A

PHILOSOPHICAL and PRACTICAL

ESSAY

ON THE

GOLD and SILVER MINES

OF

MEXICO and PERU;

CONTAINING

The NATURE of the ORE, and the Manner of WORKING the MINES; the Qualities and Uſe of QUICKSILVER; the cleanſing and refining theſe Metals:

With many uſeful

Obſervations concerning the Aſſay of Metals, the Manner of conveying them to EUROPE; and Remarks on the GOLD MINES in *Hungary*, and thoſe of ASIA and AFRICA.

Tranſlated from a Letter wrote in *Spaniſh*, by Father JAMES HERNANDEZ of the *Society of* JESUS; employed by His Catholic Majeſty to write the Natural Hiſtory of the *Weſt Indies*.

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Philoſophical, Hiſtorical, and Practical

ESSAY

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Gold, Silver, and Quickſilver MINES

IN

MEXICO and PERU.

SIR,

YOU have enjoined me a difficult Taſk, which is, to give you ſome Account of the Gold and Silver Mines in theſe Parts, and other Particulars relating to thoſe Metals, and all this within the Compaſs of a ſmall Tract. Men of your Learning very well know, that to do this well, would require a Volume; but I cannot refuſe complying with a Friend, whom I ſo much value; and ſhall therefore endeavour to reduce all that is requiſite to ſatisfy your Curioſity, to as narrow a Compaſs as the Subject will bear.

The Quickſilver is of ſuch ſingular Uſe in the refining and cleanſing of Gold and Silver, that though you do not mention it in your Letter, I have thought it would be acceptable to you to be ſomewhat particular alſo in my Account thereof. If my Performance be not anſwerable to your Expectation, impute it not to Sloth, or want of Good-will, but to want of more Capacity; for, to inform Perſons of your known Ability, none ſhould take in Hand, but they that are of an equal Genius.

What the Ancients have writ on this Subject, you are a perfect Maſter of; for which Reaſon, it will be ſuperfluous for me to repeat it; unleſs an accidental Quotation may occur, which may ſerve only to refreſh your Memory. Beſides my own Obſervations here, I ſhall add ſome few late Remarks from modern Writers. I now come to the Matter.

To what End Metals were created.

The Wiſdom of God created Metals for Medicines, Defence, Ornament, and Inſtruments of the Works of Men. It were eaſy to bring Inſtances of all Four Uſes; but the laſt is the chiefeſt among Metals; becauſe Man muſt not only be fed, like other Animals, but he muſt alſo work, according to that Reaſon and Capacity his Creator was pleaſed to beſtow on him; and his Ingenuity extending to various Arts and Handicrafts, Providence ordained he ſhould have Materials for Diverſity of Works; for Defence, Ornament, and all Sorts of manual Ope-

Operations. As various as the Sorts of Metal are which God has ſhut up in the Bowels and Caverns of the Earth, there is Uſe for them all among Men. Some are applied for the Cure of Diſeaſes, others ſerve to make Weapons of Defence againſt Enemies, others to adorn and embelliſh both Sexes, and others for Veſſels and Tools invented by the Art of Man. But above all theſe ſeveral Uſes, is that of Money in Trading, which, as *Ariſtotle* obſerves, is the Meaſure of all Things; and tho' naturally itſelf but one Thing, is virtually all Things; for Money is Meat, Drink, Cloaths, Houſe, Caſtle, and all that Man has need of. And thus, as the Wiſe Man ſays, *Money anſwereth all Things*. Men, guided by a natural Inſtinct, to the End that one Thing might ſerve for all, made Choice of that which is moſt durable and manageable, which is Metal; and among Metals, appointed thoſe the Prime in the Invention of Money, which are moſt laſting and incorruptible, being Gold and Silver. Theſe were not only valuable among the *Hebrews*, *Aſſyrians*, *Greeks*, *Romans*, and other *European*, and nearer *Aſiatic* Nations, but even among the remoteſt and moſt barbarous, as the *Eaſt* and *Weſt-Indians*; where Gold and Silver were valued, and accordingly uſed in Temples and Palaces, and for adorning of Kings and Noblemen: for though there have been ſome Barbarians who had no Knowledge of Silver or Gold, as is reported of the Natives

of *Florida*, who took up the Money Bags, and ſcattered the Money about the Shore, as of no Value. And *Pliny*, lib. vi. cap. 27. tells us of the *Babytaci*, who hated Gold, and therefore buried it, that none might make Uſe of it; yet there were formerly, and ſtill are, but very few of thoſe *Babytaci*, and People of *Florida*; and there are very great Numbers of ſuch as ſeek after, value, and hoard Gold and Silver, without having been taught it by *Europeans*. It is true, their Covetouſneſs did not extend ſo far as ours, nor did they ſo much idolize Gold and Silver, though they were Idolaters, as many wicked *Chriſtians*, who have committed the greateſt Enormities in Purſuit thereof. But it is well worthy our ſerious Conſideration, that the Eternal Wiſdom of God ſhould think fit to enrich the very remote Parts of the World, inhabited by the leaſt poliſhed People, and there place the greateſt Number of Mines that ever were known; thus to excite Men to ſeek out and poſſeſs thoſe Countries, and at the ſame time to communicate to them their Religion, and the Worſhip of the true God; thereby fulfilling the Prophecies of *Iſaiah*, "That the Church ſhould ſtretch out "on the right Hand and on the Left," which, as St. *Auguſtin* expounds it, is, "That the "Goſpel ſhould be ſpread abroad, not only by "thoſe who preached it with Sincerity and out "of Charity, but alſo by ſuch as ſhould make "it known upon human and temporal Mo-
"tives."

"tives." Thus we ſee, that thoſe Parts of the *Weſt-Indies* which have moſt Mines, and are conſequently richeſt, have been moſt inſtructed in religious Matters, God making Uſe of our Deſigns to promote his own Ends. Now to the Point.

What Metals the Weſt-Indies *produce.*

There are Abundance of Mines in the *Weſt-Indies*, and of all Sorts of Metals, as Copper, Iron, Lead, Tin, Quickſilver, Silver, and Gold; but above all other Places, the Kingdom of *Peru* abounds moſt in Metals, eſpecially Gold, Silver, and Quickſilver, inſomuch, that new Mines are daily diſcovered; and by the Nature of the Country it appears, that there are far more as yet unknown; and all that Tract of Land ſeems to be more full of thoſe Metals than any other at this Time in the World, or that we have heard of in former Ages.

The prime Cauſe, why there is ſuch Plenty of rich Metals in the *Weſt-Indies*, and particularly in *Peru*, is, as has been ſaid, the Will of the Creator, who beſtowed his Gifts, as to him ſeemed beſt: But to come to Human Reaſon and Natural Philoſophy, it is very certain, as *Pliny* obſerves, Lib. v. That Gold, Silver, and other Metals are produced in the moſt barren and unfruitful Soils. Thus we ſee, that the Lands which are temperate, and produce Graſs and Fruit, ſeldom contain any Mines; Nature being ſatisfied with giving them the proper Vigor to produce ſuch Things as are moſt neceſſary
for

for the Support of Men and Beasts. On the contrary, the dismal, dry, and barren Lands, the high Mountains, the hard Rocks, and the intemperate Climates afford Mines of Silver, Mercury, and Gold; and all the Wealth that has been brought into *Europe*, since the first Discovery of the *West-Indies*, has been taken from such dismal, barren, and dry Places; but the Love of Money makes them agreeable, plentiful, and populous. And though, as I have said, there are in the *West-Indies* Mines and Veins of all Sorts of Metals, none are wrought but those of Silver, Gold, and Mercury; and this last, because it is necessary for the cleansing of the two others. Iron is conveyed thither from *Spain* and *China*. The *Indians* use Copper; for their Tools and Weapons were made of it, and not of Iron. Since the *Spaniards* have been Masters of the *West Indies*, there has been little Notice taken of the Iron Mines, though there are many; because they look after the richer Metals, and for the rest, make use of what is sent from *Spain*, or found among the Gold and Silver. It does not appear that ever the *Indians* made use of Gold, Silver, or any other Metal by way of Money, or to give a Value to Things, but only for Ornament, as has been said. Accordingly, they had great Quantities of it in their Temples, Palaces, and Tombs, and very many Sorts of Vessels of both Sorts. Their Way of buying and selling was to exchange one Commodity

dity for another, as *Homer* and *Pliny* informs us the Ancients did. Some Things were more valuable than others, which commonly served instead of Money; and this Custom is still in Use among the *Indians*. Thus in the Kingdom of *Mexico*, they use *Cacoa* Nuts, such as Chocolate is made of, instead of small Money. In *Peru*, the *Coza*, a sort of Leaf, much chewed there, serves for the same Purpose; in *Paraguay*, little Iron Wedges; and in the Province of *Santa Cruz de la Sierra*, they have small Pieces of wove Cotton for the same Purpose. In short, the *Indians* formerly had no other Way of Trading but Bartering; and though they had vast Markets, and very much frequented, they knew no Want of Money, nor stood in Need of Brokers; for every Man knew what was fit to be given for the Thing he wanted. After the coming of the *Spaniards*, the *Indians* made Use of Gold and Silver for buying; but at first there was no Coin, and the Gold or Silver was given by Weight, as is reported of the ancient *Romans*. In Process of Time, for the greater Conveniency, Money was coined in *Mexico* and *Peru*; yet, to this very Day, there is no Coin of Copper, or other base Metal, in the *West-Indies*, but only Gold and Silver; for the great Wealth of that Country does not admit of the mean Sorts that are used in *Europe*. It is true,

Bartering of Goods by the West-Indians.

No Coins of Copper, or other base Metal, in the West-Indies, *except in some Islands.*

true that in ſome of the Iſlands, as *Hiſpaniola* and *Puerto Rico*, they have ſome Copper Pieces, like Halfpence, which are of no Value out of thoſe Iſlands, becauſe there is not ſuch Plenty of Silver; and though there be much Gold, they want Men to work the Mines: Now whereas the Wealth of the *Weſt-Indies*, and the working of the Mines, conſiſts in Gold, Silver, and Mercury, I will ſpeak of theſe three Metals, without taking Notice of the reſt.

Of Gold, and its ſingular Properties. Gold was always looked upon as the chiefeſt of all Metals, and with good Reaſon, becauſe it is the moſt durable and incorruptible; for the Fire, which waſtes and conſumes all others, only refines this, and the Gold which has been moſt in the Fire keeps its Colour and is pureſt. That is the Gold *Pliny*, lib. 33. cap. 3. calls *Aurum obritum*, the fine Gold ſo often mentioned in Holy Writ. The ſame *Pliny* tells us, that it never ruſts or decays, or declines with Age, as other Metals do; and though ſo ſolid, it is pliable, and will be wrought to a wonderful Thinneſs. The Gold-beaters and Wire-drawers are well acquainted with its wonderful Quality of being reduced to Thinneſs, and ſtretched out without ever breaking.

The *Weſt-Indies* afford an immenſe Quantity of this Metal; and it is certainly known, that the *Incas* of *Peru* had not only greater and leſſer Veſſels of it, as Mugs, Drinking Cups, Porrengers, Bottles, Pitchers, and Jars, but they

they had alſo Chairs and Biers to be carried in on Mens Shoulders, all of maſſive Gold, and they placed Statues of the ſame Sort in their Temples. There was in like Manner much of this Sort in *Mexico*, but not ſo much as in *Peru*; and when the firſt Conquerors entered both thoſe Kingdoms they found immenſe Wealth, though the *Indians* had hid and concealed much more. Though to ſome it may ſeem incredible, there is nothing more certain than that Horſes were often ſhoed with Silver, and that Three Hundred Crowns in Gold have been there given for a Veſſel containing about Five Gallons of Wine; but there are ſtill greater Extravagancies.

Great Plenty of Gold in Mexico *and* Peru.

The Gold is here gathered three ſeveral Ways, that is, what I have ſeen myſelf; for there is Grain, or Seed Gold, Gold Duſt, and Gold in Stone. That is called Grain, or Seed Gold, which is found in ſmall Bits, without any Mixture of other Metal, and needs not be melted down or refined by Fire; and the Reaſon for giving of it the Name of Grain or Seed Gold is, becauſe thoſe Pieces are generally about as big as Melon or Pompion Seeds; though ſometimes they are bigger: I have ſeen ſome which have weighed ſeveral Pounds. This Excellency is peculiar to Gold; which *Pliny*, Lib. xxxiv. Cap. 4. affirms to be found more perfect than any other Metal, that have al-

Of the various Sorts of Gold, and the gathering of it.

ways Droſs, and requires to be refined by Fire; though I have ſeen ſome natural Silver not unlike the hoar Froſt: and there is alſo that which in the *Indies* they call *Papas* of Silver, being Bits of Silver ſometimes found like our Pignuts; but this is rare in Silver, and common enough in Gold. The Quantity found of this Grain, or Seed Gold is but ſmall, in compariſon of the reſt. The Gold in Stone is a Vein of Gold growing in the very Stone or Flint: I have myſelf ſeen at the Mines of *Zanuma* in the Government of *Sabinas*, very large Stones, with Gold running quite through them, and others that were half Gold and half Stone. This Sort of Gold is found in Mines, in Veins, like the Silver, and are extraordinary difficult to work. *Agatharcides* in the fifth Book of his Hiſtory of the *Erythrean*, or *Red Sea*, as *Phocion*, in his *Bibliotheca*, informs us, deſcribes the Method formerly uſed by the Kings of *Egypt*, to get the Gold out of the Stone; and it is wonderful, how like what he there ſets down is to what they now practiſe in the extracting of Gold and Silver. The greateſt Quantity of Gold gathered in the *Weſt-Indies*, is in Duſt, found in Rivers, or other Places, through which much Water has run.

In what Parts of the Weſt-Indies *Gold and Silver are found.*

The Rivers of the *Weſt-Indies* abound with it; as the Ancients obſerved of the *Tagus* in *Spain*, *Pactolus* in *Aſia*, and *Ganges* in *India*; and what we call Gold Duſt, they name

name *Ramenta Auri*; and there alſo the greateſt Quantity found of this Metal was in Duſt, in the Rivers. There was, and ſtill is, much of it in the Rivers of the Windward Iſlands, *Hiſpaniola*, *Cuba*, and *Puerto Rico*; but little of it is brought into *Spain*, for want of People to work. The Quantity is very great in the Kingdom of *Chili*, the Province of *Quito*, and the new Kingdom of *Granada*. The moſt famous is the Gold of *Caravaya* in *Peru*, and that of *Valdivia* in *Chili*, becauſe it is full Proof, that is, Twenty three Carats and an half fine, and ſometimes better. The Gold of *Veragua* is alſo reckoned very fine. Much Gold is brought to *Mexico*, from the *Philippine* Iſlands, and *China*; but it is commonly very low. Gold is found mixed with Silver and Copper. *Pliny*, Lib. xxxiii. cap. 4. ſays, there is no Gold without ſome Mixture of Silver; but that which has Silver is never ſo fine as that which is mixed with Copper, this being always much deeper. The Gold Duſt is cleanſed by waſhing it very much in Water, till all the Earth or Sand runs out of the Trays or Troughs uſed for that Purpoſe; and the Gold, as being heavieſt, remains at the Bottom of them. It is alſo cleanſed with Quickſilver, and with *Aqua Fortis*; the Allom it is made of being of ſuch a Nature, as to ſeparate the Gold from all other Things. When cleanſed and melted, it is caſt into Wedges or Bars, in order to be brought over

The Manner of cleanſing Gold.

 into

into *Spain*; for it is not allowed to export Gold Duſt from the *Weſt-Indies*, becauſe it cannot be tried, marked, and pay the King's Fifth, till it is caſt. *Spain*, as *Pliny*, Lib. xxxiii. cap. 4. informs us, formerly abounded in Gold and Silver, more than any other Country in the World, and more eſpecially the Provinces of *Galicia*, *Luſitania*, and *Aſturias*, whence he ſays Twenty Thouſand Pounds Weight of Gold were yearly carried to *Rome*; and that the like was not to be found elſewhere. This ſeems to be verified in *Maccabees*, i. 6. where ſpeaking of the Grandeur of the *Romans*, it is ſaid, that they made themſelves Maſters of the Gold and Silver Mines in *Spain*. At this Time, *Spain* receives this Treaſure from the *Weſt-Indies*; Providence having ſo ordered it, to the End that one Nation imparting its Wealth to another, they may communicate their Government for the common Benefit. The Quantity of Gold brought from the *Weſt-Indies* cannot be aſcertained, but there is no Doubt that it is much greater than what was yearly carried from *Spain* to *Rome*. On board a Fleet, formerly, there has been entered from the Province called *Tierra Firma*, Twelve Cheſts of Silver, and each Cheſt at leaſt an Hundred Weight; and from *New Spain*, 1156 Marks of Gold, a Mark being Half a Pound: All this only for the King, beſides what came for private Perſons, entered in the Cuſtom-

Old Spain formerly produced Gold.

Quantities of Gold brought annually into Europe.

Cuſtom-houſe; and what was not entered, which is commonly very conſiderable. Of later Years the Quantities have been much greater of both Sorts. Thus much as to the Gold in the *Weſt-Indies*; we will ſpeak next of the Silver.

Of Silver.

The Reaſon why Silver has the Second Place among Metals, being next to Gold, is becauſe of its coming neareſt to it in Duration, ſuffering leaſt Detriment by Fire, and being moſt tractable and fit to work; and it even exceeds Gold, in Brightneſs and Sound. There are alſo ſome Places where Silver is valued above Gold; but this being more ſcarce, makes it more in Requeſt. Providence has laid up ſuch Store of Silver in the *Weſt-Indies*, that all the Accounts we find in ancient Hiſtory, and the celebrated Mines of *Spain*, does not come near to it. The Silver Mines are generally found on uncouth Flats, and very high Mountains; though there be alſo ſome few in Flats and Plains.

How found.

There are two Sorts of them, the one called Looſe, the other Fixed Veins. The The Looſe are Pieces of Metal, which happen to be in certain Places, where, when that Branch is ended, no more is found. The fixed Veins are thoſe that run out in Depth and Length, like the great Branches of Trees; and where one of theſe is found, there are generally many others near them.

How cleanſed.

The Method uſed by the *Indians*

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to work and cleanſe the Silver, is by melting that Maſs of Metal with Fire, which throws off the Droſs and ſeparates the Lead, Tin, Copper, or other Mixture that is among it. To this Purpoſe, they made a Sort of little Fire-pans, or Furnaces, in ſuch Places where the Wind blew hard; and theſe in *Peru* they call *Guayras*. Since the Conqueſt by the *Spaniards*, beſides this Way of Melting, which is ſtill uſed, they alſo cleanſe the Silver with Mercury or Quickſilver, and much more is done this latter Way; for there is ſome Silver Ore which cannot be cleanſed by Fire, but only with Mercury, and this is commonly the poor Ore, whereof the Quantity is greateſt. That is called poor Ore, a great Quantity whereof yields little Silver, and that rich which yields much. It is very wonderful, that there is not only this Difference of ſome Metal being ſeparated by Fire, and another Sort which cannot be done by Fire, but by Mercury; but that even ſome of the Metal which is ſeparated in melting by Fire, will not run, if the Fire be blown with Bellows, or artificially, but it muſt be the natural Air or Wind; and other Sorts of Metal run better with Bellows. The Ore of the Mines of *Porco* melts eaſily with Bellows; that of the Mines of *Potoſi* will not run ſo at all, but muſt be melted in the *Guayras*, which are the Fire-Pans or Furnaces above-mentioned, expoſed to the natural Air. It is a hard Matter to give

How ſmelted.

give a natural Reaſon for this; but conſtant Experience has ſhewn it to be infallibly true. Curioſity and Covetouſneſs have diſcovered many other Particulars concerning this Metal, ſo much ſought after by Men, ſome whereof we ſhall have Occaſion to mention. *Where found* The chiefeſt Parts of the *Weſt-Indies* *in the* Weſt- for producing of Silver, are *New* Indies. *Spain* and *Peru*; but the Mines of *Peru* are much the beſt, and among them, thoſe of *Potoſi* excell all others in the World. A more particular Account ſhall be given of them, as being one of the moſt remarkable Things in the *Weſt-Indies*.

The much talked-of Mountain of *Potoſi* is in the Province called *Los Charcas*, in the Kingdom of *Peru*; being in 23 Degrees, 40 Minutes, of South Latitude, ſo that it lies cloſe by the Tropic of *Capricorn*, at the utmoſt Edge of the Torrid Zone; and yet it is exceſſive cold, even beyond the Low Countries; whereas, according to its Poſition, it ought to be hot. The Reaſon of its being ſo cold, is its great Height, and being expoſed to very ſharp Winds, eſpecially that they there call *Tomahavi*, which is wonderful fierce, and exceſſive cold, and commonly reigns in *May*, *June*, *July*, and *Auguſt*. The Place is not only cold, but dry, unpleaſant, and altogether barren, ſo that it produces neither Fruit, Grain, nor Graſs, and conſequently ſeems not to be habitable; but the

The Mountain of Potoſi, *and Mines deſcribed.*

the Power of Silver, which attracts all other Things, has occasioned the greatest Towns in those Countries to be built there; and rendered it so plentiful in all Sorts of Provisions and Dainties, that nothing can be wished for, but what is there to be found in Abundance; and though every Thing is brought a great Way, the Markets are as full of Fruit, Preserves, Delicacies, rich Wines, Silks, and all Sorts of Ornaments, as in any other Place. The Colour of this Mountain inclines to a dark Red, and is very agreeable to behold, being like a regular Dome, or a short Sugar-loaf. It rises above all the other Hills about it. The Ascent is steep, though they go up it on Horseback; and it ends in a round Point, being a League in Compass at the Bottom. From the Foot to the Top it is 1624 common *Spanish* Yards, which make a Quarter of a *Spanish* League. At the Bottom of this Hill, and from it, rises another small one, in which there were formerly some Mines of loose Metal, which were like Purses, there being no fixed Veins; and though few, they were very rich. This Hill is called *Guayna-potosi*, signifying, *Young Potosi*. At the Foot of this small Hill begins the Town of *Spaniards* and *Indians*, who have resorted to the Wealth of *Potosi*. That Town is about Two Leagues in Compass, and there is the greatest Trade of *Peru*. The Mines of this Mountain were never wrought in the Days of the *Incas*, who

The City of Potosi described.

who were Sovereigns of *Peru*, before the coming of the *Spaniards*, though they wrought the Mines of *Porco*, which are Six Leagues from *Potosi*. The true Reason, it is likely, was their having no Knowledge of them; though others tell a Fable, that they would have dug those Mines, and heard certain Voices, which told the *Indians*, they must not touch them, because that Hill was reserved for others. In short, nothing was known of *Potosi*, or its Wealth, 'till Twelve Years after the *Spaniards* came into *Peru*, and then they were discovered after this Manner. An *Indian*, whose Name was *Gualpa*, of the Nation of the *Chumbibilcas*, which is in the Province of *Cusco*, following a Herd of Deer that ran upon the West Side of the Hill, which is very steep, and was then covered with a Sort of Trees they call *Quinua*, and Abundance of Shrubs, the better to climb a craggy Place, was obliged to lay hold of a Branch that grew out of the Vein, afterwards called *la Rica*, or the Rich; and having torn it off, discovered at the Root, and in the Hollow it left, the Metal, which was very rich. Having had Experience in that of *Porco*, and found on the Ground, near the Vein, some Pieces of Metal, which had been broke off from it, not very easy to be known, because discoloured by the Sun and Rain, he carried them to *Porco*, to be tried in the *Guayra*, that is, by Fire; and perceiving how extraordinary

How the Mines of La Rica *was discovered.*

rich it was, he privately wrought at the Mine, without acquainting any Man, till a *Guanca Indian*, of the Vale of *Xanza*, which is in the Territory of the *City of the Kings*, or *Lima*, who was a Neighbour at *Porco* to the aforesaid *Chumbibilca Gualpa*, observed, that he brought from the Founderies bigger Bars, than were usually cast of the Metal of that Place, and that he began to dress better; for till then he had lived poorly. These Remarks, and his taking Notice that the Metal his Neighbour melted, differed from that of *Porco*, put him upon enquiring into that Secret; and though the other endeavoured to conceal it, he pressed so hard that he was feign to carry him to the Hill of *Potosi*, after he had enjoyed that Treasure alone during a Month. There *Gualpa* bid *Guanca* take to himself a Vein he had discovered, near that called *Rica*, which was as rich, but harder to work; and thus they friendly divided between them the richest Hill in the World. It fell out afterwards, that the *Guanca* finding some Difficulty in working his Vein, because it was hard, and *Gualpa* refusing to give him Part of his, they fell out; and the *Guanca* of *Xanza* taking Offence on this and other Accounts, discovered that Affair to his Master, whose Name was *Villaroel*, a *Spaniard*, residing at *Porco*. *Villaroel*, to be satisfied of the Truth, repaired to *Potosi*, and finding the Wealth his *Yanacona*, or Servant had told him, caused *Guanca* to register it, and with him staked

staked out the Vein which was called *Centeno*. They call it staking, to mark out the Number of Yards allowed by the Laws, to such as discover or work a Mine; and by so doing, and notifying of it to the Magistrates, they become Masters of the Mine, and may work at it as their own, only paying the King his Fifth. In short, the first registering of a Mine at *Potosi* was on the 21st of *April*, 1545; at the Settlement of *Porco*, by the aforesaid *Villaroel* a *Spaniard*, and *Guanca* the *Indian*. Very soon after was discovered another Mine, which they call *del Estanno*, or the Tin Mine, and has been extraordinary rich, though excessive hard to work, the Ore being as hard as Flint. Afterwards, on the 31st of *August*, that same Year, 1545, was registered the Vein called, *Mendieta*; and these are the Four principal Veins of *Potosi*. *The four principal Mines of* Potosi.

It is reported of the *Veta Rica*, or rich Vein, which was the first discovered, that the Ore was above the Superficies of the Earth the Height of a Horseman's Spear, like Pieces of Rock, or an Excrescence, Three Hundred Feet in Length, and Thirteen in Breadth; and some fancy it was left bare by *Noah*'s Flood, being the most solid Part to withstand the Violence of the Waters; the Ore being so rich, that one Half of it was Silver; and this Wealth continued to Fifty or Sixty Fathoms in Depth, when it failed. As soon as this Discovery at *Potosi* was known through-

out the Kingdom, many *Spaniards* immediately reſorted thither, as did moſt of the Inhabitants of the City called *la Plata*, which is Eighteen Leagues from *Potoſi*, to take Mines there. Abundance of *Indians* alſo flocked thither; and in a ſhort Time it grew up to be the greateſt Town in the Kingdom.

Pliny, in his Natural Hiſtory, l. 33. c. 6. writes thus, "Silver is found in moſt Provinces, "but the beſt is that of *Spain*. It is produced "in barren Land, among Rocks and Cliffs, "and whereſoever one Vein of Silver is found, "it is certain another is near it; and the ſame "is uſual with almoſt all other Metals; and "therefore the *Greeks* ſeem to have given them "that Name. It is wonderful, that the Mines "which were firſt wrought in *Hannibal*'s Days "in *Spain*, laſt till this Time; and they ſtill "retain the very Names of their firſt Diſcoverers, among which, that found by *Bebelus*, "and retaining his Name, is moſt famous. "This Mine afforded ſuch immenſe Wealth, "that *Hannibal*, the Owner, had Three Hundred Pounds Weight of Silver every Day "from it; and the ſame Mine is ſtill wrought "to this Day, being now carried on the Space "of Fifteen Hundred Paces deep in the "Mountain, from which vaſt Diſtance the "*Gaſcons* draw up the Water in ſuch Quan-"tity, that it is like a River." Thus far *Pliny*, which I have thought fit to inſert here, becauſe I believe it will be agreeable to ſuch as have

have any Knowledge in Mines, conſidering that the Ancients did the ſame that is now in Practice. But that Mine of *Hannibal*'s is very remarkable, for having been wrought till *Pliny*'s Days, being about Three Hundred Years; and for its Depth, which, as has been ſaid, was Fifteen Hundred Paces, or a Mile and a Half; as alſo for having yielded that prodigious Quantity of Three Hundred Pounds Weight of Silver every Day. Yet, as rich as it was, I do not think it comes up to what has been ſeen in our Days in *Potoſi*; for, as appears by the King's Books of the Cuſtom-houſe of that Place, and is aſſerted by Men of Reputation, at the Time when the Licentiate *Polo* was Governor there, which was many Years after the Diſcovery of the Mines, every *Saturday* there were brought to pay the King's Fifth between One Hundred and Fifty and Two Hundred Thouſand Pieces of Eight, and the Fifth amounted to Thirty or Forty Thouſand Pieces of Eight; ſo that, according to this Computation, there were daily taken out of theſe Mines Thirty Thouſand Pieces of Eight, and the King's Fifth was worth Six Thouſand. It is further to be obſerved, that this Calculation is only of the Silver that was worked and paid the Fifth; and it is well known in *Peru*, that they long uſed in thoſe Parts the Silver they called Current, which was not worked, and had paid no Fifth; and it is agreed

Thirty Thouſand Pieces of Eight daily produced, of which the King had Six Thouſand.

agreed by thoſe who are well acquainted with the Mines, that Abundance of the Silver then exported from *Potoſi* paid no Fifth, being that which was among the *Indians*, and much of that which belonged to *Spaniards*, as I have ſeen even in my Time. So that we may conclude, that One Third, if not One Half of the Wealth of *Potoſi* was not entered nor paid the Fifth.

Beſides One Third Part concealed.

Another Thing is worth obſerving, which is, as *Pliny* tells us, the Mine of *Bebelus* being ſunk Fifteen Hundred Paces, and the Water drained from that Depth, which is the greateſt Obſtruction there can be in working of Mines. As for thoſe of *Potoſi*, though ſeveral of them have been ſunk above Two Hundred Fathom in Depth, yet they have never come to any Water, which is the greateſt Happineſs in Mines; for thoſe of *Porco*, whoſe Ore is wonderful rich, are not wrought, becauſe of the Water they are come to; for it is an intolerable Toil to cut Rocks and drain Water. Knowing Men affirm, that ſince the firſt Opening of the Mines of *Potoſi*, to the Year 1585, were regiſtered in the Office there, One Hundred and Eleven Millions of eſſayed Pieces of Eight, each Piece worth Thirteen Rials and a Quarter; beſides the Plate that has been exported without paying the Fifth, what is

Two Hundred Fathom ſunk, and no Water.

The Silver Mines of Porco *not wrought on account of Water.*

is ſpent as Current, and not regiſtered, being an immenſe Quantity. This Account was ſent from *Potoſi* to the Viceroy the aforeſaid Year, and much greater Wealth has ſince been brought over in the Fleets of that Kingdom; for ſince then, it has been known, that in One Year the Fleets from *Peru* and *Mexico* have brought Eleven Millions: One Half whereof was the King's, and Two Thirds of the Whole came from *Peru*. Let us now ſee how the Mines are wrought, and the Ore taken out of them, cleanſed, and refined.

Boetius, in his Book *de Conſolatione*, had good Reaſon to exclaim againſt the firſt Diſcoverer of Mines, in theſe Words:

Heu primus quis fuit ille,
Auri qui pondera tecti,
Gemmaſque latere volentes,
Pretioſo pericula fodit.

He was in the right in calling them precious Dangers, for the Toil and Danger is very great in digging up theſe Metals, ſo highly valued by Men. *Pliny*, lib. xxxiii. c. 4. ſays, there are many Metals in *Italy*, but that the Ancients would not ſuffer them to be dug, to preſerve the People. They carried them from *Spain*, and made the *Spaniards* work, as their Tributaries. The ſame is now practiſed in *Spain*; for though there is ſtill certainly Abundance of rich Metal, it is not ſought after, nor is

is it allowed, becauſe of the known Inconveniencies; and yet we ſee what immenſe Treaſure is brought from the *Weſt-Indies*, where the getting of it coſts ſo much Labour and Hazard. The Hill of *Potoſi* contains, as has been ſaid, Four principal Veins, being thoſe called *la Rica*, *de Centeno*, *del Eſtanno*, and *de Mendieta*. They are all on the Eaſt Side of the Hill, looking towards the Riſing Sun, and on the Weſt Side there are none. Theſe Veins run North and South; being Six Feet wide where moſt, and a Span where leaſt. There are ſeveral others proceeding from theſe, as the ſmaller Boughs grow from the main Branches on Trees. Every Vein has ſeveral Mines, being Parts of it, whereof divers of the Inhabitants have taken Poſſeſſion. The greateſt Mine contains Eighty Yards, and no Law will allow it to be larger; the leaſt Four. All theſe Mines are at preſent very deep. There are Seventy-ſix Mines reckoned to belong to the Vein called *la Rica*, and Twenty-four to that of *Centeno*. Some of them are Sixty, and others Eighty Fathoms in Depth, and ſo in other Mines on the ſame Hill. For an Eaſe againſt this vaſt Depth of the Mines, were invented what they call *Socabones*, which are Paſſages, or Ways, cut upon the Level into the Side of the Hill, till they come to meet thoſe

The Four Veins of Potoſi *lie on the Eaſt Side of the Hill, facing the riſing Sun, and run North and South, being Six Feet wide.*

Socabones, or Audits on the Level of the Mountain.

thoſe Veins. For it is to be obſerved, that though the Veins lie North and South, as has been ſaid, this muſt be underſtood as deſcending from the Top to the Foot of the Hill; being, as ſome conjecture, above Twelve Hundred Fathoms; and, according to this Computation, though the Mines are now ſo deep, there is at leaſt Six Times that Depth more to the Root of them, which, it is believed, muſt be prodigious rich, as being the Origin and Source of all the Mines. However, the contrary has hitherto appeared; the higher Part of the Vein having always proved the richeſt, and the lower it goes, the poorer. The *Socabones*, or Paſſages upon the Level, have been invented for the working of the Mines with leſs Expence, Labour, and Danger. They are Eight Feet wide, and above a Fathom in Height, with Doors to ſhut them up; and through them the Ore is carried with much Eaſe, the Owners of them being allowed the Fifth of all the Metal carried out that Way. Many of them are long ſince finiſhed, and others are ſtill carrying on. One of theſe Level Paſſages, which are called *Venino's*, and goes to the *Veta Rica*, or Rich Vein, was Twenty-nine Years in digging; being begun in the Year 1556, which was Eleven Years after the Diſcovery of thoſe Mines, and finiſhed on the Eleventh of *April*, 1585. This Paſſage came to the *Veta Rica*, Thirty-five Fathom above its

The Mines richer at the Top than the Bottom.

its utmoſt Depth; and from the Place where it joined the Vein, to the Top of the Mine, One Hundred Thirty-five Fathoms more; for ſo deep they deſcended to work it. The Length of this Paſſage, from its Entrance to the Vein, which they call *el Cruzero*, or the Croſsway, is Two Hundred and Fifty Yards, and they were Twenty-nine Years cutting through this, as has been ſaid. They work in perpetual Darkneſs, never knowing whether it is Day or Night; theſe being Places to which the Sun never has any Acceſs. They are not only always dark, but alſo very cold, and infeſted with a thick diſagreeable Air, which is apt to make ſuch as go in giddy, and as it were Sea-ſick; as it happened to myſelf, being ſick at the Stomach, and troubled with Retchings to vomit. The Men always work there by Candle-light, one Party by Day, and another relieving them at Night. The Ore is generally hard, and they break it with Iron Crows, which is like digging of Flint; then they carry it up on Ladders made of Three Cables of Cow's Hides, cut into Thongs, and well twiſted, with Sticks, or Rounds, laid a-croſs from one Cable to the other, ſo that one Man can go up, and another down, at the ſame Time. Theſe Ladders are Ten Fathom high; and at the End of them is another of the ſame Height, commencing at a Sort of Landing-place, or Half-pace, made in the

An Audit Twenty-nine Years in making.

The Manner of working.

the Nature of Scaffolds, becauſe there are many Ladders to aſcend. A Man carries up half an Hundred Weight in a Sort of Bag, faſtened before him, and hanging on his Back, and thus they go up, Three and Three. The foremoſt of them carries a lighted Candle, tied to his Thumb, that they may ſee, (for there is no Light of Heaven) and they holding faſt with both Hands, aſcend above One Hundred and Fifty Fathoms, which is very dreadful.

The Vein we have ſpoken of, in which Silver is found, generally lies between two Rocks, which are called *the Caſe*; one of them commonly as hard as Flint, the other ſoft, and eaſier to break. The Ore, in the Middle, is not all alike, or of the ſame Value; for One Sort of it is very rich, which they call *Cacilla*, or *Tacona*, and affords much Silver; another poor, yielding but little. The rich Ore of this Mountain is of an Amber Colour, and another Sort darker; another reddiſh, another of an Aſh Colour, and ſo of ſeveral Colours: all of it, to ſuch as do not underſtand it, looks like common Stone; but the Miners ſoon diſcover its Fineneſs by certain little Specks, Veins, and other Tokens. All the Ore dug out of the Mines in *Peru*, is carried to the Mills on the Backs of Sheep, which ſerve for Beaſts of Burden.

The Veins of Silver deſcribed.

The Ore deſcribed.

The Ore carried to the Furnaces on the Backs of Sheep.

How ſmelted and refined.

Burden. The rich Ore is refined by melting in the *Guayras*, as having the moſt Lead, which cauſes it to run; and the *Indians*, to make it melt the better, put into the Furnace what they call *Soroche*, being a very Leadiſh Ore. The Fire cauſes the Droſs to ſink to the Bottom, the Lead and Silver run, the Silver ſwimming upon the Lead, till refined, which Operation they repeat ſeveral Times. Frequently, an Hundred Weight of Ore will yield Thirty, or Forty, or Fifty Pieces of Eight by melting. I had Samples given me of Ore, that yielded above Two Hundred, or Two Hundred and Fifty Pieces of Eight, out of an Hundred Weight; a Thing almoſt incredible, were it not verified by Experience; but ſuch Ore is very rare. That is poor Metal, an Hundred Weight whereof yields leſs than Six or Seven Pieces of Eight. This Sort, for the moſt Part, is not Leadiſh, and conſequently cannot be cleanſed by Fire; for which Reaſon there lay a long Time in *Peru*, an immenſe Quantity of this Metal, being, as it were, the Refuſe and Droſs of the good Ore; till the cleanſing with Quickſilver was brought into Uſe, which has made that Droſs to yield prodigious Wealth; for the Mercury has a ſtrange and wonderful Quality for cleanſing of Silver, being of Uſe for this poor dry Ore, waſting leſs with it, than it does with the rich. At this Time, almoſt all the Silver

Refining with Mercury.

Silver in *Peru* is cleanſed with Mercury; and the ſame in the Mines of the *Zacatecas*, and others, of *New Spain*. There were formerly, along the Sides, and on the Tops of the Hills of *Potoſi*, above Six Thouſand *Guayras*, for melting of the Metal, all which burning in the Night, looked, at a Diſtance, like Illuminations, and afforded an agreeable Proſpect. Now they do not, at moſt, uſe Two Thouſand, becauſe, as has been ſaid, there is little Melting, but moſt is done by Quickſilver. In regard that the Qualities of Mercury, or Quickſilver, are very wonderful, and the Method of cleanſing the Silver with it, very remarkable, I ſhall write as much as will be proper, concerning the Quickſilver, its Mines, and the Manner of working them.

Of Mercury, or Quickſilver.

The Mercury, otherwiſe called Quickſilver, becauſe it looks like Silver alive, by reaſon of its Unſteadineſs, and continual Motion, has ſome of the moſt unaccountable Qualities of all Metals. In the firſt Place, though it is a real Metal, it is not hard, ſolid, or conſiſtent, like the others, but liquid, and running; not like Silver and Gold, which are liquid whilſt melted; but, of its own Nature, though liquid, it is heavier than any other Metal, and therefore they all ſwim in it, and will not ſink, as being lighter than it. I have ſeen Two Pounds of Iron thrown into a Pan of Quick-

Heavieſt of Metals, and therefore they all ſwim in it, except Gold.

ſilver,

ſilver, ſwim on the Top, as a Stick, or Cork, will do in the Water. *Pliny*, lib. xxxiii. c. 6. excepts Gold, which, he ſays, will not ſwim upon the Quickſilver, but ſinks. I have not ſeen the Experiment made, but the Reaſon, perhaps, is, becauſe the Quickſilver naturally clings round the Gold, and ſo encloſes it within itſelf. The moſt important of its Qualities, is that of its ſeeking out, and cleaving to Gold, and making towards it, whenſoever within Reach. Nor does it only adhere to, but ſo thoroughly incorporates itſelf, as to ſeparate it from all other Bodies it is mixed with; which is the Reaſon why they ſwallow Gold, who would preſerve themſelves from the Miſchiefs occaſioned by Mercury. When Mercury has been dropped into Mens Ears, to deſtroy them privately, they have been cured by putting Gold Probes into their Ears, which has attracted the Mercury, and came out White. When I went to *Madrid*, to ſee the Curioſities made by *Iacomo Trenzo*, an excellent *Milaneſe* Artificer, his Men were gilding ſome Braſs Work for the *Eſcurial*, which is done with Quickſilver; and becauſe the Smoak or Fume of the Quickſilver is deſtructive, they told me, that they ſwallowed Gold, which, when in the Stomach, attracted all the Mercury that had penetrated any Way into their Bodies; and by that Means preſerved themſelves from its Hurt, they voiding all together afterwards. When the Mercury

How attractive to Gold.

cury has ſeparated the Gold from all other Metals, or Mixtures whatſoever, the Fire parts that from the Gold, which then remains pure, without melting. I am of Opinion, that the Ancients knew not the Way of cleanſing Silver with Mercury, as is now uſed; for *Pliny*, lib. xxxiii. c. 6. poſitively affirms, that "it "does not adhere to any other Metal, but "Gold;" and when he ſpeaks of refining Silver, he only mentions the melting of it; whence may be inferred, that the Ancients had not attained this Secret.

Its Sympathy with Silver.

In ſhort; though there is the greateſt Sympathy between Mercury and Gold, yet, where there is no Gold, it inclines and cleaves to Silver, though not ſo ſuddenly, but by Degrees ſeparating itſelf from the Droſs of Copper and Lead that grows among it; and this without the Help of Fire, which refines other Metals by melting, though there muſt be Fire to ſeparate the Mercury from the Silver, as ſhall be ſhewn hereafter.

No Sympathy with other Metals.

Mercury has no Sympathy with any other Metal beſides Gold and Silver, but rather flies from, or waſhes and conſumes them; which alſo is very wonderful. For this Reaſon it is kept in earthen Veſſels, or in Skins of Beaſts, becauſe it ſoon penetrates Copper, Iron, or any other metal Veſſels, and ſpoils all other Matter whatſoever; and therefore *Pliny* calls it the *Poiſon of all Things*, as waſting and deſtroying them.

them. Mercury is ſometimes found in the Graves of the Dead, for it unites again after they are conſumed. It has alſo been found in the very Marrow of Men and Beaſts; for the Smoak of it getting in at their Ears, or Noſtrils, it conſolidates within, and penetrates the very Bones. Another Quality of it is, that it moves and breaks into a Thouſand little Drops, which, though never ſo ſmall, are never loſt, but, one Way or other, meet and incorporate again; and it is almoſt incorruptible, as nothing can conſume it; for which Reaſon, *Pliny* calls it, *Everlaſting Sweat*. Another ſtrange Property is, that though Mercury ſeparates Gold from Copper, and all other Metals, yet it is of Uſe in uniting Gold with Silver, Copper, or Braſs, in Gilding. Among all the Wonders of this unaccountable Liquid, that which to me ſeems moſt remarkable is, that although it is the moſt ponderous Thing in the World, it is immediately converted into the lighteſt, which is Smoak, in which it preſently flies up quite diſſolved; and then that ſame Smoak, which is ſo light, in a Moment returns again to ſuch a weighty Thing as Mercury is; for as ſoon as the Smoak of that Metal meets with a ſolid Body above, or comes into a cold Region, it immediately falls again, converted into Quickſilver; and if the Operation of Fire be repeated, it again becomes Smoak, and again Quickſilver.

Mercury found in the Graves of dead Men.

Other unaccountable Qualities.

ſilver. Certainly, the Converſion of a Thing ſo heavy into one ſo light, and then on the contrary again, is one of the ſtrangeſt Things in Nature.

The Mercury is found in a Sort of Stone, which alſo yields Vermillion, by the Ancients called *Minium*, which they held in great Eſteem, looking upon it as a ſacred Colour, as *Pliny*, l. 33. c. 7. informs us; and therefore he ſays, "The *Romans* uſed "to paint *Jupiter*'s Face, and the Bodies of "their triumphant Generals with it; and that "in *Ethiopia*, the Idols, and the Governors, "had their Faces ſtained with it." In *Rome*, Vermillion was highly valued, being conveyed thither from no Part but *Spain*, where there then were, and ſtill are, ſeveral Mines of it. They would not allow the Ore to be cleanſed in *Spain*, for Fear any of it ſhould be embezzelled; but cauſed the Stone, as it was dug, to be carried to *Rome* ſealed, and there it was ſeparated; about Ten Thouſand Pounds Weight of it being carried every Year from *Andaluzia*, which the *Romans* looked upon as a mighty Treaſure. This Note out of the aforeſaid Author may not be diſagreeable to ſuch as are curious in theſe Affairs, conſidering what Advantage was formerly made of it by the moſt potent People in the World.

How found.

The Incas of *Peru* and the native *Indians* dug the Quickſilver Mines many Years, without knowing any

Quickſilver unknown to the Incas.

thing of the Quickſilver, or coveting any thing from them but the Vermillion, which they call, *Llimpi*, and put a high Value on it, for the ſame Reaſon as has been ſaid of the *Romans* and *Ethiopians*; that is, to paint their Idols and their own Faces and Bodies, a Practice much uſed by them, eſpecially when they went to the Wars; and they ſtill uſe it upon ſome ſolemn Occaſions, calling it *Embizarſe*, that is, to adorn themſelves; for they then thought, that their Faces, ſo painted, ſtruck a Terror into their Enemies, and they now look upon it as Beauty. To this Intent they carried on extraordinary Works in the Mines on the Hills of *Guanca Velica*, which are near the City *Guamanga* in the Kingdom of *Peru*, whence they drew this Ore; and theſe Works are ſo ſtrange, that if Men at this Day go into the *Socabones* or Paſſages the *Indians* made into the Sides of the Hills, they are apt to loſe themſelves and not find the Way out again. But, as has been ſaid, they knew nothing of the Quickſilver that is found together with the Vermillion.

The Spaniards *ignorant of it for many Years.*

Not only the *Indians*, but even the *Spaniards* were many Years ignorant of this Treaſure, till the Time the Licentiate *Caſtro* governed *Peru*, in the Year 1566 or 1567, when thoſe Mines were diſcovered after this Manner: One *Henry Garces*, a *Portugueſe*, and an underſtanding Man, got ſome of that red Mineral which the *Indians*

How found out in the Weſt-Indies.

Indians call *Llimpi*, with which they dye their Faces; and having conſidered it well, found it to be the ſame that in *Europe* is called Vermillion; and knowing that Vermillion is taken from the ſame Ore as the Quickſilver is, he concluded thoſe muſt be Quickſilver Mines; went thither, made tryal, and found it to be ſo. The Mines of *Palcas* in the Territory of *Guamanga* being thus diſcovered, ſeveral went thither to refine the Quickſilver, and ſend it to *New Spain*, where the Silver was cleanſed with it; by which means many grew rich, and that Settlement of Mines, called *Guanca Velica*, was inhabited by *Spaniards* and *Indians* reſorting thither, as they do ſtill to the Work of the ſaid Quickſilver Mines, which are many and rich. Among all the reſt, that Mine is moſt famous which they call, *of Amador de Cabrera*, and by another Name, *of the Saints*, which is an exceſſive hard Rock full of Quickſilver, ſo large that it extends Eighty Yards in Length and Forty in Breadth,; and all this Square is dug down Seventy Fathoms in Depth, and above Three Hundred Men can work in it together, by reaſon of its vaſt Extent. This Mine was diſcovered by an *Indian* belonging to *Amador de Correa*, whoſe Name was *Navincopa*, of the Town of *Acoria*. *Amador de Correa* entered it in his Name; he had a Suit in Law with the King, and the Uſe of it was granted him as a Diſcoverer. He afterwards ſold it for Two

Where got in the Weſt-Indies.

Hundred and Fifty Thouſand Ducats, and thinking he had been cheated in the Sale (for ſome deemed it worth Five Hundred Thouſand Ducats, and others valued it at a Million) he went to Law again about it. When *Don Franciſco de Toledo* governed *Peru*, one *Pedro Gonzalez de Velaſco*, who had been at *Mexico* and ſeen how the Silver was there cleanſed with Mercury, offered to do the ſame at *Potoſi*. Trial being made, and anſwering very well, the Silver began to be cleanſed at *Potoſi* with the Quickſilver carried from *Guanca Velica*, which was a great Advantage to thoſe Mines; for by means of the Mercury an infinite Quantity of Silver was drawn from the Ore, that had been rejected and looked upon as Droſs. His Catholick Majeſty's Duties from the Quickſilver Mines, without any Trouble or Hazard amounts to near Four Hundred Thouſand Pieces of Eight yearly, each Piece being near Seven Ryals; beſides what it afterwards produces by its Effect at *Potoſi*, which is a prodigious Treaſure. From theſe Mines of *Guanca Velica*, one Year with another, are drawn Eight Thouſand Quintals, or Hundred Weight of Quickſilver.

What the Mines yield the King of Spain yearly.

Let us now ſhew how the Quickſilver is extracted and how the Silver is cleanſed with it. The Stone or Ore of the Quickſilver is ground, and put into large covered Crucibles over the Fire, which

How it is extracted.

which Ore diſſolving, the Quickſilver ſeparates from it by the Strength of the Fire, and exhaling with the Smoke, continues to aſcend, till it meets with ſome ſolid Body, where it conſolidates; or if it paſſes on without meeting any hard Body, it riſes till it is cold, and then conſolidates, and falls down again. When it is melted, they uncover the Crucibles, and take out the Metal, which they do when cold; for if any of that Smoak or Steam reaches the Perſons who uncover the Crucibles, the Mercury ſeizes them, and they either die, or are left in a wretched Condition, with the Loſs of their Teeth, and almoſt disjointing their whole Body. An infinite Quantity of Wood was uſually ſpent in melting the Ore, till *Roderick de Torres*, a Miner, found an Invention of great Uſe, which was the gathering a Sort of Heath that grows all over the Mountains of *Peru*, there called *Ycho*, which they burn; it is aſtoniſhing to ſee the Force of the Fire made with that Heath, for running of the Ore; and this agrees with what *Pliny* writes, that "Gold "will run with the Flame of Straw, when it "will not with the ſtrongeſt Charcoal Fire." The Quickſilver thus melted is put into Skins, (that being the beſt Way of keeping it) and ſo is laid up in the King's Warehouſes; from whence it is carried by Sea to *Arica*, and thence again to *Potoſi*, on the Backs of Flocks of the Country Sheep.

Fuel uſed in extracting the Metal.

How kept.

There

There are generally ſpent in the Work of the Mines of *Potoſi*, between Six and Seven Thouſand Quintals of Quickſilver, beſides what is recovered out of the Droſs, that remains after the firſt Waſhing; which Droſs is burnt to recover the Quickſilver in it. There are above Fifty Laboratories for this Purpoſe, in the Town of *Potoſi*, and in *Tarapaya*.

Quantity of Ore cleanſed yearly.

The Quantity of Ore yearly cleanſed, according to the Computation made by Men converſant therein, is above Three Hundred Thouſand Quintals; and from the Droſs of it refined, are drawn about Two Thouſand Quintals of Quickſilver. It is to be obſerved, that the Nature of Ore is various; for ſome Ore yields much Silver, and conſumes little Mercury; another Sort, on the contrary, yields little Silver, and waſtes much Mercury; another yields much, and conſumes much; and another gives little, and waſtes little. According as the Ore happens, ſo Men thrive more or leſs, or elſe are Loſers by their Work; but, generally ſpeaking, the rich Ore yields much Silver, and conſumes much Mercury, and the contrary happens with the poor Ore.

What Ore requires moſt Mercury to refine it.

The Manner of Smelting and Refining Silver Ore.

The Ore is firſt very well beaten or pounded with the Hammers of the Mills, which batter the Stones as the Fulling-Mills do Cloth. When the Ore is ſmall enough, they ſift it through

through Wire-Sieves, as fine as the common Sort made of Hair; and theſe Sieves, if well hung, ſift Thirty Quintals in a Day and Night. When the Ore is ſifted they lay it into Troughs, with Cavities under them, where it is ſteeped in Brine, allowing Five Quintals of Salt to Fifty Quintals of Ore; which is done, that the Salt may looſen the Silver from the Earth, for the Mercury to incorporate better with the Silver. Then they ſqueeze the Quickſilver through a rough Linnen Cloth over the Ore; ſo that the Mercury falls like Dew, and then turn the Ore that the Dew of the Mercury may reach every Part. Before the Cavities under the Troughs for the Fire were invented, the Ore was ſeveral Times moulded over with Quickſilver and then laid in Troughs, they made great Balls, till they thought the Mercury was ſufficiently incorporated with the Silver; which took up from Nine to Twenty Days in performing. They found afterwards, that Fire was of great Uſe to ſave Time, cauſing the Mercury to cling the ſooner to the Silver; and therefore they contrived thoſe Cavities, on which they lay large Cheſts or Troughs, in which is the Ore, with Salt and Quickſilver, making a gentle Fire underneath in thoſe Vaults or Cavities made for the Purpoſe; and thus the Mercury incorporates with the Silver in Five or Six Days. When it is believed the Quickſilver has done its Part in attracting the Silver, without leaving any, and ſucking it in as a Sponge

a Sponge does Water, ſo that it is incorporated in it, and ſeparated from the Earth, Lead, and Copper naturally mixed with it; then they go about to part it from all that Droſs, and to ſeparate it from the Quickſilver alſo, which is done after this Manner. They throw the Ore into great Ciſterns of Water, where it is moved about with a Sort of ſmall Water-Mills or Wheels, after the Manner of diſſolving or grinding of Muſtard; and thus all the earthy Part goes off with the running Water, and the Silver and Mercury being heavieſt ſettles at the Bottom of the Ciſtern. The Metal, ſo left behind, is like Sand, which is taken thence and carried to be waſhed again in Troughs or Trays at certain great Pools of Water, where all the reſt of the Earth goes off, leaving behind the Silver and Mercury, though ſome little of the Two laſt always goes over with the Clay, which is called the *Relaves*, or Waſhings; and even that they afterwards endeavour to ſave. When the Silver and Mercury are quite clean and ſhining, being cleared from all the Earth and Droſs, they take that Metal, and putting it into a Linnen Cloth, ſqueeze it very hard, which fetches out all the Mercury that is not incorporated with the Silver; and the reſt remains in a Maſs or Body of Silver and Mercury, like the Paſte of Almonds when the Milk of them is preſſed out; and when that Maſs or Body is well ſqueezed, only the Sixth

How the Silver is extracted from the Mercury.

Sixth Part of it is Silver, and the other Five Parts are Mercury; ſo that if the Maſs or Cake weighs Sixty Pounds, Ten Pounds thereof are Silver, and the other Fifty Mercury. Theſe Maſſes are afterwards made up like Sugar-loaves, hollow within, and each of them generally weighing an Hundred Weight. To ſeparate the Mercury from the Silver, they put them into a fierce Fire, covering them with earthen Veſſels, like the Moulds Sugar-loaves are made in, which they cover with Coals, and ſet Fire to them; and thus the Mercury evaporates in Smoak, and meeting with the earthen Caſe over it, unites there, gathering like the Steam of a Pot on the Lid, and thence runs through a Spout, like that of an Alembec, and preſerved in a proper Veſſel, the Silver remaining in the ſame Form, and as large as it was before, but Five Parts in Six lighter, being all ſpongy, and full of Holes, like a Sponge, or Honeycomb, very curious to obſerve. Of Two ſuch Loaves, or Lumps, they make One Silver Bar, weighing Sixty-five, or Sixty-ſix Marks, or Half Pounds, which is carry'd to be aſſay'd, marked, and to pay the King's Fifth. The Silver refined with Mercury is ſo very fine, that it is always reckoned at Two Thouſand Three Hundred and Eighty, as the Refiners term it, which denotes the utmoſt Purity; whenever this happens, the Silverſmiths are obliged to put in ſome Allay, to

make it work the better; the ſame is done at the Mint, where they coin it.

Of the Mills for grinding the Silver Ore, and aſſaying the Metal.

There are Two Things more to be obſerved, relating to the Silver, the Mills, and the Aſſaying: it has been obſerved, that the Ore is ground, that it may receive the Mercury. There are ſeveral Sorts of Mills for this Purpoſe, ſome working with Horſes and others with Water, of both which Sorts there are great Numbers. Now becauſe there is not Rain-Water enough at *Potoſi*, unleſs it be in *December*, *January*, and *February*, they have made great Pools, about Seventeen Hundred Yards in Compaſs, and Three Fathoms Depth, whereof there are Seven with Sluices to them; and when any of them is to be made uſe of, they open as much of the Sluice as lets out a ſufficient Body of Water, and ſhut it up on *Sundays* and *Holydays*. When much Rain falls and the Pools are quite full, they ſerve the Mills Six or Seven Months; ſo that now they pray for Rain in *Potoſi* to grind their Ore, as they do in other Places for the Corn. There are other Mills at *Tarapaya*, a Vale, Three or Four Leagues from *Potoſi*, where a River runs, and more in other Places. All the Difference between theſe Mills is, that ſome have but Five Men to ſerve them, and others Twelve or Fourteen. The Ore is pounded in Mortars, which they are continually filling Day and Night; and from thence they carry it to be ſifted.

ſifted. There are on the Banks of the Brook of *Potoſi* Forty-eight Mills, each of them ſerved by Eight, Twelve, or Fourteen Men; on the other Side are Four more, called *Tara Conuno*. In the Vale of *Tarapaya* there are Twenty-two Mills, all drove by Water; beſides theſe there are at *Potoſi* Thirty Horſe-Mills and ſome few more in its Neighbourhood.

Laſtly, The Silver is aſſayed by the Aſſay Maſters, appointed by the King to aſſign every Piece its Value. The Bars of Silver are carried to the Maſter of Aſſay, who ſets a Number upon every one; becauſe many are aſſayed together. He takes a ſmall Bit out of every one and weighs it exactly, then puts it into a Crucible, being a Veſſel made of the Aſhes of Bones ground and burnt; theſe Crucibles he places orderly in the Furnace, with a fierce Fire, where all the Metal melts; the Lead evaporates in Smoak, the Copper or Tin ſeparates, and the Silver remains extremely pure and of a fiery Colour. It is wonderful, that when thus refined, though liquid and melted, it does not ſpill, though the Crucible it is in be turned down, but remains fixed, and not One Drop falls. By the Colour, and other Tokens, the Aſſay-Maſter knows when it is refined; he then takes the Crucibles out of the Furnace, weighs every Bit again moſt exactly, obſerves how much it has loſt of the Weight, for the fineſt loſes leaſt and the coarſeſt moſt; and according to the Loſs he

 diſcovers

discovers its Fineneſs, and marks it down exactly on every Bar. The Scales are ſo nice and the Weights ſo very ſmall, that they cannot be managed with the Fingers, but with Pliers; and they weigh by Candle-Light, that no Air may come to move the Scales, becauſe on that ſmall Quantity depends the Price of the whole Bar; and therefore it requires the utmoſt Nicety to aſcertain its Value.

I have ſaid already that the Silver is carried on the Backs of *Indian* Sheep; it will be proper to give ſome Account of thoſe Animals, which I do of my own Knowledge, as all the foregoing Hiſtory is, wherein I have ſpent much Time, and taken great Pains to be perfectly acquainted with all theſe Particulars.

Of the Indian *Sheep, and their Uſefulneſs.*

There is nothing in *Peru* more valuable and uſeful than the *Indian* Sheep, which the Natives call, *Llamas*; for no Creature can be more beneficial, and that coſts leſs. This Beaſt affords Meat and Cloaths, as our Sheep do in *Europe*; and beſides, ſerves to carry all their Burdens. On the other hand, the Owners are not put to the Charge of Shoeing or Pack-ſaddles, nor ſo much as Provender, but are ſerved without any Expence, being ſatisfied with what Graſs it finds in the Fields. Thus has Almighty God furniſhed them with Sheep and Beaſts of Burden in the ſame Creatures; and as they are a poor People, ordained they ſhould put them to no Charge. There are Two Sorts of

of theſe Sheep, or *Llamas*; the one called *Pacos*, being Woolly Sheep, the other ſmooth, with little Wool; theſe latter are beſt to carry Burdens. They are larger than our great Sheep, and not ſo big as large Calves; they have very long Necks, like Camels, and it is requiſite they ſhould, becauſe, being tall they have need of it to graze. There are of ſeveral Colours, ſome all White, others quite Black, others of a ſad Colour, and others of a Mixture, which they call, *Moromoro*. The *Indians* had particular Obſervations as to the Colour they were to be of, for certain Times and Exigencies, when they were Heathens, and uſed to offer them in Sacrifice. Their Fleſh is good, though ſtrong; but their Lambs are One of the greateſt Dainties in the World, yet but few of them are killed; becauſe the greateſt Uſe of them is for their Wool, to make Cloth, and their carrying of Burdens. The *Indians* ſpin and weave the Wool to clothe themſelves; One Sort of Cloth they make is ordinary and coarſe, which they call *Havaſca*, another very fine, called *Cumbi*; of this *Cumbi* they make Carpets for Tables, Hangings, Sumpture Cloths, and other Things very curious and laſting, with a Gloſs almoſt like Silk; and what is very remarkable in their Way of weaving Wool, they make what Works they pleaſe in it, and both Sides are alike, and not a Thread nor an End is to be ſeen in a whole Piece.

Of the Indians *weaveing Cloth.*

Piece. The *Inca* Kings of *Peru* had very able Maſters at weaving this *Cumbi*-Cloth, and the prime of them lived in the Territory of *Capachica*, near the great Lake of *Titicaca*. They dye this Wool of ſeveral fine Colours, with ſundry Sorts of Herbs, and ſo make Variety of Works. All the Mountain *Indians* are either fine or coarſe Weavers, have their Looms in their Houſes, and therefore need not buy the Cloth they have Occaſion for. They hang and dry the Fleſh of theſe Sheep, calling it *Cuſharqui*, which keeps very long, and is uſed very ſparingly.

They drive Flocks of theſe Sheep loaded, like our Carriers Gangs of Horſes, there are ſometimes Four or Five Hundred and ſometimes a Thouſand in a Flock, or Gang, carrying Wine, Cocoa, *Indian* Wheat, Chuno and Quickſilver, or any other Goods; as alſo the Silver, which is all carried by them in Bars from *Potoſi* to *Arica* *, being Seventy Leagues; formerly they carried it to *Ariquipa*, which is One Hundred and Fifty Leagues. I have often admired to ſee theſe Flocks carrying One or Two Thouſand Bars, and ſometimes more, worth above Three Hundred Thouſand Ducats, without any other Guard ſave only a few *Indians*, to guide, load, and unload the Sheep, and perhaps One ſingle *Spaniard*; and thus they lay every Night in the open Field, without any other Precaution; and though the Way was ſo long and the Guard

* Two Hundred Forty-five Miles N. W. from *Potoſi*.

Guard ſo ſlender, there was never any thing loſt; ſo ſafe is travelling in *Peru*. The common Burden of One of theſe Sheep is an Hundred Weight, or an Hundred and a Half, and when they are to perform a long Journey they do not go above Two or Three Leagues a Day, or Four at the moſt. The Shepherds or Drivers of theſe Sheep have their ſet Stages, unloading where there is Paſture and Water; there they ſet up their Booths or Tents, make Fires and dreſs their Meat, and they live well enough, though it be tedious travelling. When they are to perform but One Days Journey, One of theſe Sheep will carry Two Hundred Weight and better, and go Eight or Ten Leagues, as has been done by poor Soldiers travelling about *Peru*. All this Sort of Cattle affects a cold Climate, and therefore they thrive on the Mountains, and die with the Heat of the Vales. They are ſometimes ſeen covered with Hoar Froſt, and yet healthy and ſtrong. The ſmooth Sheep have an odd Way of gazing; for they will ſtop upon the Road, lift up their Heads, and look upon a Man very earneſtly; and thus they will ſtand a very conſiderable Time, without moving, or ſhewing the leaſt Sign, either of Fear or Satisfaction: ſo that it would make a Man laugh to ſee their Sedateneſs; yet ſometimes they will take a ſudden Fright and run away with their Burden to the higheſt Clifts, inſomuch that ſometimes they are fain to ſhoot them, leſt the Bars of Silver ſhould

ſhould be loſt. The *Pacos* ſometimes take Pet and are out of Humour with their Burden, lying down with it, and will then ſuffer themſelves to be beaten to death rather than ſtir. Hence came the Phraſe uſed in *Peru*, to ſay, a Man is *Enpacado*, to ſignify he is ſullen, or dogged; becauſe the *Pacos* do thus when they are angry. The only Remedy the *Indians* have in this Caſe, is, to ſtop and ſit down by the *Paco*, and then to cheriſh and make much of him till his Paſſion is over, and he riſes; and ſometimes they are fain to ſtay Two or Three Hours before he will be in Humour. They are ſubject to a Diſtemper like the Itch or Mange, called *Carache*, which often kills them. The Remedy uſed by the Ancients was to burn the ſcabby Sheep alive, that it might not infect the reſt, the Diſtemper being very contagious. One of theſe Sheep is worth Six or Seven Pieces of Eight, or more, according to the Time and Place.

This is an exact Account of the Mines of *Peru*, as well as of the Sheep. In the next Place I muſt ſay ſomething concerning the Mines of *New Spain*, as far as may be of farther Information, without repeating any of thoſe Particulars, which have been already mentioned.

Any

Of the Mines in New Spain.

Any Perſon whatſoever that diſcovers a Mine, either of Gold or Silver, may make his Advantage of it, paying the King's Dues. A Mine forſaken by the firſt Diſcoverer for Three Months, falls to the King; ſo that any Man is free to work it, giving Notice to the firſt Owner. If he oppoſe, and aſſign a Reaſon, why he has not kept Men at Work, the Royal Audience judges whether his Oppoſition is to take place.

The King gives Sixty *Spaniſh* Yards (Three Quarters and a Nail of our *Engliſh* Yard) towards every Point of the Compaſs, from the Mouth of the Mine, or all One Way, as the Miner likes beſt; without which Space another may open another Mine, leaving Five Yards between them to part their Ground. By this it appears, that more Ground is allowed to a Mine in *New Spain* than in *Peru*, where the largeſt can have only Eighty Yards ſquare; whereas thoſe of *New Spain* have Sixty Yards from the Mouth every Way, making One Hundred and Twenty Yards ſquare. As they ſink under Ground, one may work into the others Diviſion, till he meets with his Workmen; but then he muſt retire to his own, or dig lower, that the other may not meet him again digging in the upper Part.

If the lower Mine be drowned by any Spring, as often happens, he that is above is obliged to allow the other the Sixth Part of the Ore he gets; and if the Water breaking out

in the upper, ſhould run into the lower, the Owner of the firſt of them is bound to drain it.

Theſe Mines pay the Tenth to the King, wherein they differ from the *Peruvians*, who pay the Fifth as to Silver; but in Gold there is no Privilege, they all alike paying the Fifth.

I went from *Mexico* to ſee the Mines of *Pachuca*. The firſt of them, called *Santa Cruz*, or *Holy Croſs* was Ninety-two *Eſtados* in Depth, (an *Eſtado* is Three *Spaniſh* Yards) and Ninety-two *Eſtados* is Two Hundred Ninety-ſix *Spaniſh*, or Two Hundred Twenty-four *Engliſh* Yards. The other, called *del Navarro* is Eighty *Eſtados* deep, or One Hundred Ninety-five *Engliſh* Yards. In that of *Santa Cruz* the Metal is taken out with *Malacates*: This is an Engine with a perpendicular Axletree reſting in Two Irons; about the Axletree moves a Wheel, on which, inſtead of a Rope, an Iron Chain is wound, One End of which comes up with the Ore, hanging to it, and the other goes down for more, like Buckets in a Well. The Engine is kept going by Four Mules, made faſt to a Piece of Timber that croſſes the Axletree. Two of theſe *Malacates* work at this Mine, as well to draw up the Metal, as to drain the Water, which would otherwiſe riſe and hinder the Work. I went down Five Ladders, or rather Poles, but the Miner would not let me go any farther, for Fear I ſhould tumble headlong; and indeed the Poles to go down by, were wet, and a Man's Foot might eaſily ſlip, as

as he was finding out the Notch. I went thence to the Mine called *del Navarro*, where the *Indians* brought up the Metal on their Backs, with imminent Danger of their Lives in climbing ſo many Ladders, or rather upright Poles with Notches on the Sides of them. This they do for Four Rials * a Day; but at Night they are allowed to carry up as much Ore as they can at Once, which they afterwards ſhare with the Owner of the Mine. They had wrought Five Months to make a Communication under Ground, from One Mine to the other, and convey the Water out of the *Navarro* Mine into that of *Santa Cruz*, which was deeper. The Miners had not met when I was there, but were ſo near to one another, that both heard each others Strokes.

I went Two Leagues farther to ſee the Mines on the Mountains, where I found a little Town of clay Houſes, covered with Wood, as in other Places the *Indians* cover them with Leaves of *Maguey*; and here at leaſt Twelve Thouſand got their Living in thoſe Dungeons. There are in the Space of Six Leagues about a Thouſand Mines; ſome quite laid aſide, others in which they are now at Work, and others preſerved; though ſome privately get down into them to ſteal the Ore. Eight Days before I was there Fifteen *Indians* had been killed in One Mine, the Earth falling in upon them as they were going down a narrow Mouth; the great one being ſtopped up by the Owner's Orders.

 I took

* A Rial, about Six-pence Sterling.

I took a particular View of the Mine they call the *Trinity*, becauſe it is made up of Three ſeveral Mines, diſtinguiſhed by the Names of *Campechiara*, *Joya*, and *Penol*. Though there are Three Mouths, they all go to One Vein. As for its Riches, Perſons of Reputation and well acquainted with the Place, told me, that in Ten Years paſt there had been Forty Millions of Silver drawn thence; Nine Hundred or a Thouſand Men working there every Day. When they had ſunk the Work an Hundred *Eſtados* they found Water, to drain which Sixteen *Malacates*, the Engines above deſcribed, were ſet up, and Two Millions were expended in Timber-Work, to keep the Earth from falling in. Yet Time, which conſumes all Things, has rendered this rich Mine ſo dangerous, that it is reckoned impoſſible to get more Silver out of it; and therefore all the Mouths are ſtopped up.

A Mine was opened cloſe by in the Year 1690, and another many Years after, which has yielded great Profit to the Owner, and is called *St. Matthews*'s Mine, the Veins of Ore lying Eaſt and Weſt, being eaſily found and dug. This Mine, when I was in *New Spain*, was One Hundred and Fifty *Spaniſh* Yards deep. I reſolved to ſee the Veins of Silver Ore; but having gone down Five Ladders or Poles, I was aſtoniſhed to ſee how likely it was to tumble down headlong. Being therefore about to go up again, the Miner, who has the

Charge

Charge of propping up the Mines, encouraged me, ſaying, there were but few Poles to the Bottom; whereupon, he going before, with a Light in his Hand, I ventured down the reſt, though with much Fear; becauſe I ſometimes found it very difficult to claſp the Pole or Tree with my Arms, and fix my Feet on the Notches cut in it. However, I went down Three Times as far as the Miner had told me; he having made it leſs to encourage me to proceed. Thus I came at laſt to the Place, where the Miners, with Iron Wedges made the hard Ore fly about. They told me, it was ſofter in ſome Places, and of ſeveral Colours, and having rewarded them, they gave me a Quantity of Ore. There I conſidered the Danger I had run myſelf into, and the more, becauſe it was very unwholſome being in that deep Dungeon, by reaſon of the peſtilential Damps of the Place. Having therefore ſtayed about Two Hours, I went up again in much Dread, becauſe of the Difficulty of the Aſcent, and got into the open Air very weary. I ſhould hardly have ventured down again for Two or Three Thouſand Pieces of Eight.

The Mines are ſo deep, becauſe they always dig down perpendicularly, to find out the Veins of Silver, which being dug away, as they lie horizontally, they again begin to ſink deeper, till they meet another, and that being exhauſted, down again; ſo that this Work is now of an amazing Depth.

Next

The Manner of ſeparating the Silver Ore.

Next they carried me to ſee the Ore ſeparated at the Silver Works, whereof there are many at *Pachuca*. It is done thus; When the Ore is brought out of the Mines they break it with Hammers, to ſeparate the Metal from the Stone that has no Silver in it. The Men who break it are well ſkilled in their Trade, put the Ore which is for the Fire, and that which is for the Quickſilver into ſeveral Sacks; Experience teaching them how to know the one from the other; and ſo they ſend it to the Mills.

There the Ore is ground and pounded in Iron Mortars, like thoſe uſed for making of Gunpowder, working with Water or Mules. In order to run it they mix with it a certain Proportion of burnt Lead, firſt ſeparated from the ſame Ore, which is like a Letharge of Iron, and is put with an equal Quantity of Coals into a Furnace, like a Chimney, Twelve Spans high and wider at the Top than at the Bottom. Two great Pair of Bellows blow this Furnace, Two Mules working the Engine that moves them; and whilſt the firſt Metal is melting, they lay on more, for about Six Hours. When the Lead and Silver are melted, they take off the burnt Scum with a Hook, whilſt the Silver is let run out at the ſmall End of the Furnace, through a Spout into a Mould, where it hardens; and when cold is taken out. Then they ſtop the Spout of the Furnace and lay on more

more Ore, Lead, and Coals, as at firſt, to caſt more Pigs or Bars. The burnt Lead we have mentioned is ſold by the *Indians* to their Maſters. When they have made Fifty or Sixty Pigs in a Week's Time, more or leſs, according as the Owner of the Work is in Wealth, they are put into another Furnace adjoining, to ſeparate the Lead and refine them. This Furnace is like our Ovens for baking of Bread, with a Trench in the Middle, full of wet Aſhes moulded together to receive the pure Silver. It is firſt heated with a Wood Fire in another Furnace adjoining, called the refining Furnace; and when the Pigs are ready to run, they clap great Bellows, like thoſe of the firſt Furnace, to it. Then the Silver melting, the pure Part of it runs off along the aforeſaid Trench, and the Lead or Earth drawn off with an Iron Hook, when cold, looks like a Froth or Pumice Stone. This Froth of the firſt and ſecond Running is kept to ſerve again in the Furnace, where they melt the Ore.

Smelting and ſeparating the Silver from the Lead.

Next the Pigs or Bars of pure Silver, each weighing Eighty Pounds, or One Hundred Marks, of Eight Ounces to a Mark, are carried to the King's Refiner or Aſſayer, who tries whether they are Standard, that they may be coined. If they find them ſo, they are worked, and the King takes his Tenth, there being in all Places where there are Mines, a Treaſurer, Comptroller, and another

Aſſaying the Silver.

ther Officer called *Official Major*, or Regiſter, to receive the King's Dues. If they are not Standard, they are refined over again and then marked.

It will be needleſs to repeat any thing concerning the cleanſing or refining with Quick-ſilver, of which enough has been ſaid above; only this particular may be added, that to the Mixture of the pounded Ore, Salt and Quick-ſilver, before ſpoken of in that Operation in *Peru*; they of later Years, in *New Spain*, add the Droſs of Copper, becauſe it helps to heat the Maſs and makes it ferment the ſooner. The Quick-ſilver being very dear in *New Spain*, as being carried thither from *Europe*, or *Peru*; in Conſideration of that and other Expences, the Owners of Mines are at more Charge than in *Peru*, the King has only the Tenth of their Metal; whereas, he has the Fifth in *Peru*.

Droſs of Copper added in refining Silver in NewSpain.

All the Silver produced by the Mines in *New Spain* is carried to *Mexico* to be entered in the Exchequer; and they ſay, it amounts to Two Millions of Marks a Year, each Mark of Eight Ounces, beſides what is concealed; and out of that Quantity they yearly coin Seven Hundred Thouſand Marks into Pieces of Eight, at the Mint. That Silver which is thus coined into Pieces of Eight, beſides the firſt Entry to pay the King his Tenth, is again entered in the Exchequer to pay the King a Rial a Mark, which the *Spaniards* call, *Senorage*, or the Duty

Duty of Lordſhip, that is, when the Plate is ſuch as they call, *de ley Cauſada*, or bare Standard, being Two Thouſand Two Hundred and and Ten Marvedees a Mark; and ſo up to Two Thouſand Three Hundred Sixty-ſeven Marvedees, called *ley Subida*, that is, High Standard. The King's Officers will not mark it unleſs it be ſo fine; and if otherwiſe, they firſt reduce it to the Fineneſs of Two Thouſand Three Hundred Seventy-ſix Marvedees, and then add to every Mark Five Fighth Parts of an Ounce of Alloy, to reduce it to Two Thouſand Two Hundred and Ten Marvedees, which is the Standard of the common Pieces of Eight. The Owners are at the Charge of this Work in the Furnaces of the Mint. Theſe Bars are carried to the Aſſayer for him to try whether they are the Standard aforeſaid; and if ſo, they are then ſent to the *Ornazas*, being Eight Places where they coin, in each of which is a *Capatar*, or Head of Ten or Twelve Men; to him the Bars are delivered, weighed and entered in their Books by the Clerk and Treaſurer. Here the Bars are put into the Fire to be cut, and when cut, becauſe the Silver is harſh, they are wetted with Water; and having been put into the Fire again, are coined.

There are Five Sorts of Money coined there, being Pieces of Eight, Half Pieces of Eight, Quarter Pieces, Single Rials and Half Rials. When cut according to their due Weight, they

Five Sorts of Money coined in NewSpain.

are returned to the Treaſurer, who receives them from the ſame Weigher, Clerk, and Officers. The Money coming out Black by reaſon of the Copper, is ſent firſt to the Whiteners, and then paſſing the Officers, who are to ſee it has the juſt Weight of Sixty-ſeven Rials to a Mark, it is delivered to Twenty Coiners, who are together in a great Room. To them are delivered every Day the Five Stamps, which at Night are carefully kept by the proper Officers, upon Peril of their Lives. The Money being coined is returned to the Treaſurer, with the ſame Formality before mentioned, and he delivers it to the Owner, deducting what belongs to the Officers; *viz.* the Treaſurer himſelf, the Aſſayer, Cutter, Clerk, Weigher, Two Guards, other under Officers, and Twenty Coiners. This Deduction is no Loſs to the Owner, being taken out of Two Rials added to the Value of the Plate, before it was coined; which being worth Sixty-four Rials before it came to the Mint, according to the common Weight of Thirty-four Marvedees, goes thence worth Sixty-ſeven, according to the Weight of Thirty-three Marvedees. This Increaſe is divided among the Officers, by Marvedees * and Raciones, that is, Shares or Parts, every Marvedy making One Hundred Thirty-four Raciones, or Parts, as follows;

Method of Coinage.

To the Treaſurer, Twenty-two Marvedees, and One Hundred and Twenty Raciones.

To

* Eight Marvedees make a Rial.

To the Aſſayer, One Marvedy and Sixty Raciones.

To the Cutter, Five Marvedees and Sixty Raciones.

To the *Eſcrivano*, or Clerk, One Marvedy and Sixty Raciones.

To the Weigher, One Marvedy and Sixty Raciones.

To the Two Guards, One Marvedy and Sixty Raciones.

To the *Mezino*, or Under Clerk, Sixteen Raciones.

To an *Alcalde*, Sixteen Raciones.

To the *Capataces* and *Brazajeros*, that is, Heads of the Firemen and Firemen themſelves, Twenty-four Marvedees.

To the Coiners, Eight Marvedees; which in all make Sixty-eight Marvedees.

The Chief Officers are liable to pay for any Frauds committed by their Companions, that they may be a Check upon one another; and this upon Pain of Death, particularly to the Aſſayer. The Treaſurer's Employment is worth Fifty or Sixty Thouſand Pieces of Eight a Year. Thoſe of the Aſſayer and Founder, given for ever to the Monaſtery and Hermitage of the Barefoot *Carmelites* of *Mexico*, being ſerved by the ſame Perſon, yield Fifteen or Sixteen Thouſand Pieces of Eight; that of Cutter, Ten or Eleven Thouſand; and the reſt of the great ones, ſome Three Thouſand Five Hundred, and the worſt of them Eight Hundred

 Pieces

Pieces of Eight a Year. The Maſters of the Eight Furnaces and Two Hundred Coiners have every one between Eight Hundred and One Thouſand Pieces of Eight a Year; and the meaneſt Servants earn a Piece of Eight a Day.

Though every private Citizen who has Silver may have it coined into Money, yet the Mint is almoſt continually employed by Merchants; ſome Years ago there were Three richer than the reſt, who bought the Metal of private Perſons, that were not ſo rich, paying Two Rials ſhort of the Value in a Mark; One of which they payed to the King for *Senorage*, or Duty of Lordſhip, and the other for the Coinage. The Value of Standard Silver of Two Thouſand Three Hundred Seventy-ſix Marvedees is Eight Pieces of Eight and Six Rials a Mark; they paid no more than Eight Pieces of Eight and Four Rials.

There being ſome Gold commonly mixed with the Silver, as it comes from the Mines, it is ſeparated ina nother Place, called, *el Apartado*, or the Separation. Before the Plate goes thither it muſt be ſent to the Exchequer, to pay the King's Tenth. The Separation is made in the aforeſaid Houſe, after this Manner;

The Manner of ſeparating Gold from Silver in New Spain.

The Silver being run, is made into little Balls, which are put into Veſſels with *Aqua Fortis* to diſſolve it. The Gold remains at the Bottom of the Veſſel like black Powder, and the

the *Aqua Fortis*, containing the Silver, is put into Two Glaſſes, with their Mouths together, by the *Spaniards* called *Cornamuſas*; then putting Fire to it, the Silver ſeparates into one of the Glaſſes, and the *Aqua Fortis* into the other. The Gold is run in a Furnace, and firſt caſt into round Pieces, and then into Bars; as is done with the Silver when ſeparated from it. For this Trouble there are Six Rials a Mark allowed to the Houſe, *del Apartado*, or of Separation. Both the Gold and the Silver are returned to the Exchequer where the firſt appearing to be Twenty-two Carats fine, and the Silver Two Thouſand Two Hundred and Ten Marvedees, they are then ſtamped. The Office of *Apartador*, or Separater belongs to a private Perſon in *Mexico*, who bought it of the King for Seventy-four Thouſand Pieces of Eight.

When Gold is coined, it is done after the ſame Manner as the Silver; and they have Pieces of Sixteen, Eight, Four, and Two Pieces of Eight, which laſt are called Crowns of Gold; and where the Silver pays Two Rials a Mark, the Gold pays Three and a Half.

Having acquainted you with thus much of my own Knowledge, I ſhall now inform you what others have wrote on this Subject ſince the Diſcovery of the *Weſt Indies*; for I ſhall not look back in the *Roman* and *Greek* Writers, with whom I know you are perfectly acquainted:

I will

I will therefore preſent you with ſome Extracts from *Gonzalo Fernandez de Oviedo*'s General and Natural Hiſtory of the *Weſt Indies*, in his own Words; by which it will appear how well acquainted he was with the Subject he treats of. He delivers himſelf in his Sixth Book, Chap. 8. in this Manner:

De Oviedo's *Account of Mines.*

"I have made mention in my Third Book of a ſingle natural Piece of pure Gold, found in the Iſland *Hiſpaniola*, which weighed Three Thouſand Six Hundred *Caſtilians*, each *Caſtilian* being a Quarter more in Value than the *Spaniſh* Gold Ducat. There is Reaſon to believe, that the ſame Almighty Power which formed that Maſs, made more. But, that what I am to ſay may be ſatisfactory, and find Credit, I declare, I may be believed in theſe Affairs better than another, becauſe, from the Year 1513 till 1532, I ſerved the Catholick King *Ferdinand* and the Emperor *Charles* V. as Overſeer of the Foundry in the Province of *Tierra Firma*; and His Imperial Majeſty having been pleaſed, at my Requeſt, that my Son *Francis Gonzalez de Valdes* ſhould ſince ſerve the ſame Employment, has alſo thought fit, on Account of my Age, that I ſhould take my Eaſe at Home, and apply myſelf to write this *New Natural Hiſtory of the* Weſt Indies. Therefore, I very well know, and have often ſeen, how the Gold is found and how it is dug in the *Weſt Indian* Mines; and it being all alike every where, and I having

I having cauſed my *Indians* and Slaves to dig it on the Continent, and in the Province and Government of *Caſtilla del Oro*, or the Golden *Caſtile*, and which is done after the ſame Manner in the Iſland of *Hiſpaniola*, and other Parts, I have thought fit to ſpeak of it in this Place, that I may have no Occaſion to repeat it elſewhere.

Where Gold Mines are.

There is Gold found in ſeveral Parts of the Iſland *Hiſpaniola*, as well on the Mountains and in the Rivers of the Territory called *Cibao*, being the Name of a River very famous for the Gold it affords, as at *Cotui*, and in the Mines called *St. Chriſtopher*, the old ones, and other Places. Yet they do not now gather Gold in all Places where it is to be found, becauſe of the great Expence it requires for Slaves, Proviſions, and all other Neceſſaries; for whoſoever undertakes this Work muſt have Money enough to defray the Charge it requires, and find ſuch Profit as may make it anſwer. The Gold is not equally fine in all Places where it is found, though it be in the ſame River, or comes out of the ſame Mine. The Reader is to remember, that all Gold is firſt found, either on the open Plains, or in the Woods or Mountains, or in the Rivers. The Manner of finding the Mines, either in the Plains, Woods, or Mountains is this: The Miners, who are expert in that Affair, take along with them a Number, either of

How Gold Mines are diſcovered.

hired

hired *Indians*, or Black Slaves, and when they come to ſuch a Place as they judge likely, whether in the Plain, or on the Mountain, they try it thus: They firſt cleanſe the Surface of the Earth from Trees, Plants, or Stones, and there dig up Eight or Ten Feet in Length, and as much in Breadth, but not above a Span or Two in Depth, and without going any deeper, waſh all the Earth they have dug up; and if in that Depth they find any Gold, they proceed deeper. If they find none at the firſt Span in Depth, they ſtill go on another Span, and repeat the Waſhing; and ſo again and again till they come to the hard Rock, but then, if none appear, they go no farther, but remove to another Place to make the ſame Trial. If they find it well in that Depth, without penetrating lower, they then extend in Length and Breadth; but if the Gold runs downwards, they then alſo follow it that Way, and ſo continue till they diſcover the Body of the Mine, the Extent whereof is ſettled and aſcertained according to the King's Ordinances, to a certain Meaſure on the Superficies of the Earth; and within that Compaſs, which is ſquare, or near it, they may dig as deep as they pleaſe. The Diſcoverer is obliged immediately to give Notice of it to the King's Officers, that they may regiſter and aſſign the Bounds of it, that others may take the Mines near it; and then no Man may dig within their Limits, without incurring the moſt grievous Penal-

Penalties, which are inflicted without Remiſſion; but the next Comer may mark himſelf out a Mine, to commence where the other ends; whence came the *Spaniſh* Proverb, *That he who has a good Neighbour, has a good Day*; becauſe the firſt Diſcoverer gives Notice to the Perſon he has a Kindneſs for, and deſires ſhould be his Neighbour, and ſo joins him to his Mine; and generally, when One Mine proves rich, the next is ſo too, though perhaps not altogether ſo much; yet ſometimes the Second proves richer than the Firſt. Nay, it often happens, that much Gold is found in One Mine and not a Grain in the next. This is One of thoſe Things which moſt plainly evince the Fortune of Men; for it often happens, that there are Two, Three, Six, or Ten Mines in the ſame Place, and all the reſt ſhall get pure Gold out of their Mines, and another, who perhaps has more and better Men, ſhall get none, or very little; as on the contrary, One ſhall find much, and many others very little, as happened in the Iſland of *St. John*, or *Puerto Rico* to one *Melo* a *Portugueſe*, who in a ſmall Time gathered Five or Six Thouſand *Caſtilians* of Gold, and ſeveral others who worked by him did not find enough to pay their Charges.

The Mines in Plains, or found near the Superficies of the Earth are to be ſought after near ſome River, Lake, or Spring, where the Earth may be waſhed to cleanſe the Gold, not in the ſame Place where it is dug, for that would

make it all Mire; but the Earth muſt be taken up in ſmall Parcels and carried to the Water, where it is waſhed in Troughs or Trays made for that Purpoſe, to ſee whether any Gold remains in the Bottom of them, which is done thus: Some *Indians* are ſet to dig, others to take up the Earth in Troughs and carry it to the Water, where the *Indian* Men and Women that are to waſh it, ſit. They are generally Women that waſh it, becauſe that Employment is leſs laborious than digging and carrying the Earth. They ſit on the Bank, with their Legs in the Water almoſt up to the Knees, holding the Trough with both Hands by Two Handles there are to it; and when the Earth brought from the Mine is in it, they move the Trough ſo dexterouſly, that no more Water comes into it than they will, and with the ſame Dexterity throw it out at the other End; ſo that as much runs out as in, ſtill keeping as much as ſerves to waſh and diſſolve the Earth, which thus by Degrees runs off with the Water, continually carrying ſome of it away, and the Gold being heavy always falls to the Bottom of the Trough or Tray, and when the Earth is all waſhed off remains there pure. Then the Waſher lays that by and takes more Earth to waſh after the ſame Manner. It is to be obſerved, that every Two Waſhers muſt have Two to carry and as many to dig for them. Beſides theſe *Indians*

The Manner of waſhing Gold Ore or Earth in which it is found.

dians thus employed, there muſt be others, and they are commonly Women, who look to the Houſes where they lie at Night, and dreſs their Meat, which they alſo carry out to them in the Day-time to their Work. So that when they aſk a Man, how many Waſhing-Troughs he employs, if he ſays Ten, it is to be ſuppoſed he has Fifty *Indians*, that is, Five to every Trough, though ſome uſe leſs; but the Number I have mentioned is requiſite that the Work may be well done.

Gold is found in Rivers, and Lakes after this Manner: If it be a Lake, they endeavour to drain it, if ſmall, and it can be done, taking up the Earth and waſhing it as before; but if it be a River or Brook, they turn it out of the Channel, and then gather the Gold there among the Rocks Stones; and ſometimes a great Quantity of Gold is thus found. It is moſt certain, as appears by Experience, that moſt Gold is formed on the Tops and higheſt Parts of Mountains, and in the Bowels of the Earth, the Rains falling, by Degrees waſh away the Earth, and carry down the Gold into the Rivers and Brooks, which have their Springs on the Mountains; and where this happens all the Country about affords much Gold. But for the moſt part, it is found at the Bottom of Mountains, in the Rivers, and among the Rocks, having been long gathering therein.

How Gold is found in Rivers, and Lakes.

In Mines the Veins do not always run parallel with the Surface, but ſinks towards the Center, ſometimes inclining one Way and ſometimes another, and this is no Contradiction to what has been ſaid; for tho' the Gold breaks out and is found on the Superficies of the Earth, it is not formed or produced there, but in the Bowels of it; and in this Caſe the Mines are dug down like Caves or Wells, and as they follow it down they keep continually propping and ſhoreing, to prevent their falling-in and killing the Workmen.

The lower the Gold is found in Rivers, the finer it is, I mean the lower down the Stream; ſo that thoſe who find it half a League lower than others, will have it a Carat or more finer, becauſe the more it is drove the finer it becomes; but on the other hand, they who gather it near the Source find more; this I know by Experience. Another Thing is very remarkable, that the Virgin Gold which is gathered, before it has been at the Fire, has a more beautiful and bright Colour than when it has been caſt, which ſhews how much the Works of Nature exceed thoſe of Art.

Sometimes there are large Grains or Morſels of Gold, of a conſiderable Weight, found upon the Surface of the Earth, and ſometimes deeper in it. The greateſt ever heard of was that before-mentioned, weighing Three Thouſand Six

Six Hundred *Caſtilians*, which was loſt at Sea. I ſaw in the Year 1515, in the City of *Santo Domingo* in *Hiſpaniola*, in the Hands of the Treaſurer, *Michael de Paſſamonte* Two natural Grains or Morſels of Gold, One of which weighed Seven Pounds, being Seven Hundred *Caſtilians*, and the other Five Pounds, or Five Hundred *Caſtilians*, and the Gold of them Twenty-two Carats and a Half fine; and on the Continent I have ſeen many other Grains or Pieces, weighing One, Two, or Three Hundred *Caſtilians* each, little more or leſs, and found upon the Surface of the Earth. I have alſo often ſeen the Miners and Maſters of Mines rejoice more at the ſmall Gold than at the large; becauſe it is a Sign that the Mine is more laſting and plentiful, and conſequently affords more Profit than that where ſuch large Pieces are found; it is ſometimes ſo very ſmall that it requires to be cleanſed with Quickſilver. A *Caſtilian* or a *Peſo* of Gold are of the ſame Value, each weighing Eight *Tomines*, and a *Spaniſh* Gold Ducat weighs Six *Tomines*; ſo that a *Caſtellano* or *Peſo* is worth a Quarter more than the *Spaniſh* Gold Ducat. A *Tomine* is Twelve Grains.

I muſt not omit to mention a remarkable Thing, I have been often told by Men of Experience in Mines and digging for Gold; it has happened in following the Vein of Gold, as it runs on towards the inner Parts of the Earth, that it has been as fine as

as a Thread, or Pin; and where it meets with any Cavity it fills up all the Hollow, and forms a large Grain or Morſel, and then runs on through the Pores of the Earth or Rock, as Nature guides it; and the Miners purſuing it the Way it runs under Ground, finds it as ſoft and pliable as Wax, and can wind and bend it between his Fingers; but it immediately hardens in the Air."

Ovalle's *Account of Mines.*

After *Oviedo*, I next proceed to Ovalle's *Hiſtorical Relation of the Kingdom of* Chili, l. 1. c. 4. where I find this Account. "In *Chili* there are Mines of Gold, Silver, Copper, Tin, Quick-ſilver, and Lead. The Copper Mines are wrought for caſting of Bells and great Guns; thoſe of Lead being neglected as of little Uſe, the ſame of the Tin, and alſo of the Quick-ſilver, becauſe of the great Plenty the Mines of *Guanca Velica* in *Peru* afford. Nor are the Silver Mines much regarded, becauſe thoſe of Gold afford much greater Profit. There is ſuch Plenty of Gold Mines, that they are found from the very Borders of *Peru* to the utmoſt Southern Extent of *Chili*; and therefore *F. Gregory de Leon* and other Authors ſay, this Kingdom may be called one continued Maſs of Gold. All Writers extol the Wealth of this Country, and *Antony de Herrera* in his General Hiſtory of the *Weſt Indies*, affirms, that throughout all that Part of the World there is no Gold ſo fine as that of *Valdivia* in *Chili*,

Chili, except that of *Carabaya*; at the firſt working of thoſe Mines of *Valdivia*, One ſingle *Indian* got from them Twenty-five or Thirty *Peſos* a Day, each *Peſo* being Ninety-ſix Grains, or Four Penny-Weight; ſo that allowing the Gold to be worth but Three Pounds an Ounce, and being the fineſt, the Value muſt be much greater; each *Peſo* is worth Twelve Shillings, and Twenty-five *Peſos* got by One Man make Fifteen Pounds Sterling a Day, which is a vaſt Treaſure. The Gold commonly requires no other Trouble but waſhing; yet ſometimes they are forced to follow the Vein among Rocks and Stones, and then the Profit is but ſmall; however, they continue the Work, in hopes that it will ſpread and yield more, and of finding what they call the Purſe, which is, when they come to ſome ſofter Earth, where there is ſometimes ſo great a Maſs of it all together, that a Family is at once made for ever. At *Coquimbo*, the more it rains the more Gold is found, becauſe it is then waſhed down from the Mountains. At the *Conception* is a Lake, whence much is drawn; I had ſome of it aſſayed at *Sevill*, of Twenty-three Carats fine before melting. There are alſo Mines along the vaſt Mountains called *la Cordillera de los Andes*, and on the Eaſt Side of it in the Province of *Cujo*.

Peter Martyr, in his Hiſtory of the *Weſt Indies*, ſays, the Gold about the River of *Santa Martha* in the Kingdom of *New Granada* is very

very low; but it is certain that Kingdom has yielded great Quantities, and very fine in other Parts of it. The Conqueſt of *Peru*, wrote by an anonymous *Spaniſh* Captain, ſpeaks of very rich Gold Mines in the Province of *Callao* in that Kingdom.

This may ſuffice as to the Mines of *America*, which are ſo numerous and ſo rich. It will not be amiſs juſt to take Notice of ſuch as are in other Parts of the World. *Duarte Barboſa* in his Account of the *Eaſt Indies*, informs us, that the Kingdom of *Menancabo*, on the South Side of the Iſland of *Sumatra*, produces a wonderful Quantity of Gold, as well in Mines as what is gathered in Rivers. The ſame he ſays of the Iſlands of *Java* and *Solor*. The *Spaniards*, ever ſince they have been Maſters of the *Philippine Iſlands* have brought conſiderable Quantities of Gold from thence to *New Spain*, and ſo to *Europe*. *John de Barros*, in his Hiſtory, gives us the following Account of the Gold Mines of *Sofala* in *Africa*.

Gold Mines in the East Indies.

Gold Mines in Africa.

The neareſt Gold Mines of *Sofala* are thoſe they call of *Manica*, which are in a Plain hemmed in by Mountains, Thirty Miles in Compaſs. They know the Places where there is Gold, by their appearing dry and without any Graſs. All the Country thereabouts is called *Manica*, and the People that dig the Mines, *Rolongos*; and tho' they lie between the Equinoctial and the Tropick

pick of *Capricorn*, there falls ſo much Snow on the Tops of thoſe Mountains, that many Perſons in the Winter have been frozen to death; but in Summer the Air is ſo clear and ſerene on thoſe Heights, that ſome of our Men have ſeen the new Moon in the very Day of her Conjunction. The *Cafres* work the Mines of *Manica*, which are Fifty Leagues to the Weſtward of *Sofala*; all the Gold found there is in Duſt, and they muſt carry all the Earth they dig to ſome Place where there is Water; and to that Purpoſe make Ditches in Winter to gather the Water; they generally go more than Six or Seven Spans in Depth, ſhould they go to Twenty they every where find the Bottom ſtony. There are other Mines, near Two Hundred Leagues from *Sofala*. In theſe Parts are the Rivers, *Boro*, *Quitriny*, and others, where the Gold is larger and ſome Veins of it in Stone, ſome quite clean and waſhed by the great Winter Rains; and therefore the Natives in Summer dive in ſeveral Parts of the Rivers, bringing up the Mud or Sand from the Bottom, find much Gold among it. In Lakes, Two or Three Hundred Men join to drain about half the Water, and in the Mud there is more or leſs Gold, according to the Nature of the Country; if the People were covetous they might get great Quantities; but they are ſo far from it, that they never care to take the Pains till obliged to it by Neceſſity. The *Moors* are

How diſcovered.

obliged to uſe Art to prevail on them to get the Gold, which is, cloathing their Women, and giving them Glaſs Beads of ſeveral Colours, with other Trifles they delight in; and theſe Things, they ſay, they give them upon Truſt, and therefore they muſt procure the Gold to pay for them within a Time prefixed: they are always ſo juſt as to keep their Word. There are other Mines in the Country of *Toroa*, or the Kingdom of *Butua*, the ancienteſt Mines known in thoſe Parts, all in a Plain, in the midſt whereof is a ſquare Fort of hard Stones of a wonderful Greatneſs, ſo curiouſly wrought that no Mortar can be ſeen between them; the Walls are Twenty-five Spans thick, but the Heighth is not proportionable. Over the Gate of that Structure is an Inſcription, which none of the *Moors* or any others have been able to read; almoſt round the Fort are ſeveral others, much like it in the Manner of Building, and without Lime, as alſo a Tower about Twelve Fathoms high. When or by whom thoſe Piles were erected is not known to thoſe People, who have not the Uſe of Letters. They ſay, they were made by the Devil; for according to their own poor Notions, they think they could not be the Work of Men. This is One Hundred and Sixty Leagues Weſt from *Sofala*, in about Twenty-two Degrees of South Latitude. There is no other Structure, either ancient or modern in all the Country, thoſe barbarous People having none but little wooden Huts. *Thomas Lopez* in his Voyages, ſays, there uſed formerly to be exported from the Mines of

of *Sofala* Two Millions of Ducats in Gold yearly. the *African* or *Guinea* Trade of Gold is well known, as ſo many have expreſsly treated of it. The Gold being brought from the inland Country. The Traders know nothing beyond the Coaſt; but as the Gold brought from thence is all in Duſt, no queſtion can be made but that the Natives find it in their Rivers, and waſh it without being at the trouble to work any Mines, which probably may be very rich; however, the exceſſive Heats and many other Inconveniences of the Country hinder *Europeans* from making any Progreſs far within Land.

Merin's *account of the* Hungarian *Mines.*

Of the ancient Gold and Silver Mines ſomething has been hinted out of *Pliny*, and others, which may ſuffice; but they are at this Time Mines of both Sorts in *Hungary*, which, though affording no extraordinary Treaſure are ſtill wrought; it will be proper to add ſomething concerning them, which cannot be better done than from *Merin* a Phyſician, who took the Pains to view and write of them, as follows:

Thoſe who reſolve to enter the Mines, ought to lay aſide their own Cloaths and make uſe of the Miners Habit, made of ſome very coarſe Cloth; they ſhow two Ways or Paſſages into them, the one ſhorter and eaſier the other much longer and more difficult; the firſt, which they call the Well, is like a Chimney, about Six Feet over the one Way and Two the

other, dug down to the Bottom of the Mine with incredible Labour, and ſupported with large ſquare Fir-Trees, joined cloſe to one another, of which they have great Plenty.

Through this Paſſage they draw up the Ore, in ſome Mines troubled with Springs breaking in, they bring it up in vaſt Quantities of Water, by the Help of Engines wrought by Horſes: this Water is drawn up in Buckets or Bags made of Hides, no other Subſtance being ſo well able to endure the corroſive Exhalations of the Mines. Through the ſame Paſſage the Miners, Three or Four together are let down, with their lighted Lamps, ſitting on a Leather Seat faſtened with an Iron Hook at the Top: a ſurpriſing Spectacle, conſidering, that this Paſſage is always filled with hot and ſtinking Vapours, which are often ſo ſtrong as to extinguiſh the Light of the Lamps, though the Cotton is generally twiſted together an Inch thick; ſometimes the Leather they ſit on, or the Rope being corroded by thoſe ſharp Vapours, thoſe poor Wretches tumble Three or Four Hundred Fathoms deep into an infernal Pit. At the ſame time they deſcend there aſcends a Bucket full of Ore, and if that chance to fall, they are cruſhed to Pieces by its Weight.

The Second Paſſage is carried Under-ground like a Mine, and therefore longer and more difficult, being an Alley cut through the Rocks, ſometimes with Steps and ſometimes with Ladders;

ders; here you may go upright, and there muſt crawl on all-four till you come to the Bottom of the Mine. I ſpent three or four Hours in viſiting the Mines at *Neuhauſel*; this Way is not only troubleſome but dangerous, either the Supporters placed between the Rocks, or the Steps, being corroded by the Vapours and giving way, the Perſons within the Paſſage are buried alive.

For this Reaſon the Overſeers or Inſpectors of the Imperial Mines, are obliged to viſit the Paſſages into the Mines three or four times a Year, to view the Veins, the Water-Courſes, the Paſſages and their Supporters, with all other things thereunto belonging, and to take effectual Care of them. Theſe Overſeers always go in through this laſt Paſſage, as do moſt of the Miners; and I have ſeen above One Hundred and fifty of them go thus into them every four Hours, with their lighted Lamps, in the upper Mines of *Neuhauſel*.

Both Paſſages ſerve alſo to communicate ſome Air to breathe, without which the Miners would ſoon be ſtifled. The Air is conveyed through the laſt Paſſage into the ſeveral Places where the Miners are at work, by the Help of wooden Funnels and Windows, to be ſhut or opened as Occaſion requires; which paſſing from thence forcibly through many Holes into the firſt Paſſage, fly up again, as it were, thro' a Chimney into the open Air. Theſe Exhalations, more rarefied than the Air, cauſe a continual

tinual Ventilation and ſwift Out-draught of noxious Vapours; and therefore at the Entrance of this Paſſage, the Air is exceſſive hot by its Mixture with the aſcending Vapours, though it has juſt before paſſed through the coldeſt Regions of the Mines.

This they have been taught by Neceſſity and Experience, founded upon very good Reaſon, *viz.* to force out with the Air, the venemous antimonial, mercurial, ſaline, and arſenical Spirits, mixed with the Vapours, ſo pernicious to the Brain, Heart, and Lungs. Hence it is that the Miners, after having penetrated into the firſt Region of the Earth, are ſenſible of the cool Air, for they always work naked, and breathe freely enough.

Notwithſtanding all theſe Contrivances, they are not abſolutely delivered from the ill Effects of thoſe Exhalations, though they are in ſome meaſure mitigated; for it is very rare to ſee any of the Miners live to Fifty Years of Age, moſt of them dying young and generally of Conſumptions, their Lungs being by degrees corroded by the acrimonious Particles of thoſe Exhalations. This is the Reaſon why they cannot ſtay above Four Hours at a time in the Mines, but muſt have Recourſe to the open Air to refreſh themſelves; it being certain, that were the Paſſage of the freſh Air ſtopped for one Quarter of an Hour, not one of the Workmen would eſcape with Life; which I ſpeak upon the Credit of the head Managers of the Mines, who by fre-

frequent Experience are the ſureſt Judges in the Caſe. The Miners marry their Children at fifteen Years of Age; it is almoſt incredible how thoſe young People multiply, whereof I made a particular Obſervation at the Copper-Mines of *Neuheuſel*, having there ſeen above fifty ſuch young Huſbands.

Conſidering there was nothing curious to obſerve in going down the firſt perpendicular Way, I went into the other with Four or Five Miners carrying Lamps, Torches, and a Bottle of ſtrong Liquor, to the Bottom of the Mines; and ſhall only ſpeak of the gold Mine of *Cremnitz*, being deeper than the reſt, into which I deſcended in *July* 1615, the hotteſt and drieſt Seaſon; and tho' all the deep Mines be much alike, I will not omit any Thing worth taking Notice of in the others.

The Entrance into the laſt of the Two Paſſages, is not, like the firſt, hot, but rather cold, which I was ſenſible enough of, having no other Cloaths on but ſuch as the Miners uſually wear, and coming into a moiſt and clayiſh Place, impregnated with a vitriolate Spring, which the Miners recommended to me as very medicinal, eſpecially in Agues; a Thing likely enough to be true, conſidering it belongs to a gold Ore. I found the Water very cool upon the Tongue, and ſomewhat aſtringent. The Spring does not riſe up to the Surface of the Earth. Thence we came into the Concavities, where

where the Miners were at work and ſhow'd us how the Vein of Ore ran betwixt Two Tables, as they called them. Deſcending ſtill eight Fathoms deeper we found it pretty warm, and the Heat ſtill encreaſed as we went lower. The firſt Time I went down into the Mines I was both ſurpriſed and rejoiced at this Alteration of Cold into Heat, which made me aſk the head Miner, Whence the Heat proceeded? who ſaid, From the inferior Regions, which are always hot. I further aſked him, Whether it was the ſame in all Mines? He anſwered, It was; at leaſt in all Mines of a conſiderable Depth; for after the cold Region followed the hot at a certain depth; and what Way ſoever they dig after that, they are never ſenſible of Cold. This putting me in mind of the central Heat mentioned by chemical Authors, I aſked him again, Whether the nearer they drew towards the Center of the Earth, they ſtill found the more Heat? He anſwered, That they had not obſerved any thing of that ſort; unleſs it were now and then, when they happened to meet with a Vein of ſome very hot Mineral. Adding, That at certain Seaſons of the Year they found the Heat increaſe; but that did not depend on their Depth, ſince the ſame was obſervable in all Mines. All the head Miners agreeing in this Point, I had enough to do to meditate on the Reaſon of it, which thoſe Miners owned themſelves to be ignorant of.

How the Vein of Gold lay.

To

To proceed; as we went deeper, finding the Heat ſtill increaſe, beyond whatever I had obſerved in any other Mine before, I aſked the head Miner the Reaſon; who told me, That a vitriolate Vein underneath us, was the Cauſe of that ſudden Increaſe of Heat; and, to make good his Words, he carried us ſomewhat lower, into a large Concavity, ſurrounded on all Sides with a green Vitriol, where the Heat was ſo intenſe, and the Vapours ſo ſharp, that I was ready to faint with ſweating, and my Tongue and Mouth ſeemed to be all bliſtered; which made me admire how it was poſſible for the Miners to work there. This is the beſt Vitriol; for tho' the *Hungarian* Mines alſo produce a Blue, which is very good, yet the Green found in the Gold Mines exceeds it: It is a great Pity that neither of theſe Vitriols, nor the moſt excellent *Hungarian* Antimony is tranſported to other Parts.

A Mine of Vitriol.

Paſſing forward we found on the Sides of the Paſſage, beyond this Concavity, a certain looſe Subſtance, whereof I ſcraped off about Half a Pound with my Fingers, and found it, as I came to the firſt Region in my Return, to grow hard and dry in the Cold; and as it was not tranſparent, I judge it, both by its Colour and Subſtance, to be rather a Sulphur than a Vitriol.

We next proceeded through ſeveral Paſſages and Concavities, which had afforded a conſiderable Quantity of Gold Ore for many Ages

paſt. The head Miner told us, wherever it happens that a rich Vein of Gold or Silver is ſtopped, as it often is, by very hard Rocks, whether they are only interrupted or quite loſt, they diſtinguiſh by certain Signs; they there make uſe of a certain mathematical Inſtrument, by Help whereof, and the conſulting of proper Tables of Inclinations, they judge what Way the Vein runs, and conſequently which Way they muſt trace it. I afterwards got Sight of ſuch an Inſtrument made of Braſs, divided into ſeveral Circles, with divers Needles touched to the Magnet, like thoſe in the Sea-Compaſs.

Advancing ſtill deeper, we heard the Miners at Work with their Sledges, Hammers, and Pickaxes; and coming ſoon to them, could not without much Compaſſion behold thoſe ſubterraneous Wretches, almoſt naked, working without Intermiſſion among thoſe hard Rocks, which they are forced to render the ſofter by ſtrong Fires; which in thoſe ſubterraneous Places never break out into a Flame. We aſked the poor Labourers, how they did in a Place ſo much infected with mineral Spirits and Exhalations; They anſwered; they did indifferently well then, but that when inſtead of a ſerene Air, the Weather was cloudy and tempeſtuous, they were much more incommoded with groſs Exhalations, which mixing with the Air, very much affected their Lungs and darkened their Lamps, and ſometimes quite put them out;

out; ſo that they were certainly the trueſt Tokens of Change of Weather. A Thing well worth obſerving, which ſeems to demonſtrate, that the Vapours which produce thick Clouds and ſmart Showers of Rain, are not generated in the ſuperior Region of the Earth, but much deeper.

I aſked them farther, whether whilſt they were at work in thoſe ſolitary ſubterraneous Places, they did not now and then ſee ſome Apparitions of Spirits or Demons. One of the Miners anſwered, that he had ſometimes ſeen ſuch Demons in the Shape of little black Boys, but that beſides the firſt Fright and ſome little prating to the Miners, they never did the leaſt Harm, unleſs it were ſometimes to put out their Lamps.

I alſo enquired, what it was they moſt feared in the Mines, and was told, an Earthquake; for though the Mines by Reaſon of their Openings upwards, are not much ſubject to ſuch convulſive Motions; yet when the neighbouring Earth is ſhaken by an Earthquake, if the ſame be in the leaſt communicated to the Mines, it muſt of Neceſſity ruin them, by Reaſon of the many Cavities, and deſtroy all that are within them.

This Gold Mine I am ſpeaking of, is the freeſt from Water of any deep ones I have ſeen, ſome being extremely incommoded with it; as are thoſe of *Schemnitz*, which being full of Springs in the

first Region, the Water from thence falls into the lower, and there gathering into Pools, is again carried out with great Labour and Expence, partly by the Buckets mentioned before, and partly by long wooden Pipes of Fir-Trees; a great Number of Men and Horses being employed Day and Night in forcing of it up.

An assay made by Distillation.

I shall here relate an Experiment I made of the Ore. A certain *Hungarian* Nobleman, who was Proprietor of the Gold Mine of *Woissaw*, having presented me with some Stones out of that Mine, I took one of them of about a Pound Weight, reduced into fine Powder, and putting it into a Glass Alembic, distilled it out of the Ashes. It produced about two Ounces of a Mineral Water, of a most odoriferous Scent, and so Cordial, that I had never met with the like before. The Dregs I put into a Crucible, which by a violent Calcination produced the Value of half a Ducat of Gold, twenty-two Carats fine, besides a certain Quantity of yellow Flower, not unlike Sulphur. When I considered the Quantity of Water produced out of a Stone, and its odoriferous Scent, I concluded able Men near those Mines, might find extraordinary Virtues in the Waters of them.

It also frequently happens that the subterraneous Waters carry along with them the Colour or Tincture of the Minerals through which they

A Green Rivulet producing Verdegrease.

they pass. Thus in the Mines at *Neuhausel* is a Rivulet issuing out of the Foot of a Mountain, as Green as the Vitriol itself, contained in those Copper Mines, which being conveyed from one Receptacle to another, they separate out of the said Water, by this Way of Filtration, a considerable Quantity of Verdigrease.

From this Relation, given by *Merin*, it appears, that the *Hungarian* Mines differ in many Particulars from those in *America*, all those who wrote of the latter, taking no Notice of any such constant Exhalations in them, or of such Heat and Cold, though they were all learned Men, and capable of making all proper Observations. In fine, it is easy to observe the Difference between them, which is not to be wondered at, the Soil of all Regions being so various, and producing sundry Effects, though Mines of the same Metals. This we have seen in the Kingdom of *Peru*, the Silver Mines of *Potosi* have never been troubled with Water, though carried down to a prodigious Depth; and yet those of *Porco* in the same Kingdom have been abandoned, barely on Account of the vast Quantity of Water in them, which cannot be drained, and consequently over-flowed all their Works. What *Merin* says of the subterraneous Demons seen in the *Hungarian* Mines, is left for every Man to believe or disbelieve as his Notions are in such Cases, the Author does not

not pretend to have ſeen them, but was told ſo by a Miner: of the Mines in the *Weſt-Indies*, I do not know that ever any ſuch Things have been reported.

I have far exceeded the Bounds of a Letter, and yet I knew not how to make it ſhorter, which you will eaſily forgive, ſince in Compliance with your Commands, which ſhall be always punctually obeyed to the utmoſt of my Power; for I am with all Sincerity,

Your aſſured Friend,

and humble Servant,

J. HERNANDEZ.