist some coins stamped in this mint with the date 28 September 1630, made of silver from the mines in Pietrasanta, called "ducatone quarter", with the effigy of the Grand Duchess Cristina of Lorraine, the widow of Ferdinand I ».⁴⁷

On the other hand details of the many uses for the lead produced in the Medici factories can be drawn from the account books of the Provveditore. By far the most important, in terms of the quantity used, was the manufacture of cannon balls to arm the galleys of the Grand Duke's fleet or the coastal fortifications. Nearly all the lead produced in the period 1570-1580 was sent to Leghorn « for the galleys of His Highness to Messer Filippo Ducci, Provveditore of the Arsenal » and it was only after that date that the lead was ever destined for certain fortresses of the Grand Duchy.⁴⁸

In 1586 the metal was sent to « Giovanni Seriaconi, Provveditore of the fortresses of His Highness », ⁴⁹ and in 1591 was made into cannon balls for the tower of the Salto della Cervia and tower of the Cinquale.

However the chemical composition of the Pietrasanta lead prevented it from having a good local market, as Giovambattista Carnesecchi noted:

« In accordance with the orders of V.A.S. have tried to sell it to a local artisan who tried it, and it is so hard that it does not melt and is less durable than other kinds of lead. It turned out to be no good for the hunters and soldiers, and this is the only thing it could be used for here, and therefore I see no way of employing it and if it please you send it to Pisa to the Caccino ».⁵⁰

Towards the end of the 16th century a gradual process of decline began which within the space of a few years led to the final abandonment of the Pietrasanta mines. Chronologically the closing of the Medici mines can be considered as the epilogue to a cycle of prosperity in the mining industry which had taken place in certain regions of Europe between the first and the second phase of expansion in the American silver mining industry. Though these experiments were very different, there are many similarities between them.

The mines of the Fugger, like those of the Tudors, the Dukes of Lorraine and the Medici, were opened or reopened in the first decades

⁴⁶ A.S.F., Zecca, 291.

⁴⁷ A.S.F., Manuscripts, 711, p. 279.

⁴⁸ A.S.F., Miniere Medicee, 85, c. 2.

⁴⁹ A.S.F., Miniere Medicee, 95, c. 2.

⁵⁰ A.S.F., 6052, c. 17.

of the 16th century to supply an ever growing demand for precious metals, a demand which could no longer be satisfied by imports from outside Europe, and these deposits in fact proved to bear a higher proportion of mineral than American seams.⁵²

Nevertheless in 1550, after a period of a constant rise in production, the mines of Saxony closed and were followed a short time later by all the principal mines of Europe, first by those in England, and finally by the Pietrasanta mines.⁵³

The fundamental causes of this decline in the mining industry of the Old World have not yet been fully explained, for the absence of advanced technology and the inevitable exhaustion of the seams would not alone justify the simultaneous and sudden abandonment of a venture which had yielded considerable results.

The almost complete lack of statistics on production costs hinders any inquiry into the crisis in the European mining industry, and any theses which can be formulated on the subject can be applied only to particular cases and not to the phenomenon as whole.

The picture which emerges from an analysis of the date for the Pietrasanta mines is, after all extremely static: production remained at almost constant levels for a long time, both in the organization of the productive cycle and in the technical sector, where no significant innovations were introduced.

In this relatively stagnant situation the arrival of American silver in huge quantities, and the progressive though limited, increase in production costs, which were already particularly high, left their mark. Perhaps a combination of these factors indicates the real reason why mining, in which the profit by then did not even cover the great expense, was abandoned.

⁵¹ Chaunu places the first great phase of American silver production between 1504 and 1550, the second between 1562 and 1592. Cf. P. CHAUNU, *Séville et l'Atlantique*, Paris, 1959, and R. S. SMITH, *Seville and the Atlantic Cycles in Spanish Colonial Trade*, in « Journal of Economic History », 1962, pp. 253-259.

⁵² In fact a report by Louis Capoche affirms in connection with American silver that in 1585 « many galleys had brought waste materials the quality of which does not make it worth the cost ». Quoted in P. VILAR, *op. cit.*, p. 164.

⁵³ Cf. J. U. NEF, *Silver production in Central Europe*, in « The Journal of Political Economy », 1941, pp. 575-591.

