Investments in Ore Mining in Poland from the 13th to the 17th Centuries

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I.

I. In Poland seams of various minerals were mined between the 13th and 17th centuries including iron ore and non-ferrous metals such as lead and copper. In Silesia, which had not belonged to Poland since the 14th century gold was mined as well as salt, sulphur and various rocks.[1] The production of salt and lead was at that time the most important and extensive. Salt deposits were situated not far from Cracow near the mining towns of Wieliczka and Bochnia. They were discovered in the middle of the 13th century on the site of saline groundwaters which had been known for a long time. The output in the 16th century was about 20 thousand tons of salt per annum, while in the mid 17th century it rose to 37 thousand tons, and the mines of the Cracow region were at that time, together with the mines of Transylvania, the second most important producers of rock-salt in Europe.[2] The seams of lead ores, and especially of galena mixed with silver, were

1 For a summary of the present state of research on the history of mining in Poland see the collective paper edited by J. PAZDUR, *Zarys dziejów górnictwa na ziemiach polskich* (Outline of the History of Mining in Poland), vol. I to the end of the 18th century, Katowice 1960, p. 210.

2 Research on the history of salt mining in Poland has been particularly intensive in the post-war period; the two most important papers are: J. WYROZUMSKI, *Państwowa gospodarka solna w Polsce do schyłku XIV wieku* (The State Salt Economy in Poland to the End of the 14th century), Kraków 1968, p. 137, and A. KECKOWA, *Żupy krakowskie w XVI-XVIII wieku* (Salt-mines in the Cracow Region in the 16th-18th Centuries to 1772), Wrocław, Warsaw, Kraków 1969, p. 522.

situated in several regions, but the largest and most important were those near the borders of Little Poland and Upper Silesia near the mining towns of Olkusz and Sławków. The North-Eastern parts of those seams and the mining towns of Bytom and Tarnowskie Góry in Upper Silesia had been outside the borders of Poland since the 14th century. They had been well known to the local population for a long time, most probably from the Halstatt period, and more intensive and regular mining started in the 13th century, when the output of lead was some 200-500 tons a year. In the mid 16th century it rose to a thousand tons and by the end of the 16th and early 17th centuries had reached between two thousand and three thousand tons a year.[3] For the sake of comparison it is worth mentioning that the two largest areas of copper mining Banska Bystrica (Neusohl-Germ.) in Slovakia which then belonged to Hungary, and Mansfeld in the Harz mountains were each producing in the first half of the 16th century, the period in which their output was at its greatest, 2500 tons of copper a year, and at the turn of the 16th century a thousand tons a year. In the 16th century the Bohemian centres of tin mining in the Erzebirge (germ.) had an output of 300 tons of tin each and those in Saxony 550 tons of tin each. Poland was at that period then, one of the most important producers of non-ferrous metals in Central Europe.

Polish production of lead and salt was so great that it was not only sufficient to satisfy local needs but also made regular exports possible to neighbouring countries, firstly to those in the South and West white lead was also exported to western Europe. This trade, then, brought the Polish economy into the European economic system.

II. Production on such a large scale called, of course, for substantial investments. The need for investments, their extension and the forms they took differed in the salt and lead mines because of the different techniques employed in mining operations and the different organization of the mining companies.

Salt deposits were situated in a rather small area of about ten km. in length in large deposits of up to 20,000 cubic metres which reached from several dozen to a hundred metres below ground level. Each mine was provided with several shafts and after the salt had been discovered, the risk involved in further prospecting in the underground excavations was very small indeed, and there was no danger from water as the deposits were practically dry.

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[3] For the history of Polish lead ore mining see D. MOLENDA, *Górnictwo kruszcowe na terenie złóż śląsko-krakowskich do połowy XVI wieku* (Ore Mining in the Silesia-Cracow Region to the mid 16th Century), Wrocław, Warsaw, Kraków 1963, p. 425, and D. MOLENDA, *Kopalnie rud ołowiu na terenie złóż śląsko-krakowskich w XVI-XVIII wieku* (Lead Ore Mines in the Silesia-Cracow Region in the 16th-18th Centuries), Wrocław, Warsaw, Kraków, Gdańsk 1972, p. 420. Both papers served as a basis for the present article and contain full references and lists of written sources, iconographic, cartographic and material ones.

The greatest investments were necessary at the very beginning when mines were established, prepared for mining and shafts were sunk. The further development of the mines (their deepening for instance) was a gradual process which did not involve any larger investments.

Salt, being a indispensable necessity for the whole population, was an important political instrument in the hands of the rulers. Consequently they showed particular interest in it not only for fiscal reasons but also as a factor of social integration. The production of salt in Poland had been the ruler's monopoly the since 13th century and the trade was under strict control. Salt-mines were large enterprises owned by the sovereign and managed by a complex system involving many individuals. Private contractors were given a share albeit a very limited one in the initial period of mine construction but these private investments were abolished during the 14th century and disappeared entirely in the 15th century. The whole responsibility for investments was taken over by the royal company which covered the costs out of the operating returns. If the royal Treasury did not have sufficient means at its disposal, the company was leased out, but the leaseholders had neither the right to choose their own methods and organization of production nor even to determine its range. The salt produced was always the sovereign's property and prices were not subject to free-market requirements but controlled by the authorities. Much of the salt was distributed or sold at very low prices, but nevertheless the profits from the lease of the royal salt companies were large and the lease itself so attractive that it was often sold by auction.

In the lead-mines, which are the subject of the present paper, the situation was different. The mining was not as stable as in the salt-mines and the need for investment increased with the development of production. Polish lead ore lay in seams and not in veins like most ledges of non-ferrous metals known at that period. The ledges were very extensive, spreading over some 80 km. in two more or less parallel ranges. There were numerous outcrops, bassets and exposed surface areas so the work was done opencast or else a shaft was sunk and the seam within immediate reach was worked. Then the shaft was abandoned and another sunk nearby. Hundreds of these shafts were constructed, although they were shallow and only reached a dozen or so metres below ground level, so mining was not expensive at that time and called for quite small investments. The situation changed fundamentally after the shallowest seams had been worked, however, and the need arose to reach the lower ones. These were not, however, situated very deep, at 40-60 metres (in some parts only, under hummocks, at 80-100 metres), whereas in the silver mines of Kutna Hora (Kuttenberg - Germ.) e.g. mining had been carried out at depths as great as 500 metres in the Middle Ages and in the Alps a shaft 850 metres deep was sunk in the 16th century. The majority of Polish lead ores were deposited, however, at water level and

extraction was possible only with permanent and systematic drainage of the seams. There was a considerable amount of water in Polish lead mines, twice and three times as much as in the other areas of Europe, as foreign miners who visited the area remarked. The removal of water was therefore very expensive and the extraction of ore from lower levels called for considerable investment in drainage.

Thus, as far as the need for investment is concerned, two essentially different stages in the development of Polish lead mining might be distinguished: the first was the period of low cost and small capital investment production (shallow and dry seams) and the second was marked by the increasing costs of production and high investments (deeper and water-bearing ledges). Appropriate changes in both methods and organization of production were introduced at each of these stages.

The organization of Polish lead mines was based on principles similar to those that governed all European ore mining at that time. Mining was conducted by small producers who joined together to form mining companies (*Gewerkeschaft*). They paid the ruler fees in accordance with the regulations in force in particular areas, which were based in Poland chiefly on Bohemian and Hungarian mining laws. The ruler did not then control any mining operations, but contented himself with obligatory exactions on metal, as was then the custom, (usually 1/8 of production) and with exercising supreme administrative and juridical power. The extraction of lead ores was, then, unlike that of salt, controlled by dozens and at times even hundreds of small companies. Initially the members of these companies were skilled miners, some of whom belonged to the local population and the rest foreigners from other mining centres at home and abroad. They came to Poland mainly in the 13th century as part of the migrations of that period. Italians and Germans were probably predominant among the newcomers since in Polish documents they are referred to as « *Romani sive Theutonici sive quicunque alii hospites* ». They made their homes in settlements and small towns founded near the deposits, and the royal free town of Olkusz was the largest of these. Most were shareholders in one or two mines, the richer ones also owned smelting works where they smelted their own ore as well as that belonging to poorer miners. The larger smelting works were either owned in common by a group of miners or else belonged to the municipality.

II.

Production could be financed by these small mining companies as long as mining was not expensive, that is as long as shallow seams which were dry and situated above the water level were being mined. But later when the need arose to move on to deeper ones that had to be drained, small producers were not in a position to cover the increased cost of production

and began to complain of "*graves impenses*" and "*sumptos maximos*",[4] which they were unable to defray. A difficult period for mining then started throughout the area and in some parts total stagnation occurred. Some mines were flooded, while the production of others decreased. The crisis that occurred in the Polish lands between the mid-14th and the mid-15th centuries was similar in its nature and in its timing, to the situation in many other European centres of non-ferrous metal mining.

The next development of mines occurred when large amounts of capital started to pour in from outside and investments were made which the small mines had been unable to undertake. In Hungarian, German and Bohemian mines such investments were made mainly in the silver or copper mines which contained considerable amounts of silver, and hence a product that could be sold at high prices. In Poland, however, the basic product was lead, a less precious metal which did contain some silver although this was not always extracted.[5] The fact that investments were made at all is interesting and because of them mining operations continued up to the end of the 17th century, supplying lead of high quality both to the home market and to foreign countries. The reasons for this are to be found in the increased demand for this metal which became increasingly sought after. In the Middle Ages it was used in metal production, in building and most of all in the preparation of precious metals (in the smelting of ores and in refining metals). The increased demand for lead after the mid-15th century was connected with the diffusion of the previously known, but little applied method of extracting silver from so-called "black copper" by means of "saigern". Large amounts of lead were needed in this process. Another important factor in the increased demand for lead was the widespread use of fire-arms in the 15th century. Lead was used for the alloys from which gun-barrels and fire-arms were manufactured but, most importantly, it was used in the production of bullets and cartridges. The Polish lands, together with Carinthia and Harz (Goslar), were the third most important supplier of lead to the markets of Central Europe. English lead from Cornwall did not play any important part in these markets until the mid-16th century, and the

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[4] «Magistri moncium vix cum magnis laboris et impensis gravissimis mineras plumbi effodient» stated a document from the beginning of the 15th century J. Caro, *Liber cancellariae Stanislai Ciołek*, vol. 2, Wien 1871, no. 99; Corpus Iuris Metallici Poloniae Antiquioris, ed. H. Łabęcki, Warsaw 1841, nos 14, 15, 19.

[5] Silver was occasionally extracted from the richest lead in the 12th century, and on a fairly regular basis from the mid 16th century to the 18th century. Peak production amounted to between 200 and 600 kg per annum and in exceptional cases in the early 17th century to as much as 1200 kg a year. However, large amounts of lead containing some silver were always being sold without the silver extracted. Cf. D. Molenda, *Produkcja srebra w Polsce w XVI i XVIII w.* (The Production of Silver in Poland in the 16th and 17th Centuries), in *Społeczeństwo, gospodarka, kultura.* Studies in honour of Marian Małowist on the 40th anniversary of his academic career, Warsaw 1973, pp. 223-240.

Bohemian and Serbian mines provided only small quantities from time to time. Polish lead was supplied in the first place to the centres of silver production in Slovakia, which then belonged to Hungary (Lubietova, Brezno, Gelnica, Smolnik and especially Banska Stiavnica, Kremnica and Banska Bystrica, near which a big "Saigerhütte" had operated since the end of the 15th century). These imported up to 200 tons of Polish lead every year while 50-100 tons a year were supplied to Bohemia (mainly to Kutna Hora) and on a smaller scale Jachymov (Joachimstahl-Germ.). In the 16th century lead from Poland also appeared on the markets of Dresden, Freiberg, Leipzig, Nurnberg and Thuringia and was supplied to the local smelting works ("Saigerhutte"). As early as the Middle Ages it was dispatched on the River Vistula through Gdańsk to Flanders, although this trade route grew in importance mainly in the 16th century. Hundreds of tons a year were sent through Gdańsk to Western Europe after the end of the 16th century.[6] Polish lead was sold on foreign markets at high prices, higher than the lead from Goslar or Carinthia, because it contained a large amount of silver, which was not often extracted on the spot and due to its good metallurgical properties.[7] The transport, especially overland to Bohemia and Hungary, was of course very expensive. In both these states, however, lead supplies were free of tax and the rulers were interested in the efficiency of the silver smelting works where lead was needed as the indispensable raw material, so it enjoyed

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[6] See also other papers on the trade in Polish lead: J. Dąbrowski, *Kraków a Węgry w wiekach średnich* (Cracow and Hungary in the Middle Ages), « Rocznik Krakowski », 1913, vol. 13; S. Kutrzeba, *Handel Krakowa w wiekach średnich na tle stosunków handlowych Polski* (Cracows' trade in the Middle Ages and Polish Commercial Relations), Craków 1912; K. Pieradzka, *Handel Krakowa z Węgrami w XVI w.* (Cracow's Trade with Hungary in the 16th Century), Craków 1935; R. Rybarski, *Handel i Polityka handlowa Polski w XVI w.* (The Trade and Commercial Policy of Poland in the 16th Century), vols I-II, Poznań 1928; J. Małecki, *Związki handlowe miast polskich z Gdańskiem w XVI i pierwszej połowie XVII w.* (The Commercial Relations of the Polish Cities with Gdańsk in the 16th and the First Half of the 17th Century), Wrocław 1968; M. Bogucka, *Handel zagraniczny Gdańska w pierwszej połowie XVII w.* (The Foreign Trade of Gdańsk in the First Half of the 17th Century), Wrocław, Warsaw, Craków 1970; D. Molenda, *Czesko - polskie kontakty w górnictwie kruszcowym w XV i XVI w.* (Bohemian - Polish Contacts in Ore Mining in the 15th and 16th Centuries), « Rozprávy Národního Technického Muzea v Praze », vol. 26, 1967, pp. 143-166; J. Vlachovič, *Slovenská meď v 16. i 17. storoči*, Bratislava 1964; T. Werner, *Das fremde Kapital im Annaberger Bergbau und Metallhandel des 16. Jahrhunderts*, « Neues Archiv für sächsische Geschichte », 1936, vol. 57; E. Koch, *Das Hütten- und Hammerwerck der Fugger zu Hohenkirchen bei Georgenthale in Thüringen 1495-1459*, « Zeitschrift des Vereins für Thüringische Geschichte und Altertumskunde », Neue Folge, 1926, vol. 27, p. 309.

[7] « Das polnisch [Blei] viel reiner und dem Schmelzen zu tauglicher als das Goslar ist » reads the statement made by officials in Kutna Hora in 1571, as well as « zu den Schmelzen der hiesigen Kluss und Aertz ... viel tauglicher und mit etwas geringernn Cossten der Silber halben, die darinnen sein », *Státni ústředni archiv* (Prague), Stare Montanum 4/4, year 1571; also Registra vol. 81, p. 420.

particular favour.[8] Waggons carrying Polish lead to Hungary were loaded on their return with copper from the Slovak mines (in Hungary) which made transport more profitable. Furthermore, lead supplied to the refining centres in Hungary was sold for local silver which in turn was taken over the frontier illegally in most cases and supplied to Polish mints at favourable prices.

For these reasons Polish lead was in great demand, which stimulated further important investments in order to increase production, and the investments opened up prospects of considerable profits.

III.

The inflow of capital and investments were closely associated with the organization of mining in the period by numerous small companies. The initial form of investment were the loans granted to these small enterprises, and these were mostly repaid not in cash but in ore or metal. If the miners were unable to repay one loan they would sign a contract for another with other creditors or with the same person who had already lent them money, thus becoming still more dependent on the lender.[9] Even long-term contracts for permanent credit from one creditor were signed. This system, which was well known and described in different European centres of ore mining of that period, grew to such proportions that it is evident that further mining of the deposits depended on it entirely. The lenders who financed the mines and indirectly provided the finance for mining operations, were described as "strangers" i.e. people from outside mining, and in Poland were called "*prepositores*", "*impositores*", "*verleger*", or "*forleger*". Together with the small producers and the mine workers, they were the third factor of crucial importance for the development of mines, and official documents and miners' regulations acknowledged their importance.

But this system for providing finance for production, and investment in capital expenditure, was only a partial solution, for production itself

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[8] « . . . Nam si plumbum nullum advectum civitatibus montanis fuerit, argentum quoque nullum confieri poterint », Archives of the city of Kremnica, fons 18, fasc. 4, no 197.

[9] e.g. « Paluch recognovit, quod Bartosch Brescator est primus eius prepositor super omnium mineram, quod habet vel habiturus est penes omnes eius bonos sub et super terram existentes, mobilia et immobilia », Central Archives of Ancient Records (Warsaw), Varia 63, p. 119, year 1450; « Petrus Zausmid hat bekant, das er dem ersamen herrn Jorge Schwarz schulding ist rechtliche schuld CC und neuwnczen mark polnisch munze, das her im vorlegit hat of das Bergwerk zu Ilkus, das da genannt ist zum Stolnik, und ouch was noch darauf gehen wirt, in solch weise, das her Jorge sal seyn der irste das bley czu nemen und czu entphalen vor seyne schult, als den ander vorleger der bergwerk nemen werden », *State Archives in Cracow*, Consularia Cracoviensia, vol. 428, p. 459, year 1443.

remained in the hands of the small producers and was carried on by small companies. Permanent credit and regular sales as well as prompt payment enabled them to continue mining, but the system was not conducive to radical innovations such as the drainage of greater areas of the deposits which required substantial funds. Small producers reliant on credit were not in a position to undertake such operations. Because of the terms on which the credit was obtained, in particular the high interest, they tended to carry on their mining operations on a wasteful, extensive and not intensive basis. The merchants who loaned the capital were free to decide upon the terms of loans, whereas the small producers who were burdened with debts were unable to sell their ores or metals to other buyers as they were obliged to supply all their ore or metal to the lender and were subjected to their monopoly rights. Their advantage over the small producers was not only economic, for they often had administrative power as well, as when they also acted as the royal officer called "Zupnik" (Bergmeister-Germ.) on behalf of the ruler. As a result they could reduce the prices paid for the products supplied by the small producers, and these as a rule were 10-15% and sometimes even 25% or more below market prices. In those circumstances the small producers were impoverished, making it impossible for them to modernize mining operations. The profits from mining were absorbed by the creditor's capital which at this stage was usurious rather than productive.

No radical changes were brought about until capital began to flow directly into production. This process started in Poland in the mid-15th century and reached a peak at the turn of the 15th century, again in the second half of the 16th century and at the beginning of the 17th century.

Investment in production started with the building of smelting works which smelted ore which was still bought from small producers. In fact in Poland there were no smelting works as large as those built by the famous "*Saigergesellschaften*" in Thuringia or around Nurnberg, but at the turn of the 15th century a dozen or so smelting works were constructed. Some improvements and innovations were introduced, such as the reduction in the use of woodfiring in the smelting process (to save wood), the building of larger works with 6 furnaces each, and the extraction of silver from the richest lead which until then had been sold abroad with the silver intact. The cost of a smelting works of this sort in Olkusz was equivalent to the price of a brickhouse or to 9 tons of lead. The output o fthese smelting works was already considerable and they could smelt large quantities of ore. Often the raw material bought from small producers was insufficient, which is why the owners of these new smelting works were the first to start production on their own account and to prospect for deposits in new areas.

The latter was particularly popular and was carried on extensively towards the end of the 15th century and at the beginning of the 16th

century. In the period from the beginning of the 15th century to the mid-17th century there were over 80 joint stock prospecting companies in Poland. Our knowledge of their existence is based on the fact that they enjoyed royal privileges which granted them rights to operate on preferential terms.[10] These companies prospected mainly in the upland regions of South Poland in the Carpathian and Tatra Mountains where small deposits of silver ore were discovered at the turn of the 15th century. These territories lacked richer seams and the activities of a large number of prospecting companies failed to yield important results.

It became evident that use should be made of those mines which had been in existence for a long time but which were flooded and deserted. They were taken over from the impoverished small producers or else, where mines had been completely deserted, whole regions were taken on lease or purchased, thus ensuring the right to mine all the deposits situated in that area.

Intensive drainage of the mines was undertaken first of all. Initially shafts were used for the removal of water, since most of this region was rather flat, which made the building of drainage galleries rather difficult. Water was brought to the surface in leather sacks or by pumps of various kinds. All the installations required power, and since rivers and streams were scarce in the area, horse-driven equipment was used. Horse gears and whims were constructed which were larger than in other mining centres, the largest being driven by 24 to 30 horses simultaneously, teamed in pairs, which as the work was carried out in six-hour relays meant 120 horses for one drainer. The high costs of this kind of drainage resulted not so much from the cost of building and maintaining wooden drainers and whims (pumps of the "*Heintzenkunst*" system were used in most cases) but from the cost of purchasing, maintaining and tending a huge number of strong, healthy horses which were also continually being replaced. Weekly expenses for hiring, tending and maintaining 120 horses were equal to the sum needed for drilling a gallery 18 m long or covering the cost of 3.7 tons lead. As the drainage was carried on without breaks, even for Sundays or holidays, these high costs were constant.[11] Consequently attempts were made to reduce the cost of drainage and special companies were formed to provide finance for inventions and improvements both in regard to drainers and hoists

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[10] D. Molenda, *Poszukwania górnicze w Tatrach, Pieninach i Beskidzie Sączkim do 1772 r. w świetle analizy przywilejów poszukiwawczych* (Prospecting in the Tatra Mountains, Pieniny and Beskid Sądecki to 1772 in the light of the prospecting privileges), « Studia z dziejów górnictwa i hutnictwa », vol. 14, 1970, pp. 55-64.

[11] In 1473 the Olkusz miners were granted a privilege by the bishop of Cracow giving them permission to work on holidays, sanctioned at a later date by the Pope. « Necesse est, ut aqua continue non sine magnis laboribus extrahuntur ». Vetera Monumenta Poloniae et Magni Ducatus Lithuaniae, ed. A. Theiner, vol. II, Roma 1863, no 271.

which would reduce the number of horses involved. In the 15th and 16th centuries there were about 30 such companies, which are known to us from the privileges of monopoly which they were granted in order to introduce new inventions.[12] Despite this, costs were increasing, for the deeper the mining operations the greater the pressure of water. To make things worse, the great irregularity of the seam structure meant that it was never certain whether a given area, although drained at such expense, would be rich enough, which added to the risk of the investments. Also only a part of the seam was drained by this method and water from the neighbouring undrained areas could flow there.

In spite of unfavourable conditions, at a later period draining galleries were constructed which caused water from a large part of the seam to flow downwards and thus made possible the safe mining of greater areas. The seam situated under the galleries was drained by means of drainers which removed water no farther than to the level of the galleries. Though the gallery was only built once, the cost of the investment was tremendous because of the specific features of Polish mines. They were situated — as we have already mentioned — on rather flat terrain so that the galleries had to begin a long way away from the mine and at times were driven through areas that were spoils (regions with no deposits), kilometres long, so that they were far enough below the surface at the point where the mine was to penetrate. Long sections of the galleries were shallow, built just below surface. Near ground level sand was to be found throughout the area, sometimes mixed with water, which resulted in the appearance of liquid mud. Therefore almost the whole length of the galleries had to be provided with strong, solid timbering which furthermore caused great technical difficulties during construction.

The highly competent Prussian mining experts who visited these mines in the 19th century considered the courage and skill of Polish miners of the past to be astounding and called the construction of galleries under such unfavourable circumstances "*herkulische Arbeit*". In fact it was generally thought that drainage galleries should not be built in the flat terrain because it was too difficult and arduous and so very expensive. Indeed, in the mid-16th century the cost of 1 km of gallery amounted to about 7,000 *zlotys*, which was equivalent to the price of a large ship in Gdańsk or Elblag and was 17 times the price of a brickhouse in the centre of Olkusz.

Ten drainage galleries were built in these difficult conditions (one in the 15th century and nine in the 16th century), totalling 37 km in length (and eight galleries with the total length of 13 km in the part of the ledges

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12 D. Molenda, *Patent a postęp. W sprawie rozwoju prawa patentowego w górnictwie kruszcowym w XV i XVI w.* (Patent and progress. On the question of the development of patent law in ore mining in the 15th and 16th Centuries), « Kwartalnik Historii Kultury Materialnej », vol. 17, no. 1, 1969; pp. 73-88.

which was situated in Upper Silesia). The building was undertaken by the mining companies ("*Stollengewerkschaft*") and the total cost of the galleries may be roughly estimated at about 300 thousand *zlotys*, that is the sum invested by the Fuggers-Turzons company in the modernization of the copper and silver ore mines in Slovakia, then in Hungary, between 1496 and 1526.

Such large scale investments had considerable consequences. It was then possible to start mining water-bearing seams thoroughly and meticulously down to the level of the galleries and in some places below this level. The operating companies were large enterprises employing up to several hundred workers and carrying out the whole of the production process, from the extraction of ore to the sale of the metal smelted from the ore. These companies also bought larger quantities of ore from small producers. They employed not only hired labour but also some "sub-contractors" who operated on their own, mining the seams which were already drained and made accessible by the large company.[13] Though in many centres small producers predominated, most production was carried out by the small number of large enterprises on which the prosperity of the mining centres was then based.

IV.

The source of these investments is one of the most important questions. What was the origin of that capital, what social groups knew how to make use of the situation where Polish lead was in demand and were prepared to risk large sums that would enable them to gain great profit later on?

In Poland, as in the majority of European ore mining centres, it was initially mainly merchant capital, and this came from both burghers from Poland and from foreign merchants. It was characteristic of Poland, however, that the gentry and clergy, including public officials of high rank, as well as the rulers played an important part in these mining investments — though it was not as important as that of the merchants.

Another peculiar feature of Polish mining was the establishment of joint stock companies, in which both Polish and foreign shareholders were to be found and where the shareholders of the same company were often noblemen together with merchants.

As early as the end of the 13th century, those who first showed a keen interest in the Polish lead mines were the townsmen and merchants of Cracow. The town, which had close business relations with Hungary and

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[13] Organizational changes in the Polish mines are discussed in D. MOLENDA's paper *Die Struktur der Unternehmungen im polnischen Silber- und Bleierzbergbau bis zur Mitte des XVI. Jahrhunderts*, « Troisième conférence internationale d'histoire économique. Munich - 1965 », vol. 10. Paris 1974, pp. 296-315.

Bohemia, was the centre of trade in Polish lead. Lead was weighed on a special pair of scales there and was transported to other places at home and abroad by land or on the River Vistula, and foreign sources therefore refer to it as "Cracow lead". Cracow merchants also enjoyed a number of trade privileges, including exemption from home tariffs which was another factor favouring the export of Polish lead. We known the name of Cracow town-people who were dealing in lead and purchased the product from the mines in the 14th century. From the very beginning the organization ot the lead market was beyond the means of small producers. Craft production of metal did not developed in the small towns of the mining regions nor were there any larger centres for the smelting of precious metals and the lead was dispatched to distant markets. The purchase of lead and the organization of its sale was thus taken over by the merchants from nearby Cracow.

From the 14th to the late 16th century the *zupniks* (or *Bergermeisters*) and the leaseholders of the royal mines were nominated among the inhabitants of Cracow. They showed particular interest in the largest town of the mining area — Olkusz, which they had most probably founded and where as early as the 14th century, they possesed houses of their own in the market place. They held the office of town reeve (*advocatus*) of Olkusz and were also the first to lend money to the small producers of Olkusz. One of them, for instance, was Jan Szwajdnicer who at the same time held the office of overseer of the Olkusz region, was the leaseholder of the King's mines, and had authority over the town as the town reeve of Olkusz, while between 1449 and 1451 it was he who lent three quarters of the loans to small producers. He was also an important merchant, exporting lead to Slovakia and Flanders. Up to the 17th century the majority of the merchants (*forlegers*) who lent money to the small producers of Olkusz were Cracow burghers who at the beginning of the 15th century also started to invest in metal production. In the 1460's Turzon, Tesznar and Zebart built in Mogiła near Cracow a large smelting works where Hungarian copper was refined and silver probably extracted using Polish lead. It operated for 50 years, and was a large, modern enterprise which was described in Polish chronicles of the period and compared with Etna because of the clouds of smoke that floated over it. At the turn of the 15th century eight townsmen of Cracow owned smelting works in Olkusz and in the middle of the 16th century their number increased to ten. They bought great areas of forest and took on lease the neighbouring villages in order to secure fire wood for their works.

In the mid 15th century they began to purchase mines and were partners in the majority of the drainage companies. Between 1460 and 1480 a company operated in Cracow « *Gesellschaft des Bergwerks von Bley zu Ilkusch* » whose partners were rich Cracow merchants, and were called

« *die bleyherren der gesellschaft* ». They were mine-owners and exported lead to Hungary. In 1538 50% of the lead output of the Olkusz region came from the mines owned by the eight citizens of Cracow and in 1551 the wealthiest of 35 producers in the Olkusz region were five inhabitants of Cracow who supplied as much as two-thirds of the total lead production. of the investors in the companies building drainage galleries in the initial period, when substantial capital was required but before profits began, 60% were citizens of Cracow. In the following years the Cracow investors bore more than 50% of the cost of extending and maintaining the galleries. In the 15th century the most important Cracow families who contributed to mining investments in Poland and generally traded in lead as well were: Czarny alias Niger, Tesznar, Turzon, Szwajdnicer, Kreydlar, Morsztyn, Beck and Salamon. In the 16th century the best known names were those of Betman, Boner, Ber, Kezling, Szylling, Krupek, Kaufman, Bank, Czipsar, Augermundt, Tratkopf and Fogelweder. The fortunes of many of these families originated in lead production and trade, and they were also shareholders in mines in Hungary-Slovakia, Bohemia, Moravia, Lower Silesia and even Sweden.

As Polish lead mining promised to yield high profits it was of interest to foreign, as well as Polish merchant investors.[14]

The Italians were the first to be attracted by Polish lead. At the turn of the 13th century they began to settle in Cracow where they were given the name of *"gallici"*. Acting as agents of Italian bankers they transferred church taxes from Poland to the Apostolic See. But the leasing and administration of the salt mines was also in their hands until the end of the 15th century. The important part they played in the organization of the royal salt company is well known, for they brought specialists from Italy and totally reorganized the salt trade.

Later, towards the end of the 14th century, but mainly in the 15th century, the sources indicate their growing interest in Polish lead. Several Italians who had settled in Cracow traded in lead and took over the farm of the ruler's lead ore mines. In the 14th century these were mainly Genoese like Paulinus Gallicus, Peterlinus Gallicus, Gottfridus Gallicus Fattinanti, Mikolay Manente, in the salt mines and Jakub and Stefan in the lead mines. At the beginning of the 15th century Florentine, Venetian and Milanese families also took their place, being in the most part the agents of local

[14] For the attraction of the countries of Central and East Europe in the Middle Ages for Italian and High German merchants (the prospects for profitable investments and favourable terms of sale for their own products and for the purchase of local ones) see the comprehensive paper by M. Małowist, *Wschód a Zachód Europy w XIII-XVI wieku. Konfrontacja struktur społeczno-gospodarczych* (East and West Europe in the 13th-16th Centuries. A comparison of the socio-economic structures), Warsaw 1973, pp. 247-250 and ff.

banks and commercial companies. In the 15th century the office of the Olkusz "*zupnik*" was held by Ludwik and Albicius Celenti, the agents of the Medicis, and the "*zupnik*" of the salt and lead mines was Piotr Picorano (alias Bikarini) from Venice, alos the Medici's agent. They were tradesmen maintaining business relations between Cracow, Wroclaw, Nurnberg and Venice and it is likely that they also exported Polish lead through these channels.[15] In the 16th and 17th century Italians residing in Cracow still helped to provide finance for the lead ore mines but they were not important investors and had no connection with any larger firms. The most important were Mikolay Alanci alias Alantsee, Antoni Osthowicz Italus de Cento, the Delpac family, the Orlemus family, Karol Soderini, the Pinoccios; Dominik Alemani and Stanislaw Amenda, who even held the office of "*zupnik*".

Together with the Italians, the Nurnberg merchants played in the Middle Ages an important role with regard to Polish mining. Their trading activities in Central Europe are well known; they ran companies maintaining commercial relations across the Alps between Italy (Venice) and the Carpathian Mountains. They first appeared in Cracow ar the beginning of the 14th century entering into business with the local merchants. The trade in salt and non-ferrous metals was their particular interest. After the 14th century they also had great influence in Hungarian gold and silver mining, and the management of the mines came under their control, and they exported the local silver-bearing copper. By then silver was extracted from copper by means of the "*saigern*" technique which was to be generally applied in the mid-15th century. Polish lead was therefore much in demand. As they had financial and commercial relations with the Italians, they soon joined them in trading in Polish lead.

The Nurnberg merchants increased their activities in particular around the turn of the 14th century. There were the 15 agents or partners of the Nurnberg firm Kamerer-Seiler, which operated in Cracow and four representatives of the firm Flextorfer-Zenner.[16] Klauss Kezinger, the plenipoten-

[15] The activity of the Italians in medieval Poland is discussed in full in the papers of J. Ptaśnik based on comprehensive materials from Polish and Italian archives. J. Ptaśnik, *Z dziejów kultury włoskiego Krakowa* (On the History of Italian Cracow), « Rocznik Krakowski », vol. 9, 1907, pp. 1-148; J. Ptaśnik, *Italia mercatoria apud Polonos saecule XVIineunte*, Rome 1910; J. Ptaśnik, *Włoski Kraków za Kazimierza Wielkiego i Władysława Jagiełły* (Italian Cracow under the Reign of Casimir the Great and Ladislaus Jagello), « Rocznik Krakowski », vol. 13, 1911, pp. 49-110; J. Ptaśnik, *Studia nad patrycjatem krakowskim wieków średnich* (Studies on the Cracow Patriciate in the Middle Ages), « Rocznik Krakowski », vol. 16, 1913, pp. 23-95; J. Ptaśnik, *Kultura włoska wieków średnich w Polsce* (The Italian Culture of the Middle Ages in Poland), Warsaw 1922.

[16] W. Stromer, *Nürnberger Unternehmer im Karpatenraum. Ein oberdeutsches Buntmetall - Oligopol 1396-1412*, « Kwartalnik Historii Kultury Materialnej, vol. 16, 1968 no 4, pp. 642-662; W. Stromer, *Das Zusammenspiel Oberdeutscher und Florentiner Geldleute bei der Finanzierung von König Ruprechts Italienzug 1401-1402*. In: *Offent-*

tiary of the first firm, was one of the most enterprising of them. He had sent money to the royal salt company and to various lead mines. In 1405 the second firm was given, in the person of its agent Marek, the monopoly over the copper trade in Hungary and over the purchase of Polish lead for the Hungarian mines. The company started to reduce lead prices and banned the export of Hungarian silver to Poland. In response to these measures the Cracow merchants withheld their supplies of lead, and this resulted in several years of stagnation in the lead trade which discouraged investments in Polish mining. Kezinger skilfully took this opportunity to act as intermediary in the Polish king's negotiation for a loan from the Venetians. He gained control of the export of Polish lead to Hungary, with the Italian "*zupnik*" P. Picorano and A Celenti who had also taken part in the negotiations. He also became the creditor and employer of the small producers of Olkusz. In reward for his initiative he was given the mining region of Trzebinia, with its flooded and deserted mines by the king. Together with his brother Walter and some of the Cracow merchants he organized a large mining company to undertake drainage operations and build the first drainage gallery on the site of the lead deposits. The Italian and Nurnberger investments in Polish lead ore mining paid extremely well, as they secured monopolies over the supply of Polish lead to her southern neighbour and were able to sell at lucrative prices the metal produced by the mines they owned themselves or else purchased at low prices from their debtors, the small producers.

In the following period the activity of the Nurnberg merchants was less important. They were no longer the representatives of German companies, but became simply citizens of Crakow of Nurnberger descent. Andrzej Czerynger, who in the 15th century owned a smelting works in Olkusz, was one of those involved in smelting along with Hans Koler, son of Christian, who between the sixties and the eighties was in charge of the smelting works at Mogiła near Cracow, to which we have referred already. Also worth mentioning is Kilian Staude from Nurnberg, a constructor of drainage appliances who visited Olkusz in 1482 and gave an interesting description of the local mines; five years later one of the biggest and most active of the companies owned from Cracow, which was concerned with the drainage of the Olkusz mines, operated there using the drainage appliances he had constructed.[17]

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liche Finanzen und privats Kapital im späten Mittelalter und in der ersten Hälfte des 16. Jahrhunderts, « Fortschungen zur Sozial- und Wirtschaftsgeschichte », vol. 16, Stuttgart 1971; W. Stromer, *Oberdeutsche Hochfinanz* (1350-1450), Wiesbaden 1970, pp. 119-125, 143-148, 448-495.

[17] Mikołaj Staude's relation quoted in: P. Albinus, *Meyssnische Bergchronik oder Commentarius von den Bergwerken*, Dresden 1589, p. 85; Privilege granted to the draining company for the construction of Staude, Central Archives of Ancient Records, Warsaw, Metryka Koronna, vol. 14, p. 194 and vol. 15, p. 55.

Around the turn of the 15th century the investments made by the Fugger-Turzon company played an important part in Polish mining. The Turzon family were citizens of Cracow from 1465, and they had developed connections with Polish mining and metal production before they entered into partnership with the Fuggers. Jan Turzon made large purchases of Polish lead in the 1460, which he exported to Slovakia. He was also concerned with mining; he bought mines and in 1475 and 1487 established companies to drain the mines of Olkusz using the constructors' inventions and not his own, as is often erroneously stated. He operated in other mining regions as well in Poland in partnership with other merchants and also ran companies in Slovakia from the 1470's and in Goslar (between 1478-1496) carrying on drainage operations on a larger scale.

The company he formed with the Fuggers was founded in 1494 and after gaining control of Hungarian and Slovak copper and silver mines, it started to operate in Poland. Slovak copper was largely exported through Cracow on the River Vistula to Gdańsk and then by sea. In Cracow Polish lead was also purchased for the smelting works the firm owned in Thuringia and Lower Silesia, but especially Slovakia. A special road was even made across the Carpathian Mountains in order to facilitate the transport, of copper and lead; it was known as the "Turzons' road" and led across Orava and the Jablonkowska pass, skirting the old road on which high tariffs were to be paid. In Cracow the agents and merchants of the Fugger-Turzon company made purchases of lead with such rapacity, that royal privileges permitting their activity were granted under the stipulation: *ut et alii plumbum cohemere atque acquirere possint*, limiting their monopolistic tendencies. The purchase of lead was conducted jointly through advancing credit to small producers throughout the mining area, which was sanctioned in the privileges of the firm in the following terms: « *in provisionem tamen laborantium in montibus seu fodinis plumbi alias fyrleggerstwa, Georgius Hegel vel qui pro tempore negotiis Fuggerorum prefuerit...* ».

The Fugger family are referred to in the documents of the Polish mining towns as the main creditors of the small producers at that time. The firm also undertook direct investments in the lead mines, and in 1538 was among the shareholders of the mine in Olkusz (the Fuggers' agent being George Hegel). The most important operations were carried on in the Długoszyn region. The Fugger-Turzon company gained a concession, just like Kezinger had done at Trzebinia. Between 1523 and 1524 they built a drainage gallery and for several years they worked the local mines which had previously been flooded, very intensively, and obtained considerable quantities of the precious lead. Luszowice was another region where similar operations were undertaken by the Fugger firm alone after the Turzons had quit the company during Anton Fugger's management. In 1541 another drainage gallery was built here; less effectively however. Both galleries were constructed by

companies in which the main investors, besides the Fugger, were Cracow burghers. The Fugger family's investments came to an end when they withdrew from mining in Hungary in the mid-16th century.[18]

In assessing the role of foreign capital in Polish lead mining it should be stressed that these investments were important and contributed to a considerable extent to solving one of the most crucial problem — the drainage of the deposits, for it had made possible the construction of 3 galleries. In general, however, these were sporadic, short-term investments, usually lasting only a few years at most and mostly undertaken at the beginning of the 15th century and in the first half of the 16th century. Besides, they were involved with the smaller mining centres rather than the larger ones. They generally drew on the capital of the Cracow merchants who contributed most of the investment expenses, on a permanent basis throughout the whole mining area. Cracow capital, then, took the lead in the development of the lead mines in Poland. It is also of great importance that the profits on the investments made by the Cracow merchants were left at home whereas the profit on those financed by foreign capital went abroad.

Besides merchant capital, the Polish nobility and the clergy held an important share in the investments in Polish lead mining. The first to invest, from as early as the 15th century, and the most enterprising, were the owners of the lands where the deposits were to be found or of the areas near the royal free mining regions. Besides the families of the middle gentry from Central Poland, the bishop of Cracow owned much of the land around the episcopal town of Sławków, which was rich in deposits. This prompted the middle rank Cracow clergy and the administrator of the bishop's estates to take an interest in the mines as well.

The nobility and the clergy did not usually manage the mines themselves but bought shares in the merchants' companies, and eagerly lent money to the small producers in exchange for ore. They were particularly interested in investing in the construction of smelting works on their own lands which was more profitable for them than for the towns people, as they could obtain wood free from their own forests. They employed cheap and even unpaid

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18 J. PTAŚNIK, *Przedsiębiorstwa kopalniane krakowian i nawiązanie stosunków z Fuggerami w początku XVI w.* (The Mining Companies of the Citizens of Cracow and the Establishment of Relations with the Fuggers at the Beginning of the 16th Century), Kraków 1902; J. PTAŚNIK, *Turzonowie w Polsce i ich stosunki z Fuggerami* (The Turzons in Poland and their Relations with the Fuggers), « Przewodnik Naukowy i Literacki », 1905, no 33, pp. 828-1120; J. PÖLNITZ, *Jacob Fugger*, vol. 2, Tübingen 1951, pp. 501-502 and ff.; G. PÖLNITZ, *Anton Fugger*, vol. 1, Tübingen 1958, p. 404; S. KURAŚ, *Materiały do dziejów górnictwa i hutnictwa z Archiwów Metropolitalnego i Kapitulnego w Krakowie 1479-1640* (Texts on the History of Mining and Smelting in the Metropolitan and Capitular Archives in Cracow 1479-1640), in « Studia z dziejów górnictwa i hutnictwa », 1959, vol. 3, nos 2, 10, 17 and 20.

serf labour in the smelting works as well as in the transport of wood, ore and the metal which they supplied to the Cracow merchants.

In the 15th century, however, the nobility and the clergy did not play any important role in mining as such. Only towards the end of the 15th century and at the beginning of the 16th century did a markedly greater interest in this branch of production spread to wider circles of the nobility, including senior state officials. They started to purchase smelting works from the previous owners or to build new ones, to establish drainage companies, to finance inventions in this field and to buy shares in prospecting companies.

It was then that the Polish kings Alexander I and then Sigismund I, both of the Jagellonian dynasty, first began to invest in Polish ore mining. The first royal investments in mining were not very great but they played an impórtant part, since they encouraged many noblemen and clergymen from the royal court to follow their example. Mining became fashionable, so to speak, and interest was aroused in it for its own sake. Great profits were anticipated there and the growing fortunes of the European companies and the rulers of Hungary, Bohemia and Austria were watched with keen interest.

The investments of greatest importance, however, were those which king Sigismund Augustus made between 1547 and 1572. This sovereign played an essential role in the radical development of the largest Polish mining centre in Olkusz, and more precisely in the draining of the local deposits. The king bore one fifth of the cost of building the local drainage galleries; he provided all the funds for the first and covered one eighth of the expenses connected with the construction of the second. This was of great significance since, following his example, other people took the risk of constructing the drainage galleries, a type of investment which was still new in Olkusz. What made the king provide large sums of money was the increasing demand for lead for armaments, both for heavy artillery and small fire-arms, in the wars which were being waged on the Eastern frontiers of the Polish state. The fact that the king undertook these investments was a proof of his wise and far-sighted economic policy and of his knowledge of mining problems, as was the purchase of Georgius Agricola's work *"De re metallica libri XII"* for the royal library immediately after it was published in Basel in 1556.

The nobility's contribution to the financing of the Olkusz galleries was of considerable importance and amounted to one sixth of their cost. Shareholders of noble descent constituted two fifths of the total membership of the drainage companies. After the Cracow merchants, whose capital played the predominant part in investment in mining and credit advances to the local small producers, the nobility was the third group to contribute to the construction of drainage galleries in the Olkusz mines. The resulting boom

in production at the turn of the 16th century was the greatest known in the whole history of Polish lead mining.

In the 17th century the Cracow merchants gradually withdrew from mining. Their place was taken by the nobility and especially by the magnates who by the middle of the 17th century owned most the mines in Olkusz, which was then the only centre still in operation. The reason for their withdrawal lay in the decreasing profitability of the seams once those drained by the galleries had been worked out. Only poor deposits were left or else those situated under the galleries, which could only be drained with the use of drainers.

The mining of these seams was profitable for the noblemen not only because they were able to smelt ore at low cost, as we have mentioned, but also because of the favourable privileges they enjoyed. After the 16th century the importance of the nobility increased constantly in relation to other social groups. The commercial privileges which they had been granted helped them to organize the completely tariff-free export of lead. Moreover, they were not obliged to observe the administrative regulations or to pay the charges involved which were obligatory for commoners. They also avoided paying taxes and the mining dues or else were able to obtain exemptions or considerable reductions on them.

In the course of the 17th century mining operations in the lead mines run by the gentry and the magnates became increasingly wasteful and investments were reduced to the minimum. Mining continued in such a manner to the end of the 17th century when the galleries, which were not properly maintained, caved in and underground operations came to an end for almost two hundred years.