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Dávila; fue alcalde ordinario de México en 1564, y uno de sus hijos, que llevó el mismo nombre, fue obispo de Yucatán. Finalmente, doña Catalina de Salazar vino viuda de Ruy Díaz de Mendoza, del que tuvo un hijo y una hija que trajo consigo; aquí contrajo segundas nupcias con el conquistador de la Nueva Galicia, el capitán Cristóbal de Oñate; uno de sus muchos hijos fue Juan de Oñate, quien hizo la conquista de Nuevo México. Todos tuvieron familias numerosas —“fueron grandes pobladores”, como entonces se decía—, y sin duda, en nuestro México actual, quizá aquí mismo, todavía deben haber muchos descendientes del intrépido don Gonzalo de Salazar, “el que se alzó con el reino”.

NOTES ON THE MEXICAN SILVER MINING INDUSTRY IN THE  
1590's\*.

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THAT SILVER MINING was an important part of the economy of Mexico during the whole colonial period needs no stressing. The quest for mines and the subsequent exploitation of ores were responsible for the early exploration of many areas, for much of the growth of internal trade, and for agricultural development in many regions. Silver itself was the vital fluid of the body economic, the major export of the colony, and one of the major incentives impelling Spain to maintain her exclusive control over many great and empty tracts of territory. Despite these and other familiar qualities of the industry, the ubiquity of mining in Mexico still surprises. The few great names ring out in both manuscripts and ancient and modern historical writings: Taxco, Pachuca, Guanajuato, San Luis Potosí, Zacatecas, Parral. These were indeed the places from which most silver came. But the dozens of lesser centres which existed, and which played their part in their day, are long gone from view.

A most revealing manuscript held by the British Library (BL) gives a reminder of these lesser centres' existence, while providing a good measure of their importance relative to the great mines. It also offers much general information on Mexican mining in the last years of the sixteenth century a time in the industry's history about which little is yet known. From the manuscript, estimates of silver production can be made. And a surprising conclusion about the mining labour force also emerges: free Indian wage

\* I am much obliged to Judith Reynolds Bakewell, Elinore M. Barrett and Michael L. Conniff for their criticisms of this article. The errors that remain are my own responsibility. PJB.

labourers comprised almost 70% of it. This finding goes far towards contradicting past assumptions that mining labour in colonial Mexico was forced labour.

The manuscript<sup>1</sup> is wrongly described in the Gayangos catalogue of the Library's Hispanic documents<sup>2</sup> as 'Estado de minas y mineros en el Perú'. It consists of a large table showing the names of mining centres in four areas of colonial Mexico in 1597: New Spain, Zacatecas, Guadiana and Guadalajara. Clearly, these areas correspond to the jurisdictions of the Treasury offices (*cajas reales*) of Mexico City, Zacatecas, Durango and Guadalajara—the offices into which flowed the tax taken by the Crown on silver produced. These jurisdictions extended to embrace all the mining centres of the day. (The term 'New Spain' will be used in this essay only in the sense of the territorial jurisdiction of the *caja real* of Mexico City. See the Map for the rough boundaries of the four areas and locations of mining centres).

The BL table summarises the results of an official inspection, or *visita*, of the mining industry. For most centres in the four regions it gives twenty-four pieces of information. Nine of these data are about mercury, which was a basic raw material in the silver refining process: its supply to the mines under the current Crown monopoly, and various estimates of the debts owed by miners in each centre to the Treasury for mercury received. Then for each centre is shown the number of *mineros* in it,<sup>3</sup> the number of functioning refineries (*haciendas en beneficio*), the number of dilapidated refineries (*haciendas caídas*), the number of animal and water powered stamp mills (*ingenios*), the number of machines for washing refined ore (*ingenios de lavar*), the number of mules in use, the number of black slaves held, the number of free Indian wage-labourers (*naborios*), and the number of forced Indian labourers (*indios de repartimiento*). Other data given for each centre are: the amount of ore being refined at the time the information was collected; the additional numbers of forced labourers that the miners were petitioning the Crown to grant them; and the amounts of maize, candles, salt and pulverised iron that miners were asking the Crown to supply to the industry at subsidised prices.<sup>4</sup>

<sup>1</sup> British Library, Additional Manuscripts 13, 976, item 61 (ff. 346-7).

<sup>2</sup> Pascual de Gayangos, *Catalogue of the manuscripts in the Spanish language in the British Museum*, 4 vols., London, The Trustees, 1875-93.

<sup>3</sup> Owners of both mines and refining mills, or at least of one or the other.

<sup>4</sup> Maize to feed Indian labourers and animals; candles to light mines; salt and triturated iron as reagents in the refining process. Subsidies on these supplies were not granted by the Crown.

The BL table seems to be the full original of the table accompanying a document held by the Archivo General de Indias (AGI) in Seville. This document has the title 'Relación del estado que tienen las minas de esta Nueva España y las de Zacatecas y lo que deben los mineros a su Magestad y el azogue en especie que se les halló y la calidad de sus haciendas, cantidad de gente que tienen, y lo que más piden para el avío de ellas, sacado [*sic*] de las visitas que se hicieron en particular de todas las dichas minas por comisarios que fueron a ello con bastantes instrucciones de lo que debieron hacer'.<sup>5</sup> This AGI 'Relación...' consists of a six-page commentary on the visitas, followed by a table giving statistics for the mines of New Spain and Zacatecas (with its adjacent mining village of Pánuco). The AGI table does not supply any information about the other mines of the Zacatecas area, nor those of the Guadiana and Guadalajara districts. The BL table does show these missing districts; there is, however, no commentary attached to it. The categories of data in the BL table are the same as those in the AGI 'Relación...', and the figures are the same for the mining centres mentioned in both. (The Bancroft Library of the University of California at Berkeley possesses a typescript copy of the AGI 'Relación...' and a protograph of the table accompanying it. These form part of the collection entitled 'Bancroft Library Transcripts').

The are obvious limitations to the BL table. Numerous entries are filled either with a horizontal line or with zeros. It is impossible to tell in which cases these blanks indicate a verified absence of items in a particular category, and in which cases the information was simply not gathered. So, for example, for six of the minor centres of the Zacatecas district (Las Nieves, Santiago y San Marcos, Chalchihuites, Santiago, la Hacienda del Capitán Urdiñola and Mazapil) entries for the nine categories of mercury data are shown by a series of noughts. These centres were clearly operating at the time of the visitas, since the chart shows them to have haciendas en beneficio. Since it is unlikely that they were all smelting centres (which would not require mercury), the table should contain some record of the mercury they had received for use in amalgamation. That it does not suggests that it is incomplete. Again, in the Zacatecas district, only the small Zacatecas-Pánuco area is shown as having ingenios de lavar. A horizontal dash is the only entry in this category for the other centres in the district—some of which almost certainly did possess

<sup>5</sup> AGI México 24, ramo 1, No. 7a — an enclosure with a letter of Viceroy Monterrey to the king, dated Mexico 24 April 1598. The 'Relación...' itself is unsigned and undated. A note on the reverse states that the visita referred to took place in early 1597.

sess ore washing apparatus. Yet again, a footnote to the table accompanying the AGI 'Relación...' says that the officials who collected the information failed to count all the mules in use. Other examples of doubtful completeness could be given. In general, it seems that data are least complete for the Zacatecas district, rather fuller for Guadiana and Guadalajara, and complete for New Spain. For all four districts, though, some important categories do fortunately seem fully recorded: mineros, haciendas en beneficio, ingenios, esclavos, naboríos, repartimiento. Other categories of rather less interest also appear complete—for example, the petitions made to the Crown for subsidised supplies of mining goods.

*The purpose of the manuscript.*

The BL table and the AGI 'Relación...' summarise the findings of an inspection of the Mexican silver industry made early in 1597 by officials specially appointed for that purpose (*comisarios*). The inspectors appear to have been sent out by the Viceroy Conde de Monterrey, who is probably the author of the 'Relación...' (paragraph 4 of which is written in the first person, evidently by Monterrey). The inspection was made with the particular purpose of determining the sums owed to the Crown by mine and refinery owners for mercury, and the likelihood of their being able to pay off those debts. How had these mercury debts arisen?

In an effort to make a profit from the sale of mercury to silver producers, and to ensure that a constant supply of mercury was available to them, the Crown and its agents in Mexico had tried, between 1559 and 1572, to set up a monopoly of the production and distribution of mercury. To maximise production of silver, the Crown had soon found it necessary to advance mercury to miners on credit. A large debt quickly grew up, which the Crown always had difficulty in recovering. Variuos ingenious procedures for advancing mercury supplies were then devised during the final quarter of the sixteenth century, designed to improve the Crown's chances of collecting the value of new mercury issues.

The mercury debts shown in the BL table originated in a series of *depósitos* made in 1582 by the Viceroy Conde de Coruña. A *depósito* was an amount of mercury issued on credit to a refiner by the Treasury. The refiner was expected to maintain the amount of the *depósito* thereafter as a steady stock, so that he would always have mercury at hand to process his ores. The method by which the stock was to be kept up was known as *consumido*. By this, the refiner, when taking a quantity of silver to the Treasury for taxing and

assay, was to receive from the Treasury the amount of mercury he was thought to have used in producing that quantity of silver. The general ratio (known as *correspondencia*) between silver produced and mercury lost was known: it varied in time and place from a lower level of some 80 marks (40 lbs.) of silver gained per *quintal* (100 lbs.) of mercury lost, to a maximum of some 140 marks of silver per *quintal* of mercury.<sup>6</sup> The overall *correspondencia* in the mining industry in the early 1590's is given in the 'Relación...'<sup>7</sup> as about 115 marks per *quintal* of mercury—a high ratio, which, if accurately stated, would suggest some degree of prosperity and profitability in the industry of that time. The ratio may not, however, have been so consistently high in the 1590's as is noted below.

One large advantage to the Treasury of the *correspondencia-consumido* system of replenishing a refiner's mercury stock was that it encouraged him to bring to the Treasury all the silver he produced. If he did not do so, he would receive less new mercury from the Treasury than he had used up in previous refining—and eventually would have none left, since in law, though not wholly in practice, no mercury could be had outside the royal monopoly. The system thus helped the Treasury to ensure that all silver produced in Mexico was brought in for taxation.<sup>8</sup>

Having received the *depósitos* issued by Viceroy Coruña in 1582, and other issues of mercury made during the rest of the 1580's, the miners and refiners of the centres listed in the BL table the Crown, in July 1590, no less than 617,024 pesos de oro común (of 272 maravedís)—the value, at

<sup>6</sup> This range of ratios holds for Mexico in the sixteenth and seventeenth centuries. In later times in colonial Mexico, and in silver mines of Spanish South America, the silver yield per unit of mercury lost seems to have been generally higher.

<sup>7</sup> Paragraph 3.

<sup>8</sup> At this time in Mexico, a tenth (*diezmo*) of all silver refined by mineros was due to the Crown in return for access to the subsoil, which was in law the exclusive property of the monarch. The tax rate varied from place to place and from time to time. See: P.J. Bakewell, *Silver mining and society in colonial Mexico. Zacatecas 1546-1700*, (Cambridge, England, 1971), p. 182; D.A. Brading and Harry E. Cross, 'Colonial silver mining: Mexico and Peru', (*Hispanic American Historical Review*, Vol. LII, No. 4, November 1972, pp. 545-79, pp. 561-2). For further information on the mercury supply question, see: Bakewell, *Silver mining...*, ch. 7; Brading and Cross, 'Colonial silver mining...', pp. 562-5, 570-6; A. Matilla Tascón, *Historia de las minas de Almadén*, Vol. I (*Desde la época romana hasta el año 1645*), Madrid 1958; Guillermo Lohmann Villena, *Las minas de Huancavelica en los siglos XVI y XVII*, Seville, 1949.

current prices, of some 3,740 quintales of mercury.<sup>9</sup> To enable the debtors to pay off this amount, the viceroy of the day, Don Luis de Velasco (the younger), decided to issue another depósito to them — this one totalling, according to the BL table, 6,917 quintales.<sup>10</sup> The value of this depósito, together with the outstanding mercury debt of 1590 (a total of 1,828,787 pesos de oro común), was to be paid off thenceforth by *veinteno* — i.e. a twentieth of all the silver produced by miners and refiners. New issues of mercury, including the amounts needed to maintain depósitos, were to be made after 1590 only when paid for cash down (*de contado*). Between July 1590 and February 1597, the total sum paid by *veinteno* against the 1590 debt was 668,321 pesos de oro común — leaving the refiners still owing the Crown 1,160,466 pesos. It was their ability to pay off this debt that was the main object of the 1597 inspection.

Viceroy Monterrey, in paragraph 3 of the 'Relación...' concluded that the Crown was not taking a great risk in tolerating the mercury debt. As security, the refiners could offer their processing plants. They had many guarantors (*fiadores*). (To obtain mercury on credit from the Treasury, the refiner had to supply a guarantor). And finally, the 1597 inspection had shown that the refiners of New Spain and Zacatecas-Pánuco (the only areas referred to in the 'Relación...') had in stock at the time 2,558 ½ quintales of mercury worth 422,743 pesos de oro común.

Monterrey was probably being over sanguine about the security of the debt. The refiners claimed, according to paragraph 5 of the 'Relación...', that the cash cost of building their processing plants had been 5 million pesos de oro común. But the resale value of these haciendas depended on market conditions at any particular time. If the Crown had foreclosed on the debt (as it eventually did in the 1630's), seized the haciendas and offered them for sale or lease, their effective value would have been far less than the building cost. Neither was the existence of guarantors more than a token of security, since the majority of guarantors were other silver refiners. The mercury stock was similarly a poor form of security for the Crown, since a large part of it, at the time of the inspection, was actually being used for amalgamation, and was not readily accessible. Furthermore, what would it

<sup>9</sup> The debt may have been higher still, since the completeness of the figures shown in the BL table for centres outside New Spain, is doubtful.

<sup>10</sup> This figure may be a slight understatement, since the BL table fails to show any depósito in 1590 to fifteen smaller centres in the Zacatecas, Guadiana and Guadajajara districts.

have profited the Crown to recall the mercury it had issued? That would have brought silver production almost to a halt, and left the Crown with a large amount of mercury that could serve no purpose. Finally, although it was true that in New Spain and Zacatecas-Pánuco, there was this stock of some 2,558 quintales, that quantity was far less than the depósito issued in 1590 to those same areas (5,149 quintales). That is to say, the depósito system, by which a refiner's stock of mercury was to be maintained at a constant level, had failed. The refiner had been using up his individual depósito, and presumably not declaring some of the silver had produced with it, so as to save himself part of the royal tenth due on output. This tax evasion did not increase the mercury debt; but on silver not declared, the *veinteno* was not collected, which meant that the 1590 debt was not being paid off as it should have been.

Despite Monterrey's reassurances of 1597, therefore, the Crown was carrying a large mercury debt that it had little probability of collecting by any means that would provide for continued high output of silver; and the Crown was concerned that output should continue high. In the 1630's, faced with a pressing need for immediate cash, the Crown did eventually grasp the nettle and foreclose on the mercury debt. The cost was a severe depression of the Mexican silver mining industry lasting until the final third of the seventeenth century.<sup>11</sup> In the first two decades of that century, attempts were made, similar to Velasco's in 1590, to recover the debt by encouraging silver production through liberal issues of mercury. The result of this policy was only to increase the debt.

#### Silver production, 1590-97.

The 'Relación...' and the BL table contain information from which rough estimates of silver production between July 1590 and February 1597 can be made. The 'Relación...' (paragraph 3) states that in that period total cash sales of mercury by *consumido* in New Spain and Zacatecas-Pánuco were about 2,500,000 pesos de oro común. The BL table does not show *consumido* sales, but does record for all four districts receipts from the *veinteno*. From both *consumido* and *veinteno* an approximation of production can be calculated.

If the price of mercury is known, then the quantity of mercury bought with the 2,500,000 pesos de oro común under *consumido* can be found. Then, if the *correspondencia* is also known, an estimate of silver output can be

<sup>11</sup> For this, see Bakewell, *Silver mining...*, chs. 8 and 9.

made. The price of a quintal of mercury in 1590 was 110 pesos de oro de minas; from 1591 to 1597, 100 pesos de oro de minas.<sup>12</sup> It is impossible to know how much mercury was bought at each price; and for the purposes of argument there is probably not much risk of distortion in assuming that the average price from July 1590 to February 1597 was 101 pesos de oro de minas. This type of peso was valued at 450 maravedís; the peso de oro común at 272 maravedís. Therefore, the approximate amount of mercury bought by consumido was:  $(2,500,000 \times 272) / (101 \times 450) = 14,961.5$  quintales. These figures, it should be repeated, derive from the 'Relación...' and therefore refer only to New Spain together with Zacatecas-Pánuco. This, however, was clearly not the total amount of mercury used between 1590 and 1597, since, as mentioned before, the depósito declined substantially in that period (by 2,591 quintales), and the quantity of mercury by which the depósito fell was presumably also used for refining. Therefore, in New Spain and Zacatecas-Pánuco, total mercury consumption was  $14,961.5 + 2,591 = 17,552.5$  quintales. At a correspondencia of 115 marks of silver per quintal, silver output would therefore seem to have been 2,018,537.5 marks; or, in rough terms, two million marks.

Using information from the BL table, it is possible to go from this estimate of production in New Spain and Zacatecas-Pánuco to one of total output in Mexico. The table gives apparently complete information on the number of functioning refining mills in all four districts. The total number of such mills in New Spain and Zacatecas-Pánuco is shown as 237. On average each mill thus yielded 8,517 marks of silver between July 1590 and February 1597. The total number of mills shown for all Mexico in the BL table is 373. Total output in Mexico was therefore in the region of  $(372 \times 8,517) = 3,168,324$  marks in that same period. (This calculation assumes that the number of mills had not varied between 1590 and 1597; and that the output of each mill was the same. Both these assumptions are unwarranted, but not so much so as to invalidate the calculation.) It should be emphasised that this figure of some three million marks refers to production by amalgamation only, and that to it should be added production by smelting, which will be mentioned in due course.

The veinteno may also be used to make estimates of production, since it was supposedly a twentieth of all amalgamated silver produced. The BL table shows veinteno collected in each of the regions between July 1590 and

<sup>12</sup> Bakewell, *Silver mining...*, p. 172.

February 1597, in pesos de oro común. These may easily be converted into production figures in marks.<sup>13</sup> Veinteno and production figures are then as follows:

Region	veinteno (pesos de oro común)	production (marks)
New Spain	396,619	906,558
Zacatecas	195,259	446,306
Guadiana	13,596	31,077
Guadalajara	62,847	143,650
		1,527,591

The total output suggested by the veinteno figures is therefore only about half the three million or so marks calculated from the consumido. What can account for this wide discrepancy? First, it is likely that the veinteno was not fully collected, so that calculations of output derived from it are likely to be on the low side.<sup>14</sup> Secondly, the correspondencia of 115 marks per quintal of mercury, used above, may be too high for this period as a whole.<sup>15</sup> Thirdly, it is likely that some of the mercury paid for under consumido had not yet yielded silver at the time of the inspection of 1597. (There had been, on the other hand, no carry-over of mercury from before 1590 into the period of Velasco's new depósito of that year, since all mercury stocks were recalled before the new depósito was made.) These considerations, taken together, suggest that output figures derived from consumido may be too high, and those derived from veinteno too low. As a very rough estimate of total silver production by amalgamation in the four regions from mid 1590 to early 1597, a figure of 2,500,000 marks is not implausible.

<sup>13</sup> I.e., marks of 2380 maravedís — the accepted standard fineness of amalgamated silver.

<sup>14</sup> Cf. AGI México 23, ramo 2, No. 35 — an *advertimiento* of Viceroy Velasco II to his successor, the Viceroy Conde de Monterrey, dated México 20 January 1596. Velasco complains that miners have avoided paying the veinteno by not bringing silver to the Treasury.

<sup>15</sup> Cf. AGI México 23, ramo 1, No. 9 — Viceroy Velasco II to Philip II, México 4 April 1595. Velasco reports that in 1590 he ordered mercury distribution by consumido at a correspondencia of 115 in New Spain, and 140 in Zacatecas. But he has recently learned that at Zacatecas the current ratio of silver gained to mercury lost is 100 marks per quintal; and so has ordered a correspondencia of 100 to be generally observed in Mexico.

To this amount must be added production by smelting. This cannot be calculated from any data given in the BL table. The sixth paragraph of the 'Relación...', however, gives some information about smelting, mentioning Zimapán, Ixmiquilpan, San Luis Potosí and Sichú as smelting centres (*congregaciones*). It is stated that the last two were the most productive, and the 'Relación...' suggests that with encouragement from the Crown in the form of subsidised supplies, they alone might together yield 100,000 marks of silver a year. It does not indicate how much Zimapán and Ixmiquilpan produced; nor does it refer to any production by smelting in the amalgamation centres, though some did undoubtedly take place, since smelting was the most economical way of refining the pockets of very high grade ore that were occasionally found. All considered, a total smelting output of 150,000 marks a year seems reasonable. This would be in addition to an annual amalgamated output between July 1590 and February 1597 of roughly 370,000 marks — giving a total annual output in Mexico from all silver mining centres, by all methods of refining, of 520,000 marks. Given the amount of guesswork entailed in arriving at this figure, it would be wise to round it off still further, to half a million marks.

The state of the industry in 1597.

A little simple analysis of the information given in the BL table makes it possible to assess the state of the silver industry in the four regions. In making this assessment, it is convenient to consider information about refining plant separately from that on labour.

The predominant position of New Spain in silver mining at this date is perfectly clear. It had by far the largest numbers of refiners (*mineros*), functioning refineries (*haciendas en beneficio*) and stamp mills (*ingenios*.) Table I, which ranks the dozen largest refining centres of Mexico, judged by the number of *ingenios* they had, clearly demonstrates this predominance of New Spain: it had eight of the twelve leading centres, and only one centre in New Spain (Ozumutlan) did not fall in the top dozen. New Spain also had by far the largest number of functioning refineries and of refiners. (See Table 2.) Next in ranking, to judge by these same criteria, came the Zacatecas district; then the Guadalajara district; and finally Guadiana.

Calculation of some basic ratios, however, suggests differences in the industry's vigour in the four regions — differences that do not wholly correspond with the ranking made according to plant. Of particular interest are the ratios between the number of *ingenios* in a district and the number

of *mineros* (I/M), and between the number of *ingenios* and the number of *haciendas en beneficio* (I/H). The ratios in the four regions are as follows:

	I/M	I/H
New Spain	1.31	1.57
Zacatecas	2.01	2.40
Guadalajara	1.14	1.14
Guadiana	0.92	1.00

The Zacatecas district, therefore, had on average a larger number of stamp mills per refiner, and a larger number per refinery, than any other district. The processing capacity of individual refineries in the Zacatecas district was thus probably correspondingly greater than elsewhere, and investment in fixed capital by individual refiners also would seem to have been larger. The centres in the Zacatecas district where these tendencies were most evident were: Avino (I/M and I/H of 4.67), the twin centre of Fresnillo and San Demetrio (I/M and I/H of 3.13), San Martín, Las Nieves and Santiago (all three with I/M and I/H values of 2.5), and Zacatecas-Pánuco (I/M 1.91 and I/H 3.25.) Few centres in New Spain and the other two districts had values approaching these. Other things being equal, the larger capacity of refineries in the Zacatecas district, and the higher ratio of individual investment there, suggest a greater buoyancy and confidence in the Zacatecan mining industry than elsewhere — a sense of richer prospects. This expectancy was borne out by the rapid rise of silver production in the Zacatecas district between the final years of the sixteenth century and the mid 1620's.<sup>16</sup>

There is some indication, indeed, that from 1590 on the Zacatecas district had experienced a greater prosperity than the other regions, in that the rate of *veinteno* payment per refiner had been far higher there than in the other districts. The following table illustrates this. It shows *veinteno* payments between mid 1590 and early 1597.

District	<i>veinteno paid</i> ( <i>pesos de oro</i> <i>común</i> )	<i>mineros</i>	<i>veinteno/mineros</i> ( <i>pesos de oro</i> <i>común</i> )
Zacatecas	195,259	89	2,193.9
New Spain	396,619	261	1,519.6
Guadalajara	62,847	56	1,122.3
Guadiana	13,596	26	522.9

<sup>16</sup> Bakewell, *Silver mining...*, pp. 241-2.

The high veinteno payment in the Zacatecas district is all the more striking when the reported difficulty of enforcing veinteno collection there is taken into account. (See note 14 above.) Doubtless, collection was also incomplete in Guadalajara and Guadiana, since they were areas just as remote as Zacatecas from the centre of Spanish administration. But the indicated rate of veinteno payment in those areas is so much lower than the one in Zacatecas that there can be little doubt that the figures shown here provide an accurate ranking. A further sign of Zacatecas' lead here is that the BL table, from which the above data are taken, records veinteno payments for *all* centres in New Spain, Guadalajara and Guadiana, but fails to show any such receipts for six of the minor centres of the Zacatecas area.<sup>17</sup> Even with this omission, the table shows the Zacatecan refiners making significantly higher veinteno payments than their fellows in other districts. If the nineteen refiners of the centres for which the BL table shows no veinteno payments are excluded from the calculation, then the remaining seventy refiners of the Zacatecas district paid on average, from 1590 to 1597, 2,789.4 pesos de oro común in veinteno — almost twice as much as the refiners of New Spain.

A further sign of Zacatecas' vitality is that had the smallest proportion of disused refineries (*haciendas caídas*) to functioning ones (*haciendas en beneficio*) of the four districts, as is shown in the following table.

District	A. Haciendas en beneficio	B. Haciendas caídas	A + B	B as percentage of A + B
Zacatecas	75	14	89	15.7
New Spain	217	47	264	17.8
Guadalajara	56	46	102	45.1
Guadiana	24	32	56	57.1

The decay of at least the refining section of the silver industry in Guadiana and Guadalajara is clearly shown by these figures. It is very likely that the high percentage of disused refineries in these regions also reflects a decline in ore extraction. Mining itself might have continued at a level commensurate with the former number of working refineries, with ore being sent to New Spain or the Zacatecas district for processing. But the high cost of freight makes that procedure unlikely.

<sup>17</sup> I.e., Las Nieves, Santiago y San Marcos, Chalchihuites, Santiago, Hacienda del Capitán Urdiñola, Mazapil.

One final point of interest about plant indicated by the BL table is the difference in power sources apparent among the four regions. The stamp mills of the haciendas required considerable energy; and washing vats were sometimes also power driven.<sup>18</sup> Two sources of adequate energy were available — water and animals.<sup>19</sup> The numbers of ingenios driven by each source in the four regions were as follows:

District	Water powered	Animal powered	Total	Water powered as % of total	Animal powered as % of total
New Spain	167	174	341	49	51
Zacatecas	7	168	175	4	96
Guadalajara	25	39	64	39	61
Guadiana	6	18	24	25	75

In no region did water power predominate — though it drove almost half the ingenios of New Spain. In Zacatecas it was almost unknown — only being used in Fresnillo, Chalchihuites, Avino and the Hacienda of Captain Francisco de Urdiñola, all of which were sited on or near streams of some size and permanence. The variations in power sources were naturally the result of differences of climate and land form, both between and within regions. New Spain was on the whole wetter and hillier than the other areas — providing more fast streams and more opportunities for damming them than existed elsewhere. But even in New Spain there were considerable differences from centre to centre. Zacualpa, for instance, had 23 water powered stamp mills, but only 3 powered by animals. It lay in a area of seasonal and only moderate rainfall, to the south of the volcano called the Nevado de Toluca. But this was an area of deep valleys cut by streams, which were presumably used to drive water wheels.<sup>20</sup> Guanajuato, conversely, had 44 animal powered mills, but only 2 driven by water. It like the centres of the Zacatecas district to its north-west, was in an area of low rainfall — but also one of wide plains, which were as suitable for raising large numbers of mules as they were unsuited to building dams.

<sup>18</sup> For a description of washing vats, see Bakewell, *Silver mining...*, p. 267.

<sup>19</sup> The animal most commonly used was the mule. The BL table has a column for 'ingenios de mulas' for New Spain and Zacatecas. For the Guadiana and Guadalajara districts the corresponding column is headed 'ingenios de caballos'. It is uncertain whether any differentiation was intended.

<sup>20</sup> Peter Gerhard, *A guide to the historical geography of New Spain*, (Cambridge, England, 1972), p. 397.



Labour.

The BL table provides an interesting conspectus of the labour force employed in the mining industry. In summary, the situation was as follows. (See Table 3 for information on labour in individual centres.)

District	Black slaves ( <i>esclavos</i> )		Free Indian wage workers ( <i>naborios</i> )		Draft Indian labour ( <i>repartimiento</i> )		Total labour force
	Total	%	Total	%	Total	%	
New Spain	892	14.6	3582	58.8	1619	26.6	6093
Zacatecas	200	9.3	1956	90.7	0	0	2156
Guadalajara	110	16.4	559	83.6	0	0	669
Guadiana	61	27.1	164	72.9	0	0	225
Totals	1263	13.8	6261	68.5	1619	17.7	9143

The BL table refers merely to *esclavos* — not specifying whether they were Indian or black. The likelihood is that they were black, since although Indian slavery was not unknown in the late sixteenth century, nor even in the late seventeenth, especially in the north, Indian slaves were usually specifically identified. *Naborios* were in effect free Indian labourers, hired for a wage by miners. *Repartimiento* Indians were those drafted into tasks of general public utility, under Spanish regulations imposed mainly in the late 1570's.<sup>21</sup> The BL table appears to record the whole of the mining industry's labour force — that is, employees both in extraction and refining; there is no indication in the table, nor in the 'Relación...', that the labour information given applies to only one task or the other.<sup>22</sup>

The most remarkable revelation of the BL table concerning labour is,

<sup>21</sup> For further information on labour in general, and particularly in mining, see: Woodrow W. Borah, *New Spain's century of depression*, (Ibero-Americana 35, Berkeley and Los Angeles 1951), pp. 30-44; Bakewell, *Silver mining...*, pp. 124-9; Robert C. West, *The mining community in northern New Spain: the Parral mining district* (Ibero-Americana 30, Berkeley and Los Angeles 1949), ch. 3; Brading and Cross, 'Colonial silver mining...', pp. 557-60.

<sup>22</sup> The BL table indicates that in 1597 there were 1014 *naborios* in Zacatecas and Pánuco. Bishop Alonso de la Mota y Escobar, visiting Zacatecas at some time between 1602 and 1605, found approximately 1,500 Indians working in all sections of the mining industry. Allowing for the fact that Zacatecas' silver output grew considerably between 1597 and 1605, it seems reasonable to suppose that the 1014 *naborios* of 1597 were

undoubtedly, the very small size of the work force. There were fewer than 10,000 workers in the whole of the silver industry, producing two-thirds of the value of Mexico's exports to Europe at the end of the sixteenth century.<sup>23</sup> The smallness of the figure tends to reinforce earlier arguments<sup>24</sup> that the decline of the Mexican native population in the sixteenth and early seventeenth centuries was not the major determinant of the mid-seventeenth century decline of the mining industry.<sup>25</sup>

A second notable feature of the industry's labour force, clearly shown by the BL table, is the preponderance in it of free-wage workers. They comprised almost 70% of all labourers in 1597. There were almost as few forced Indian labourers as there were black slaves. Woodrow Borah, using the incomplete version of the table held by the Bancroft Library, stressed this prevalence of free labour in his now classic essay, *New Spain's Century of Depression*, pointing to it as typical of the response of the Spanish economy of sixteenth century Mexico to the decline in Indian numbers.<sup>26</sup> That is, as a great part of the native population existing at the time of the Conquest vanished, the Spaniards brought into operation a series of labour systems that ensured them a progressively larger share of the remaining Indians' labour time. The final step in this series was the coming, and rapid expansion, of free wage-labour, which gave Spanish employers complete access to the work-effort of those Indians they chose to hire. The Bancroft table used by Borah does not show, however, any information for the Guadalajara and Guadiana districts, nor for the Zacatecas district beside Zacatecas and Pánuco themselves. The

those working in both extraction and refining and that the BL table's labour data for other regions also apply to both extraction and refining. See Alonso de la Mota y Escobar, *Descripción geográfica de los reinos de Nueva Galicia, Nueva Vizcaya y Nuevo León* (Instituto Jalisciense de Antropología e Historia, Guadalajara, 1966), p. 66.

<sup>23</sup> See François Chevalier, 'Les cargaisons des flottes de la Nouvelle-Espagne vers 1600' (*Revista de Indias*, Año IV, No. 11, 1943, pp. 323-30), p. 329. Indeed, the proportion of silver in the export to Europe may have been larger even than this, since Chevalier refers to 1609, by which time the value of non-metallic exports from Mexico to Europe had risen well above its level of the final years of the sixteenth century.

<sup>24</sup> E.g., in Bakewell, *Silver mining...*, pp. 199-201; and D. A. Brading, *Miners and merchants in Bourbon Mexico, 1763-1810*, (Cambridge, England, 1971), pp. 9-10.

<sup>25</sup> For a discussion of the decline, see Brading and Cross, 'Colonial silver mining'..., pp. 568-74. The major restraints on the industry in the seventeenth century seem to have been lack of mercury, depletion of ores, and — until the final third of the century — lack of capital.

<sup>26</sup> Pp. 37-8.

total absence of repartimiento in these areas adds strength to Borah's argument. Repartimiento, it is true, still persisted in New Spain, providing just over a quarter of mining labour there. Draft labour was clearly more firmly rooted in New Spain than elsewhere, since Central Mexico had from long before Conquest a denser and more sedentary native population than the other areas under discussion here. It is thus a region in which repartimiento was easier to implement.

The social implications of this prevalence of free wage-labour in the mining industry still remain to be investigated. Naboríos seem, by the late sixteenth century, to have formed a compact professional mining force, more completely a part of the Spanish economy of Mexico than other native groups. Many of them lived permanently in the mining towns, which were largely new Spanish foundations, unfamiliar in form, and often in location, to the Indian. (The northern mining centres, for example, were in areas strange to the naboríos, who came mainly from Central Mexico). In Zacatecas, and presumably elsewhere, some naboríos lived in the refining haciendas themselves — others in the town, congregating into *barrios* according to their regional origins. Despite this attempt to find solidarity and comfort in gathering like with like, the mining naboríos must have been exposed to an intensity of acculturative influences not experienced by the majority of Indians. The history of this early industrial proletariat of native Mexicans awaits its researcher.<sup>27</sup>

Still unknown, also, is the extent to which these naboríos were retained by debt. The first paragraph of the 'Relación...', notes that they owed a large sum to their employers, and that these went to great expense to recover naboríos who fled without paying off their debts. These debts were presumably contracted as advances of wages or of goods on credit against wages. Nevertheless, it is impossible to know whether the employers purposely allowed the debts to arise in order to *retain* labour, or whether they had to offer advanced wages in order to *attract* scarce skilled labour in the first place. There is evidence from Zacatecas that in the late sixteenth century the latter practice was the origin of naboríos' debts, and that, in fact, the debts were a singularly ineffective means of retaining labour.<sup>28</sup>

<sup>27</sup> Eric R. Wolf has provided a highly interesting account of this proletariat in and around Guanajuato in the late eighteenth century, in 'The Mexican Bajío in the 18th century: An analysis of cultural integration', *Synoptic studies of Mexican culture*, ed. Munro S. Edmundson (New Orleans, 1957).

<sup>28</sup> Bakewell, *Silver mining...*, pp. 125-6. Cf. the findings of William B. Taylor, who suggests that in eighteenth century Oaxaca, a Spanish land-owner might compete

It should perhaps be said that there is no necessary contradiction between the earlier statement made here that shortage of labour was not a major determinant of the mining industry's seventeenth century decline and this evidence of competition for naboríos. What the employers sought was experienced mine labour. The native population never fell to so low an ebb that it could not supply the few thousand skilled workers needed in mining, though employers might have to bid ever higher to secure the skilled labour they wanted. The cost of mine labour seems therefore likely to have risen as the total Indian population fell. In this sense the decline of the native population acted to depress the mining industry. But even this was a less severe cause of the industry's difficulties in the seventeenth century than the shortages of capital and mercury that beset it from about 1630 onwards.<sup>29</sup>

The relatively small proportion (about 14%) of black slaves in the work force may seem surprising, in view of the heavy nature of mining tasks and the Spaniards' common belief that the black was physically superior to the Indian.<sup>30</sup> But it was soon found that blacks died quickly when put to underground mine labour, and that in general they tended to sicken easily in the cool conditions of the high Mexican mining towns. Heavy mortality, added to the high capital cost of black slaves, thus meant that they were used rather little in the mining industry.<sup>31</sup>

The BL table lists fifty silver mining centres in Mexico (if the double centres, such as Zacatecas-Pánuco, are counted as one). Three of these, in the Guadalajara district, were apparently abandoned, having neither refineries, refiners nor workers. Presumably, though, to merit inclusion in the table, they had been active fairly recently. These 50 centres contained 604 ingenios. On average, therefore, they had about 12 each; though in fact the distribution of ingenios among them was very unequal. The twelve leading centres shown in Table I had 460 ingenios — or 76% of the total. It is therefore explicable that the history of Mexican silver mining in the early to middle

for Indian labour by offering a higher cash advance than his neighbours. See *Landlord and peasant in colonial Oaxaca* (Stanford, 1972), pp. 149-50.

<sup>29</sup> For an account of the decline of one of Mexico's major silver mining districts, that of Zacatecas, see Bakewell, *Silver mining...*, chs. 6-8. It must be admitted that the degree to which the Zacatecan case was typical is not yet known.

<sup>30</sup> J. I. Israel, *Race, class and politics in colonial Mexico, 1610-1670* (Oxford 1975), p. 67.

<sup>31</sup> Israel, *Race...*, pp. 25-6. For similar observations about the use of black slaves in Peruvian mines, see Frederick P. Bowser, *The African slave in colonial Peru, 1524-1650* (Stanford, 1974), pp. 13-14, 119.

colonial period should be dominated by a small number of great names. But the importance of the lesser centres should not be underestimated. The existence of each was the outcome of arduous exploration, which, though much of it was fruitless, represented an addition to Spanish knowledge, and sometimes settlement, of outlying regions. Each centre, large or small, stimulated the growth around it of a new local economy, developing to supply the mines with food, animals and raw materials. Long-distance trading also grew up to link the centres, and incidentally to increase the intensity of Spanish occupation of Mexico.

Perhaps the most striking conclusion to emerge from this study of the BL table is the predominance of the mines of New Spain. There has been a tendency, doubtless reinforced by the earlier work of this author, to assume that after the strikes in the Zacatecas district in the mid-sixteenth century, the majority of Mexican silver came from the mines of the northern plateau. The BL table, however, shows New Spain still dominant in 1597, with the central mines of Pachuca and Taxco leading the field by a large margin. According to the veinteno record (see 'Production' above) New Spain was yielding two-thirds of Mexico's silver in the 1590's. Even making a large allowance for the vagaries of the veinteno figures, it can hardly have been producing less than half Mexico's total. The first great silver age of the northern plateau therefore seems to have come in the early decades of the seventeenth century, with the great boom at Zacatecas, the prosperity of San Luis Potosí (in the AGI 'Relación'... a budding producer, still regarded as a smelting centre), and the Parral strike of the early 1630's.

\* Table 1

The twelve largest refining centres of Mexico in 1597, by numbers of ingenios.\*

Centre	Region	Ingenios
1. Pachuca	New Spain	82
2. Taxco	New Spain	81
3. Zacatecas + Pánuco	Zacatecas	65
4. Guanajuato	New Spain	46
5. Sultepec	New Spain	40
6. Zacualpan	New Spain	26
7. Cuautla	New Spain	26
8. Fresnillo + San Demetrio	Zacatecas	25
9. Tlalpujahua	New Spain	19
10. Sombrerete	Zacatecas	18
11. Temascaltepec	New Spain	17
12. San Martín	Zacatecas	15

\* The significance of the ranking in this table depends on the assumption that all ingenios were of roughly the same size and milling capacity. It must be admitted that at present this assumption cannot be verified. As far as can be seen from the BL table, all these ingenios were operative and functioning.

Table 2(a)\*

New Spain. Mining centres, ranked by numbers of ingenios, with refining plant and refiners.

Centre	Total ingenios	Ingenios de mulas	Ingenios de agua	Mineros	Haciendas en beneficio	Haciendas caídas
Pachuca	82	23	59	52	49	3
Taxco	81	45	36	61	47	14
Guanajuato	46	44	2	29	23	6
Sultepec	40	23	17	35	29	7
Zacualpan	26	3	23	23	21	2
Cuautla	26	23	3	14	16	0
Tlalpujahuá	19	13	6	19	10	9
Temascaltepec	17	0	17	18	18	0
Ozumutlan	4	0	4	10	4	6
Totals	341	174	167	261	217	47

\* In Tables 2 and 3, blanks and noughts appear as in the BL table. The spelling of place names has, where possible, been modernised.

Table 2(b)

Zacatecas district. Mining centres, ranked by numbers of ingenios, with refining plant and refiners.

Centre	Total ingenios	Ingenios de mulas	Ingenios de agua	Mineros	Haciendas en beneficio	Haciendas caídas
Zacatecas + Pánuco	65	65	0	34	20	14
Fresnillo + San Demetrio	25	24	1	8	8	—
Sombrerete	18	18	—	12	12	—
San Martín	15	15	—	6	6	—
Avino	14	11	3	3	3	—
Las Nieves	10	10	—	4	4	—
Charcas + La Habana	9	9	—	7	7	—
Chalchihuites	6	5	1	6	6	—
Santiago	5	5	—	2	2	—
Mazapil	4	4	—	4	4	—
Hacienda del Capitán Urdiñola	4	2	2	1	1	—
Santiago + San Marcos	—	—	—	2	2	—
Totals	175	168	7	89	75	14

Table 2(c)

Guadalajara district. Mining centres, ranked by numbers of ingenios, with refining plant and refiners.

Centre	Total ingenios	Ingenios de caballo	Ingenios de agua	Mineros	Haciendas en beneficio	Haciendas caídas
Izatlán						
[Etzatlán?]	11	10	1	8	8	—
Ocotitlán	10	6	4	10	10	—
Tenamache	7	6	1	6	6	—
Chimaltitlán	7	0	7	6	6	—
Guajacatlán						
+ Apala	4	4	—	4	4	9
Real de Santa Ana	4	4	—	4	4	—
Chiametla	4	2	2	3	3	17
Moloya	4	2	2	2	2	—
Jocotlán						
+ Jora	3	1	2	3	3	8
Espíritu Santo	2	1	1	2	2	7
Huauchinango	2	1	1	2	2	—
Ostoticpac	2	1	1	2	2	—
Zacatongo	2	0	2	2	2	—
San Felipe	1	—	1	1	1	1
Tecorito	1	1	—	1	1	—
San Pedro Analco	—	—	—	—	—	4
San Gerónimo	—	—	—	—	—	—
El Carrizal	—	—	—	—	—	—
Totals	64	39	25	56	56	46

TABLE 2(d)

Guadiana district. Mining centres, ranked by numbers of ingenios, with refining plant and refiners.

Centre	Total ingenios	Ingenios de caballo	Ingenios de agua	Mineros	Haciendas en beneficio	Haciendas caídas
San Andrés	6	3	3	3	3	5
Topia	5	3	2	6	6	2
Mapimí	3	3	—	3	4	—
Guanaceví	3	3	—	4	3	—
Santa Bárbara	2	2	—	3	3	10
Los Papudos	2	1	1	1	2	1
Todos Santos	1	1	—	2	—	2
Coneto	1	1	—	1	1	7
El Caxco	1	1	—	1	1	4
San Bernabé	—	—	—	1	1	—
Indé	—	—	—	1	—	1
Totals	24	18	6	26	24	32

TABLE 3(a)

New Spain. Mining centres, ranked by numbers of labourers, with slaves, naboríos and repartimiento Indians.

Centre	Slaves	Naboríos	Repartimiento	Total labour
Pachuca	109	1 168	394	1 671
Taxco	266	834	406	1 506
Guanajuato	42	415	166	623
Cuautla	178	244	200	622
Zacualpan	117	364	126	607
Sultepec	130	222	66	418
Temascaltepec	46	172	133	351
Tlalpujahuá	4	137	113	254
Ocumutlan	0	26	15	41
Totals	892	3 582	1 619	6 093

TABLE 3(b)

Zacatecas district. Mining centres, ranked by numbers of labourers, with slaves and naboríos. There is no repartimiento labour.

Centre	Slaves	Naboríos	Total labour
Zacatecas + Pánuco	130	1 014	1 144
Fresnillo + San Demetrio	22	230	252
Hacienda del Capitán Urdiñola	10	120	130
Avino	—	121	121
Sombrerete	8	106	114
Mazapil	3	94	97
Charcas + La Habana	1	83	84
San Martín	6	71	77
Las Nieves	20	27	47
Santiago + San Marcos	—	44	44
Chalchihuites	—	29	29
Santiago	—	17	17
Totals	200	1 956	2 156

TABLE 3(c)

Guadalajara district. Mining centres, ranked by numbers of labourers, with slaves and naboríos. There is no repartimiento labour.

<i>Centre</i>	<i>Slaves</i>	<i>Naboríos</i>	<i>Total labour</i>
Chimaltitlan en Guadalajara	26	137	163
Ocotitlan	18	65	83
Tinamache en Guadalajara	3	63	66
Chiametla	35	24	59
Moloya	1	42	43
Izatlan	-	40	40
Guaxacatlan + Apala	4	33	37
Xocotlan + Xora	2	31	33
San Felipe	10	20	30
Cacatongo	-	25	25
Tecorito	2	23	25
Ostoticpac	-	24	24
Real de Santa Ana	9	11	20
Huauchinango	-	14	14
Espíritu Santo	-	7	7
San Pedro Analco	-	-	-
San Gerónimo	-	-	-
El Carrizal	-	-	-
Totals	110	559	669

TABLE 3(d)

Guadiana district. Mining centres, ranked by numbers of labourers, with slaves and naboríos. There is no repartimiento labour.

<i>Centre</i>	<i>Slaves</i>	<i>Naboríos</i>	<i>Total labour</i>
Topia	51	51	102
San Andrés	10	25	35
Guanaceví	-	28	28
Mapimí	-	24	24
Los Papudos	-	15	15
Santa Bárbara	-	12	12
Todos Santos	-	4	4
Coneto	-	4	4
Indé	-	1	1
El Caxco	-	-	-
San Bernabé	-	-	-
Totals	61	164	225