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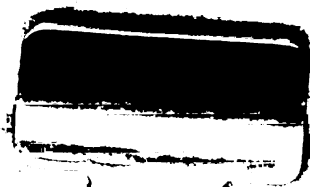
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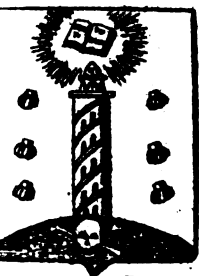
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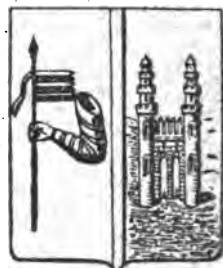
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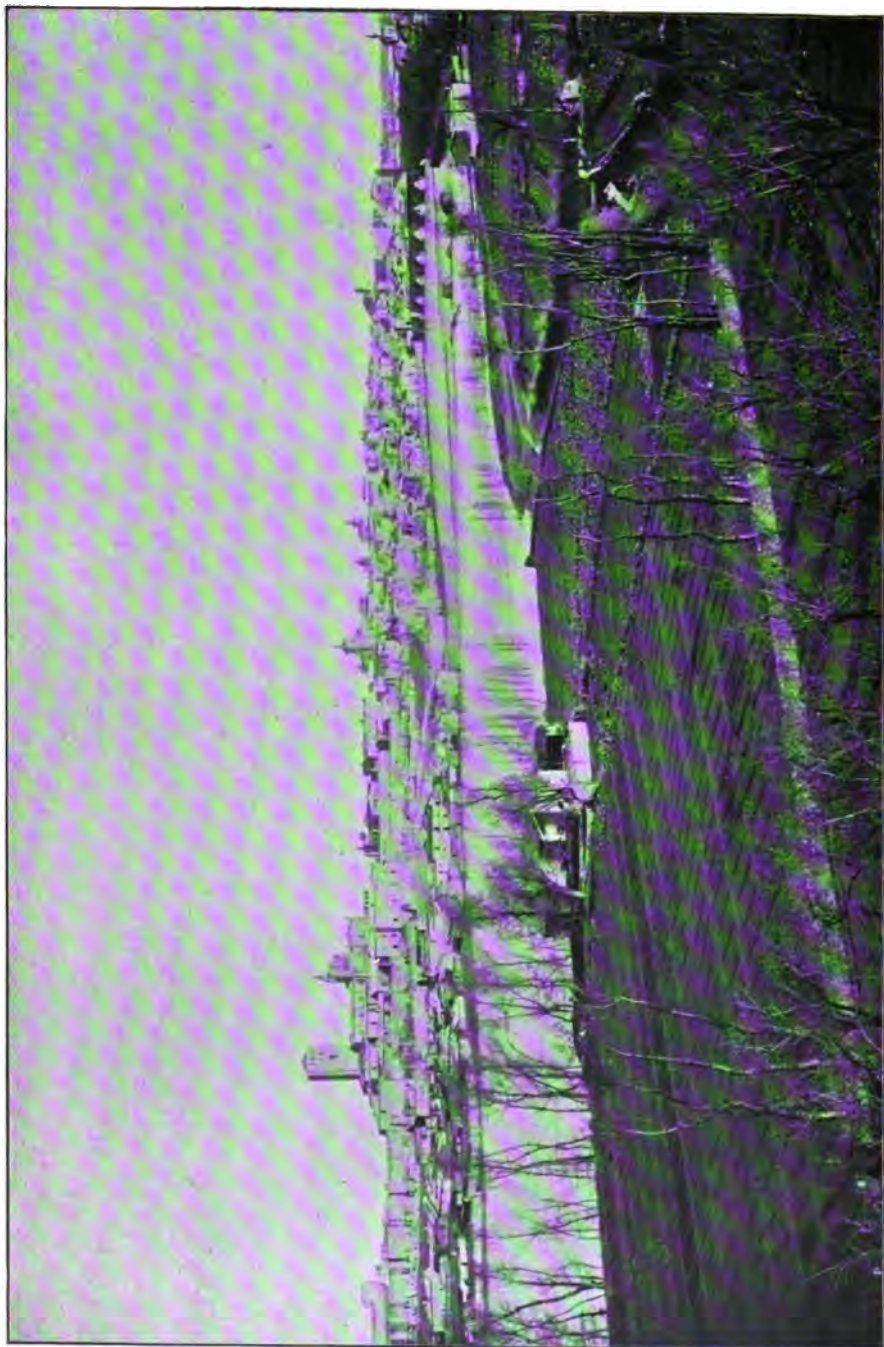
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ZAMORA





ZAMORA.

TIN-MINING IN SPAIN

PAST AND PRESENT

BY

WILLIAM COPELAND BORLASE, M.A.

*Parliamentary Secretary of the Local Government Board, 1886 ;
A Deputy-Warden of the Stannaries of Cornwall ; Sometime Hon. Sec.
and Member of the Council of the Royal Geological Society of Cornwall ;
Author of ' Historical Sketch of the Tin-Trade in Cornwall,'
' The Dolmens of Ireland,' etc., etc.*

GENERAL MANAGER OF SEVERAL TIN-RESERVATIONS IN THE PROVINCES
OF CORUÑA AND ZAMORA IN SPAIN, AND TRAS-OS-MONTES IN
PORTUGAL, MENTIONED IN THE FOLLOWING PAGES.

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ROBERT BANKS LAVERY, ESQUIRE,

WHOSE ENTHUSIASTIC

INTEREST IN THE SUBJECT HAS LED HIM

TO GIVE A

PRACTICAL STIMULUS TO THE DEVELOPMENT

OF THE TIN-INDUSTRY

IN THE IBERIAN PENINSULA, THE WRITER

INSCRIBES THE FOLLOWING

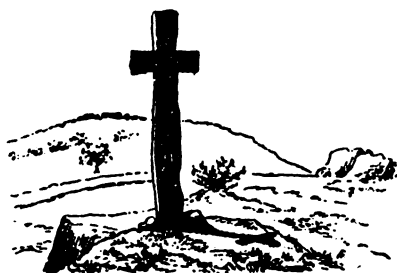
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ANCIENT CROSS NEAR SAN MARTINHO.

TIN-MINING IN SPAIN, PAST AND PRESENT.

IN the year 1548, the date at which the hopes of Spain, commercially speaking, were reaching their zenith, the verse-maker Molina, in his metrical description of Galicia, wrote the lines which I freely, though fairly, translate as follows:—

“Add to Galicia’s treasures here adduced,
“That year by year our Realm hath tin produced,
“So plenteous, in the Vale of Monte-Rey,
“That ores are dressed and smelted day by day;
“The metal white, of quality so rare,
“Not even England’s purest can compare
“With that which holds the mart in each Medina’s fair.”⁽¹⁾

To this effusion is appended the following expanded comment in prose:—

“Besides other mines of many metals held in high account, which exist in this Kingdom, and in which have been found gold, silver, and even precious stones, as for example, fine turquoises discovered in the lands of Valdiorres,⁽²⁾ there is tin in abundance and of excellent quality which occurs in the Valley of Monte-Rey and the district surrounding. So considerable is the quantity that in the chief fairs of Castile no other kind is sold, and so fine is the quality that the tin which is brought to Spain from England, Flanders, France, and other parts, however highly reputed it may be, in no respect

excels ours, but, on the contrary, it is maintained that ours excels all the other, a fact which is plain to every expert on this subject."

In the following century, as we learn from Boan's⁽³⁾ MS. *History of Galicia*, the country adjacent to Monte-Rey and Verin was still celebrated for its tin-mines, which were then numerous, and their produce reckoned more valuable than the best imported metal. "Mixed," we are told, "with bell-metal and copper, plates of superior quality were made of it, which the gentlemen of Castile reckoned to be as good as silver, and from which they ate." Some interesting names and traditions hung around this tin-bearing district, which were still extant in the last century. It was believed that the mines had been worked by the Knights Templar, while with regard to some in Penouta, one league east of Viana, and nine leagues north-east of Monte-Rey, a story was current that they had been worked by the Carthaginians. Señor Murguia tells us that in the 16th century there stood near Ribadavia on the Minho a tower called Torre de Osiris, a picture of which it may be supposed had been preserved, since that writer says that he regards its construction as Semitic. North-west of Monte-Rey, and between that place and Orense lies the haunted Lake of Limia, otherwise called Leguna de Antelas, about which the strange tale was told that the swarms of gnats which hovered around its shores were the enchanted army of King Arthur of Britain.⁽⁴⁾

In less than a century from the date when Boan wrote, these mines of Monte-Rey, and indeed those of the Province of Orense in general, were actually forgotten, so that, towards the close of the eighteenth century they were spoken of as

being then discovered. Strange as this may seem, it appears that the reasons are not far to seek. The first was the blow given to the home industries of Spain by the incalculable financial disaster which resulted from the wreck of the Armada, and the extravagant policy which had brought about its equipment, and the second was the concentration of the best energies of the nation, mental and physical, upon the golden prospects which were opening out in the trans-Atlantic dominions which were successively being subjected to Spanish rule, and the consequent wholesale immigration thither of those who were engaged in developing home resources. It is not that the tin was wanting or was poor ; but it was that gold had a glamour which the dark metal lacked.

Cornide, in a MS. account of the products of Galicia,⁽⁵⁾ written in 1783, and preserved in the Royal Library at Madrid, mentions two tin mines in the vicinity of Monte-Rey which had been re-discovered and set to work in the 18th century. The first and principal one was that of Arcucelos, two leagues north of Monte-Rey, where fine oxide of tin, or cassiterite, was found in quartz lodes traversing the granite. The work was then carried on by arrangement with Don Pedro de Saura, Minister of State for the Kingdom of Galicia, under the direction of his two sons. The second mine was called Villardeciervos from a village of that name situated one-and-a-half leagues south-east of Monte-Rey, in the interior of the mountain of Rios, half a league from the Portugese frontier.

This mine the native peasantry had been in the habit of working for themselves, and, being jealous of interference, carefully concealed the fact of its undoubted richness. In

about the year 1763, an Italian, having some knowledge of chemistry, called Peronimo Argenti, drove an adit some 60 poles (*varas*) in length, and succeeded in extracting from it tin described by Cornide as embedded in sand, from which, by the use of his chemicals, as he stated to that writer, he had obtained also some silver, an ingot of which he preserved of the weight of an ounce. Some samples of the tin from this mine were placed in the Royal Museum at Madrid, where Bowles, author of the *Physical Geography of Spain*,⁽⁶⁾ saw them, and affirmed that the mineral closely resembled tin from Cornwall. The Italian ceased his operations because of the cost of obtaining some secrets of chemistry, which he appears to have thought would have directed him to the lode which, in his ignorance of mining, he had lost, and because—his friends refusing to co-operate—he got tired of the undertaking. Subsequently this mine, as well as that of Arcucelos, was worked by the Royal Treasury

Schulz, a German, appointed by the Spanish Government Inspector of Mines, and who wrote, in 1835, a geological description of Galicia,⁽⁷⁾ states that the oxide of tin occurs at Villardeciervos in narrow veins traversing micaceous amphiboliferous schist, of a reddish colour. These veins run parallel to the direction of the rock and dip, like it does, almost perpendicularly. The matrix and accompaniments are quartz, schorl, and yellow mica. A junction of granite and slate takes place at the side of Villardeciervos. During the first years of the present century works of development, on a large scale, were set on foot at the expense of the Government. Regular shafts of considerable depth were sunk, and tin of

superior quality was produced. In a very short time, however, they were abandoned (about 1805), "not," says Schulz, "because they were by any means exhausted, but because it was impossible that any mine could be made to pay a profit when the administration was so ostentatiously extravagant, and the works so unnecessarily costly and elaborate." "It would not be amiss," he adds, considering the cause of their abandonment, "to have further investigations set on foot, and a survey prepared in order to see whether these deposits might not be worked profitably, if proper economical methods prevailed." The lesson taught by this mine should not be thrown away. The fault is one which has been repeated in the case of other tin mines in Spain in more recent times. Schulz clearly thought highly of the producing capabilities of the mine, if properly treated, and of the quality and value of the tin. The reservation is now in English hands, and it is to be hoped that before long the advice given by the German mining-engineer may be taken, and that economical development may commence.

Besides the tin-mines just described, the Province of Orense contains two other districts in which the mineral occurs more or less plentifully. The first is in the eastern part of the province, in the hills of Penouta and Ramilo, two leagues east of Viana, and close to the borders of the Province of Zamora. Here, according to Schulz, the cassiterite appears either in small lumps (*masses*), or in narrow veins. Sometimes it is disseminated through the granite, often partially decomposed. Sometimes the veins traverse the micaceous schist which is contiguous to the granite. The conditions, in short,

closely resemble those under which the mineral is found in the neighbouring province of Zamora, and in that of Tras-Os-Montes in Portugal, some forty miles to the south-east. The discovery of it is said to date from the close of the last century, and some attempts were made to develop it, but these were abandoned at the same time and for the same reason as those made near Monte-Rey. It has, as Schulz adds, never received a fair trial, although in 1849, it was giving sufficiently remunerative results to the peasantry of the surrounding villages, who worked it as tributors, and dressed it by their own crude process, on their own account.

The remaining stanniferous district in the Province of Orense, stated by Schulz to be the principal one, lies in the mountains of Montes and Avion on the border line of Pontevedra, and partly within the limits of the latter province. The lodes in Couso de Avion are characterised as rich. They were discovered, or rather perhaps re-discovered, about the year 1830, and works of development upon them had commenced in 1835. Their importance increased until more than thirty lodes had been opened out within an area of three square leagues. Some of the veins are of great regularity, and of considerable richness, measuring from 1 to 20 centimetres in width, and producing tin which Schulz describes as "massive oxide," *i.e.*, cassiterite. It is accompanied by white quartz and yellowish mica. The veins traverse, as usual, the micaceous amphiboliferous schist, close to its contact with the granite. In 1835, their development had not been suspended since their discovery, but it had not then been allowed the full scope it deserved, by reason of the absence of roads, the isolation of the

situation, and the low price at which English tin could then be obtained in Spain. Roads have since been made; the district has been opened up, and the import duty on ingot tin from England is so heavy that it should cause the Spanish people to look to their home production.

In this stanniferous district, so Schulz adds, fine samples of tungstate of lime, of wolfram, and of blende, are found abundantly, and occasionally white emeralds.

Two leagues north of Couso de Avion is Pesqueiros, in the Province of Pontevedra, and district of Montes, where the geological and mineralogical conditions are similar to those just described. Tin in considerable quantity was found here about the year 1834. It occurs in veins and stringers in the micaceous basaltic gneiss, at a short distance from the line of junction of the latter with the granite. "In Presqueiras," says Schulz, "an attempt was made to work these prospects, and the undertaking paid its expenses." The work of development was not, however, prosecuted with the energy and application which such things require. "Not only, however," adds this writer, "does this prospect deserve attention, but other new ones can be also found in the direction of the *tin-belt*, which is of great extent, as is proved both by the frequent indications of the existence of the ore in this vicinity, and by the fact that such rich lodes have been worked at Couso de Avion."

I have myself been shown in Alcañices beautiful museum-specimens of amber-colored crystals of tin brought by miners from Avion, and Schulz tells us that "four leagues further south from that place, and, approximately speaking, in the same direction, in Monte Balsidron, a quarter of a league south-east

of Ribadavia, he had found excellent tin-ore mixed with wolfram and schorl, in a matrix of quartz and granite, close to the transition of the latter into gneiss. "This point" he adds, "deserves some investigation which cannot be costly." South of Monteforte, also on the line of junction, is the tin prospect of Doade, which was, I believe, if it is not now, in English hands.*

Passing now to the south-east, we find, in the Province of Zamora,† a considerable number of tin prospects on the borders of the Portugese province of Tras-Os-Montes, and not a few in the latter district itself. Among those in Zamora may be mentioned that of Arcillera, about 4 kilometres east-south-east of Alcañices, at a point where an upheaval of granite has taken place in the Cambrian strata. This mine has two shafts of considerable depth, sunk originally by a French Company. It is at present in English hands, and in course of development. About seven miles to the south-south-west of it, and in Portugal, there are two tin-prospects, those of Codeso and Raposo, near the village of San Martinho, which the same English Company is also working. These are near a junction of the granite with micaceous schist. To the west-north-west of this place, in the direction of Bragança, and also, therefore, in that of Villardeciervos in Orense, of which I have previously spoken, is the reservation of Coelhoso which has produced much valuable tin and also wolfram. Returning again to the Province of Zamora, we have tin-prospects at Brandilanes, which are, in common with Arcillera and San Martinho, being developed by English enterprise. These lie about 6 miles east of San Martinho, and, like it, are near the junction of

*The localities of these and the other tin-mines in the Province of Orense are indicated in the map at the end of these pages, and in the Table accompanying it.

†See also p. 19, *infra*.



GRANITE GORGE ON THE
RIVER ESLA AT RICOBAYO.

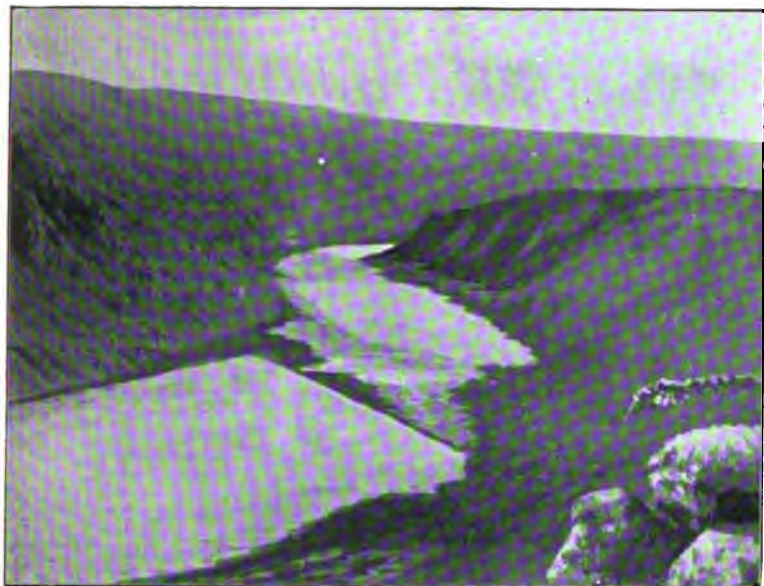
Cambrian rocks with micaceous schist and granite. A few miles south-east of this is another tin-prospect at Castroladrones. Passing southwards from this point we arrive at the Douro, which here runs through gorges of great depth, through the micaceous schists traversed by granite. About 8 miles south-east of Brandilanes, and 16 south-east of Arcillera, lie two bold tin-prospects near the villages of Villadepera, on the west of the river, and of Carbajosa, on the east. A few miles east of the latter is the magnificent granite gorge of Ricobayo, through which the river Esla delivers its tributary waters into the Douro. Near their junction is the tin prospect of Pino de Oro.

In 1846, Don Luis de la Escosura, a Spanish Engineer, published a *Descripción de las Minas de la Provincia de Zamora*. From this, and from the *Avisos de Zamora* for February 12th, 1876, we learn that, as long ago as the year 1566, there were discovered in Villardepera, "mines of silver, gold, and other minerals." In 1618, the Government granted a concession to develop a tin-mine at Figuerela and a silver-lead mine at Nuez. In 1634, a like concession was made for a copper-mine at Muga. There was another silver-lead mine between Vide and Senil. Much more recently, antimony, manganese, iron, etc., have been worked in this district. All the above-named prospects, as well as new ones, more recently discovered, occur within an area of from 16 to 20 square leagues, in a country almost entirely metalliferous, and are enclosed within an area defined by the courses of the rivers Douro and Esla, from Ricobayo to the north-east frontier-line of Portugal.

Among the tin prospects of this district, that of Villardepera calls for special attention, both from the well-defined fissure-vein which has been partly, but insufficiently developed, and from the quality of the cassiterite which it contains. South-east of this, on the right bank of the Douro, above its confluence with the Esla, lie the tin properties of Almaraz, which are also in course of development under the same English Company which is working those at Arcillera, Brandilanes, and San Martinho, above mentioned. The whole group bear in a direction S.E. and N.W.

Tin-mining has been extended as far south-east as the Province of Salamanca, where the mineral appears under alluvial conditions, as it does also in the provinces of Beira and Minho, and in portions of Tras-Os-Montes in Portugal. Eschwege⁽⁸⁾ discovered tin in the sands as well as in the granite of Valongo, north of the Douro, and near Oporto, where Cambrian and Silurian strata occur side by side with the metamorphic rock and the granite. Stream-works were set on foot here with considerable success, but the unsettled state of the country is said to have brought the enterprise to a standstill. The formations in which the mineral occurs in general in the Portuguese provinces are either alluvial gravels, or stock-works in the granite, or tin-bearing veins of quartz in the older slates.

Tin-mines were worked in Portugal in the time of Agricola,⁽⁹⁾ and the small native blast-furnaces, in which it was smelted are mentioned. Tin-streaming, on a small scale, is one of the oldest industries of the country.



TWO VIEWS OF THE RIVER DOURO
NEAR ALMARAZ.

Speaking of the presence of the mineral generally in Spain and Portugal, it may be said to run in a broad belt or band, passing, like an heraldic "bend" across the Peninsula from the Province of Coruña, in the north-west, to those of Zamora and Salamanca in the south-east. The principal rivers which intersect this belt are the Douro, the Esla, the Limia, the Minho, and the Tambre, all of which are fed by streams carrying, some of them, a good head of water all the year round, and most of them a sufficient supply to keep a Pelton-wheel or Turbine for a crushing mill at work at from nine to seven months out of the twelve. The mineral, as is the case also in Cornwall, follows the junction of the granite with the killas or schist, which is often highly micaceous. The quartz, especially near the confluence of the Esla with the Douro, strikes the gold-miner as singularly like gold-quartz and should be tested as such, especially since it is known that Villardepera was actually producing gold in the 16th century, and that the Carthaginians, Romans and Moors successively worked gold-mines in Spain.⁽¹⁰⁾ The sands of the river Sil in the Province of Leon are known to be auriferous, and gold-mines were worked in that district in the 17th century. The curious fact was stated to me by a gentleman resident in Spain, and who has explored the mountains of Leon, where most primitive modes of life prevail, and where the flocks of peasant-farmers have still to be protected from wolves by the aid of lanterns and the cries of the shepherds at night, that the stone-troughs, hollowed out for the purpose of conveying water for the gold-washings by the slaves of the Romans, have been brought into requisition

ever since, whenever a revival of the ancient industry, even down to a few years since, has taken place.

I have still to speak of the tin-bearing districts at the north-western end of the belt, namely those in the Province of Coruña. Schulz, to whom I have several times previously referred, stated in 1835 that he had found fine and large crystals of tin-oxide opposite Porto Mouro, on the left bank of the Tambre, at a spot $2\frac{1}{2}$ leagues from Santiago. They occur, he says, in veins in feldspar and quartz, that is to say perhaps, in the "gossan," or decomposed granite, which forms the superstratum of the hard granite below.

Pliny describes the whole district from the Pyrenees to the Douro as full of mines of gold, silver, iron, lead, and tin.⁽¹¹⁾ In another passage⁽¹²⁾ he tells us that tin is a product of Lusitania and Galicia, and in a third, since I have referred above to gold, I may add that he speaks of Asturia, Galicia and Lusitania as together furnishing annually 20,000 lbs. of that precious metal. Schulz⁽¹³⁾ in a paper on a kind of stanniferous-pyrites which he terms *ballisterosite* gives us very curious accounts of two ancient mines in the Asturias, situated respectively at Salabe on the Cantabrian coast, a league and a half to the east of Ribadeo, in the district, so he thinks, of the tribes called Artabri, from whose ports tin was exported, and at Ablaveda, one league south of Salas and seven east of Oviedo, on the banks of a river which he identifies with the Nalon or Noelus of the ancients, on which lay the famous town of Argentolea. The operations at Salabe were conducted by means of a huge open-working, sunk, according to Schulz, on a deposit of tin occurring in plutonic rock in the centre of clay-

slate-schists belonging to the Cambrian system. The excavators found the ore so valuable that they took it bodily out, so that not even a trace of a lode has been left behind. More than 4,000,000 cubic mètres were removed from a pit 20 mètres deep, the bottom of which is now covered by a deep bed of turf. Three adit levels for drainage purposes were bored at various periods through the cliff to the sea, the last and lowest being almost on a level with the water, so that its mouth is filled every winter with pebbles. A tortuous aqueduct, three leagues in length, brought to the works the water necessary for the treatment of the ore which was broken by manual labor on hand-mills of quartz and the mineral subsequently melted in a number of small furnaces enclosed in a fortified area formed by a double vallum and ditches.

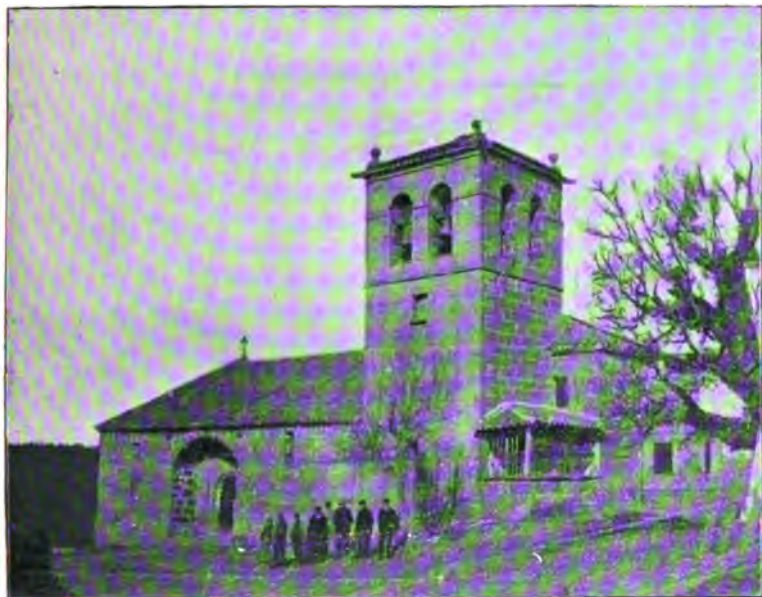
The works at Ablaneda, on the side of the mountain, in the Devonian formation, are described as no less astonishing than those at Salabe. Here three channels or aqueducts, skilfully cut in very hard quartzite, from one to three leagues in length, brought in the supply of water requisite for the work, and here too a bed of turf forming a bog or lagoon has accumulated at the bottom of the excavation. A vein of arsenical and copper pyrites traverses the diorite which rests on the granite a little to the south, but Schulz came to the conclusion "from many indications geological and mineralogical," that the primary and special object of the miners was tin.

Stanniferous pyrites is found in the middle of the argillaceous schists near Ribadeo and Mondonendo, and the peculiar form of it named *ballisterosite*, from Señor Lopez Ballisteros, author of a work on the Mining Laws of Spain, was found two

leagues south of the former place in the mountains of Vidal and Trabada in argillaceous schists, mixed with ordinary pyrites, and near the junction with the zones of plutonic rocks. The discovery of its true nature was made by a village blacksmith while experimenting in his forge with the pyritous-schists for gold. Perceiving that he extracted white malleable metal he at first thought it was silver until he proved it to be tin. Whether it could ever be made payable commercially is very doubtful. M. Paillette⁽¹⁴⁾ considers it the material of which certain coins of white metal and other objects such as lamps, found in old fortified sites near mines in Spain, were formed.

Returning to the tin-mines of Galicia pure and simple, there are reservations, the one near Noya (probably the Noela of Pliny,⁽¹⁵⁾ in the country of the Celtici), the other near Santiago to which I would call attention.

The first, which is in the Province of Coruña, is called San Finx, or San Fix (in the *Mapa General de España, Madrid, 1792*, sheet 96), from a river of that name which falls into the Bay of Noya. It is situated at an elevation of 250 mètres above the sea level, near the summit of a divide in the mountains of Barbanza, which separate the Bays of Arosa and Noya, and terminate in the wild and rugged promontory the extreme point of which is Falcoeira. That this was one of the most ancient and notable of the tin districts of Ancient Spain is, I think, a fact which scarcely needs demonstration. It is to the district of the Celtici that, with far greater probability than to any other district, we may assign the "Celtic tin" mentioned by the pseudo-Aristotle.⁽¹⁶⁾ Very ancient workings,



1. CHURCH OF VILLADEPERA, WITH OSSUARY
UNDER THE TOWER.



2. MINERS' BARRACKS AT THE
SAN FINX TIN-MINE.

too, consisting of open casts all along the back of the lode, exist at San Finx. The lode itself is extremely well defined, and developments now taking place show the quantity of tin-oxide to be very considerable, while the quality surpasses that in almost any stanniferous district. A sample of 10 tons cut out from the lode, in by no means a particularly rich portion of it, gave an average of nearly 3 per cent black tin, while hand-picked stuff contains as much as 75 to 80 per cent of tin ready for the smelter without need of dressing. No steam-power need be used for dressing-plant as the water in the stream is sufficient for the mill. A road, too, has just been completed from the mine to Terragona on the Bay of Arosa, whence barges can convey the black tin to the gates of the smelting-house at Carril on the opposite side.

The other Galician tin-reservation to which I referred is called "Tyre and Sidon," and is situated near the villages of Fontão and Merza, in the district of Carbia, and Province of Pontevedra, 8 kilometres from the road from Santiago to Orense, and 40 from the former of these places. To the south of the mines is the river Deza, a tributary of the Ulla, which flows into the Bay of Arosa. As in the case of San Finx, these mines were worked by the ancients, the method being to open up a trench or cast on the back of the lode, thus forming a pile on either side, just as was the case in the "old men's workings," as they are called, in Cornwall. As in the latter country also, cavernous workings were sometimes resorted to. From the outcrop at the river the lodes at "Tyre and Sidon" can be traced and worked for 3,000 feet in the mountain side. The more modern system of operations has

been to sink shallow shafts, and to make small drives or open-cast works. Oxide of tin is plentiful, as also is wolfram, but no miner-like attempt has ever been made to develop the prospects by tapping the lodes in depth.

It is, seemingly, to these "Tyre and Sidon" mines, that Sñ. Daniel de Cortázar⁽⁷⁾ refers when he says that the tin-zone, so far as he knew it, commenced in the township of Merza in the northern limit of the Province of Pontevedra, and, crossing that of Orense by the watershed of the mountain Testeiro and the Sierra de Suido, where the most important deposits occur in the districts of Beariz and Abion (Avion), thence deflected eastwards by Ribadavia, Freas de Eiras, Monte-Rey, and Villardeciervos to the frontier line of Portugal. Speaking of the Province of Orense this writer says that the tin occurs there under two distinct conditions. Either small particles of cassiterite, in company with arsenical pyrites, are found distributed through the granite, which latter has the appearance and characteristic structure of gneiss, or the mineral shows itself in larger bunches in quartz lodes accompanied by wolfram, the which lodes at times pass out of the granite and across into the micaceous and talcose schist, without, however, suffering any sensible change either in their direction or composition. Schorl and yellow mica almost invariably accompany the oxide of tin.

Works which are described as "important" were carried on in this province down to a date shortly before Cortázar wrote (1873) by an English Company styled the Medina United Tin Mines, who, for a period of ten years, exploited an area of ten pertinencias in the districts of Gomesende and Freas de Eiras. Their energies were principally concentrated on two mines

called San Guillermo and San Pedro, where they cut five vertical quartz lodes, not exceeding 50 centimetres in width, bearing N.E. and S.W., all impregnated with tin and arsenical pyrites, and variable in value. These lodes are in the granite, passing into the schist which adjoins it on the northern side. Other quartz lodes run transversely to them, that is, in a direction E. and W., but these are unproductive.

The methods employed in the development of these prospects, as well as in dressing the ore seem to have combined the native Spanish ones with those more modern and approved. Thus a shaft was sunk, 80 mètres deep, and levels driven, but, when these failed in results, trenches were dug and open casts made upon the backs of the lodes. The ore, after being crushed, was hand-sorted, and washed in sieves, and in cases where it was accompanied by arsenical pyrites, it was calcined. It was finally caught on fixed tables, the product obtained from which is stated to have been 40 per cent of black tin which was exported to England to be smelted. The mines were abandoned in 1871, and were taken over by a Spanish Company. The rest of the tin reservations in the district were worked at irregular intervals by unauthorised persons—peasant fosseckers, who pilfered the tin.

I may here quote what the same writer tells us of the mines in the adjacent province of Zamora. In 1844, he says, according to Señor Ezquerro, the tin-mines of Carbajosa, Pino de Oro, and Villardepera were exploited, as well as the antimony mines of Losacio. The tin is described as occurring in lodes of white quartz, semi-transparent, and analogous to some between Mombuey and Asturianso, at a junction of highly

micaceous gneiss with granite. They bear in a direction N.E. and S.W., and are vertical. They form an extensive parallel series, more than six kilometres in length, and are plainly to be seen in the two rugged banks of the river Douro.

The richest deposits have been found to be those of Villardepera. The oxide of tin is disseminated through the quartz irregularly though abundantly, but owing, as we have seen, to the unintelligent modes of working, it has not as yet been made to produce the important results which true miner-like methods should certainly achieve.

In 1863, according to the mining statistics of the province, besides the reservations just mentioned, those of Almaraz and Arcillera had been set to work, but during that year only two mines in the district are quoted as producing tin. The black tin was at that time smelted in a small Spanish furnace from which was obtained $11\frac{1}{2}$ cwt. of metal which was sold and used in the province. In the following year there were three reservations in the same country on which prospecting work for tin was being carried out.

Having had occasion several times to allude to the antiquity of tin-mining in the Peninsula, I can scarcely omit to add a word or two on the subject of the claims of that country to be considered the producer of the tin in use, for bronze especially, in the Mediterranean in the earliest ages of commerce, and also to have been, as some have contended, the veritable Cassiterides, or "tin-islands" mentioned in the most ancient writers, and vaguely located somewhere in the ocean beyond the Straits of Gibraltar.

The question of the whereabouts of the Cassiterides has furnished almost a literature of its own, the controversial point being whether Britain, *i.e.*, Cornwall with the Islands of Scilly, was the locality indicated, or whether it was the western and northern districts of the Peninsula. Into the details of this I need not enter. It will be sufficient to say that among the advocates of the British theory were Camden, Borlase, Sir C. Hawkins, and Dr. George Smith of Camborne, and that on the Spanish side we have had Cornide, Perez Quintero, and, more recently, Murguia, while Florez, like Harduin, did not believe that such islands existed. Certainly, if they were indeed islands, there is not now nor ever was a sufficient quantity of tin in Scilly to justify the application of the name tin-islands to that little group, and the same fact applies equally to the islands under Coribedo and in the Bays south of Finisterre, namely Salbora Arosa, Cartagada, Grove, and the Cies, Scias, Cicas or Bayona Isles. In the Island of Ons alone, near the mouth of the river of Pontevedra, or Lerez, on the banks of which the Cileni⁽²⁸⁾ of Pliny are supposed to have been settled, some indications of tin-quartz were found, so Cornide tells us; and he adds also that he had surveyed the neighbouring coast and observed a substratum of ferruginous sand very similar to that in which the tin of Monte-Rey occurs. Murguia has connected the name of the three islands at the mouth of the Bay of Arosa, namely the Cies or Cicas (supposing an *n* to be introduced, making it *Cincas*, as in *Finx* for *Fix*, above mentioned, and many more place names), with the ancient word for tin found in the German *Zin*, Polish *Cyna*, &c. He points also to the name *Cinca* applied to a valley where tin is found, and also to the

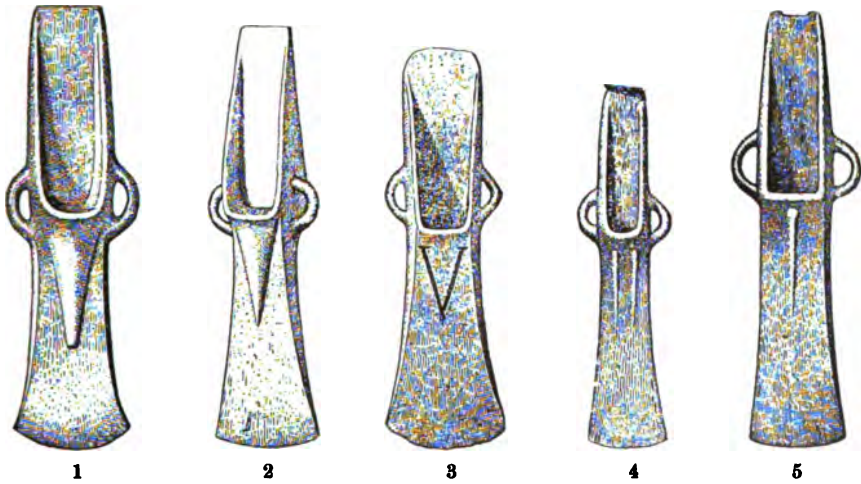
name of the city of Cinania, the Citania of Briteiros, near Guimaraes, recently explored by Señor Martins Sarmento, as derived from the same source. Such etymologies, however, are very doubtful, and I lay no stress on them, although that of the *Cicas* is worth noting, particularly in connection with the statement of Cornide and Murguia that in a MS. at Oviedo, called *Itacio*, containing what purports to be a copy of a division of Bishoprics by Wamba, but which was regarded as a forgery in the 12th century, the district assigned to the See of Cale is "from Albia as far as Losala and from Olmos to the *Islas Casiterides*." I have not been able to consult the original of this, but in Loaysa's edition, in which that writer, like Florez, seems to follow a copy by Morales, the name Sola stands in place of "Casiterides."⁽¹⁹⁾ In any case, all that could be derived from such a statement would be the supposition that, at the date when the MS. was written, a notion existed in the writer's mind that these islands in the Bay of Arosa were the tin-islands of the classic authors. Similarly, in old maps of Galicia the *Cicas* are marked *Insulae Deorum*, the "Isles of the Gods." Murguia⁽²⁰⁾ notices also that the island of Cortegada, in the Bay of Arosa, which is accessible on foot from Carril at spring-tides, contains shafts and other evidences of ancient mining, which he believes was for tin. At the foot of the neighbouring Cordillera of the Barbanza, however, iron is found, so that possibly that was the mineral sought for. This author does not seem aware of the existence of the tin-mines of San Finx in the upper part of this same range. A certain locality, he goes on to say, between Carreira and Corrubedo preserves the significant name of Campo das Minas. Don P. Sarmiento

described it as covered with *mamoas*, that is, sepulchral tumuli, which enclosed cinerary urns, found in such great number that the spot obtained the name of the "place of pots" (*olerios*). Some held that it was the cemetery of a city said to have existed near Carragal. In fact all the coast around the islands of Cies presents traces of the existence in former times of a large population, and of a considerable mining industry, in which certainly tin bore a great part. What applies to the Bay of Arosa applies equally to that of Pontevedra. In the estuary near the last-named town there are traces of the existence of lacustrine habitations. At Puente Caldelas fine deposits of tin were found. Don P. Sarmiento states that three leagues from Pontevedra, in Gayolas, Cerdon, and Murados, in the parish of Antas, mines of tin were also discovered. The name *Antas* naturally strikes Murguia as curious, since it is the word invariably applied in Portugal to those huge megalithic chambers called *dolmens*—the *cromlechs* of the antiquarians of the last century. On one of the highest ridges of the Barbanza range, about eight or nine miles west of San Finx, there is, at a place called La Grana, a group of seven of these structures, partly buried in tumuli. I was informed that they are in Galicia (where they are called *garetas* or *antis*), invariably composed of eleven stones, ten of which form the walls of the cell or vault, while the eleventh, a flat one, and often a stone of very large size, (from nine to twelve feet square), forms the roof. The chamber is usually of horse-shoe shape, or, rather, ovate in ground plan, with flattened ends. I was informed that gold beads had been occasionally found in them, of which I hope to obtain a specimen. Structures, similar in detail, occur in the

Basque Provinces, as for example at Eguilaz in Alava.⁽²¹⁾ A most remarkable feature about them is that, while they bear a family likeness to the series of megalithic structures of the dolmen class in general, they have their *exact counterpart* both in the number and arrangement of the stones, which is in itself peculiar, in a monument at Cloverhill, near the great prehistoric cemetery of Carrowmore in the country of Sligo,⁽²²⁾ in Ireland, a structure which, judging from sculpturings on the interior faces of some of the stones of the chamber, we may probably assign to the latter period of the Bronze Age (say B.C. 500).

But the points for comparison which Archæology and Ethnology hold out to us between West Britain and Ireland on the one hand, and Galicia on the other, are not confined to the megalithic remains. No object of antiquity is better known to the antiquary than the bronze *paalstab* celt. In its simple form, or with a single loop, it may be said to be found everywhere throughout the north, west, and centre of Europe. There is, however, an extremely rare and peculiar form of it, namely with two loops, and that has been found exclusively in Cornwall and Devon (in the mining districts especially), in Ireland, and in the western and north-western portion of the Iberian Peninsula. [*See illustration for examples.*]

In my work on the "Dolmens of Ireland"⁽²³⁾ I have given five examples of these implements, taken respectively from Cornwall, Devon, Ireland, and Montalegre and Alemteyo in Portugal. Where, however, particular and peculiar types of bronze implements occur, which are not common to other countries, but are, nevertheless, so closely similar that they



Five Bronze Implements called *Paalstab Celts*.

- 1. Ireland :** **2. Cornwall :** **3. Devon :** **4. Portugal :** **5. Portugal.**

might almost have come out of the same mould, a proof is afforded, as reasonable as we can ever hope to attain, that the inhabitants of the two respective districts, in which they are found, were in communication during the period when the implements were in use. Now, that bronze celts were manufactured in West Cornwall I have evidence to show, and that they were also manufactured in the Peninsula I see no reason to doubt. My proof as to Cornwall consists in the fact that rough lumps of smelted tin, locally known as "Jews Tin," and also of copper, which latter bore the form of the stone-bowl into which it had been run, were found side by side with spoiled *paalstabs* and *socket-celts* in the embankment of a cliff-castle at Cape Cornwall near the Land's End.

Bronze celts of this class belong, according to the eminent Swedish archæologist Montelius,⁽²⁴⁾ to the best period of the Bronze Age in Northern Europe, the approximate date of which he estimates at from 1250 to 1050 B.C. At that period then—the very period to which has been assigned the foundation of Gades by the Phœnician merchants—Cornwall and the Western coast of Spain were already in communication with each other, and both were producing the mineral, and from that the metal, necessary for the formation of implements, the original locality of the prototype of which it would be foreign to our present purpose to attempt to discover.

It is not, however, Archæology alone which leads us to the conclusion that, in remote ages, there was intercourse between the tin-bearing portions of Britain and the Peninsula. The likeness of certain Galician ethnic types to certain Irish types has often been commented on; but the likeness of Galician

faces to Cornish faces, in the Land's End district especially, is even more marked, and is indeed unmistakeable. In going from Terragona into the Barbanza range I passed, near the coast of Arosa Bay, a small village, and sitting down to have my meal of cakes and red wine in a large grocery-store, where there were many buyers, I could have declared, had it not been for the Gallego *patois* and certain differences in costume, that I was once more at home in a Cornish village. On the other hand I could point out Cornish miners now employed in Spain who would pass for native Gallegos. In the case of the women, oddly enough, the likeness is more marked than in that of the men, but the resemblance is not confined to one or two examples, but is almost universal. Into the detailed characteristics of the types space does not permit me here to enter. The short dark type, known in Ireland as a Kerry type, with sharp twinkling grey eyes, splay noses and nostrils markedly in evidence, low forehead and swarthy face, is distinctly recognisable, as are others also. It is enough to say that they are types totally distinct from those ordinarily met with in the villages of other parts of Spain and Portugal, although they may be observed here and there in the larger towns to which Gallegos often go as servants. One trait in their character at east these people possess in common with the Irish and Cornish, namely their intense love for their little holdings and their desire to save money to purchase the freeholds. The legends of Galicia, too, especially those connected with lakes, the people of that district share with the Irish, as well as spuerstitutions in regard to witches and the like.



A GALLEGO;
FROM MURGUIA'S 'GALICIA.'

We will now consider for a moment whether all these indications of early intercommunication between the two great tin-bearing districts of Western Europe do not help us to solve the problem of the Cassiterides. The more we attempt to give these so-called islands a geographical position, the more they fade into the fabulous regions of the hazy sun-down. Those Mediterranean peoples to whom Phoenician merchants sold their tin knew no more than we do where it came from. There were stories current of islands out beyond the Pillars of Hercules, Atlantis,—the Isles of the Blessed, or the Isles of the Gods, the Oestrymnides, and others.⁽²⁵⁾ What would be more natural than for merchants, from the very first, to have taken advantage of such beliefs as a convenient method of preserving their secret by wrapping it up in legend, and coining for their purposes yet another group, "The Cassiterides?" That the Carthaginians continued to keep secret the source whence they derived their tin, we know from the tale told of the ship's captain who ran his ship ashore rather than reveal the passage to the Romans.

From its closer proximity to Gades it may be naturally supposed that northern and western Spain would be the first to supply the Mediterranean markets with tin. But even, as we have seen, from the earliest period to which the traffic can be assigned, that vaguer land beyond the sea, namely Cornwall, had seemingly been brought into relation with the Spanish coast. Both districts were alike producing tin in the Bronze Age, and together they represented the "Cassiterides" of the merchants.

Being unaware that tin had ever been raised in any appreciable quantity in the Peninsula, I followed the lead of Dr. William Smith, of Camborne, and, in a *brochure* printed more than twenty years since, entitled *An Historical Sketch of the Tin-Trade in Cornwall*,⁽⁴⁶⁾ I used an exhaustive argument to show that Cornwall alone could have supplied the commodity to the merchants from the days of the Phoenicians onward. A study of the mines along the tin-belt in the Iberian Peninsula, pursued with the aid of such works as have been published on the mineralogical features of north-western Spain and of MS. authorities at Madrid, has, however, I freely admit, completely altered my views.

The ancient tin-workings of Galicia alone prove to be of enormous extent, while the actual ore which remains *in situ* and unworked is not only plentiful in quantity, and easily attainable, but in quality unrivalled, and, whatever Cornwall may have produced in the past, superior to the average of the mineral at present raised in that county.

That it was from the bays and estuaries of Ferrol, Noya, Arosa, Pontevedra, and Vigo, as well as possibly from an island or two along that coast, that tin first found its way into the Mediterranean I feel no doubt, when women on the coasts which lay over against the Artabri,⁽⁴⁷⁾ or the predecessors of that tribe, were probably washing it in wicker baskets, centuries before a Roman writer spoke of the process, in much the same fashion in which I have watched them washing it at the present day, only that little birch brooms are now employed to brush the ore, after it has been hand-broken between two rough stones, as it is carried down over the

bed-rocks of some stream into shallow artificial basins scooped in the surface of the stone, by water which is allowed to escape gradually from little dams of turf drawn across the course.

Cornwall, we may be sure, was not far behind Spain in point of time in contributing her proportion of the metal to augment the supply, a fact which may be inferred from considerations of navigation, but especially from the archæological proofs, to which I have above referred, of inter-communication having existed between the two districts at a period coeval with, if not anterior to, the foundation of Gades.

As to the "Tin-Islands," the "Cassiterides," they never, geographically speaking, had a fixed position. Like the mysterious floating islands of turf on certain Irish lakes they were heard of now on one shore, now on another. Their name was a delusion and a myth, and a very convenient one, in which as in a web of gossamer, the merchant princes and ship's-captains could envelope each and every stanniferous country, as they discovered them one after the other, along the shores of western Europe from the Douro to the Tambre, (the latter in the country of the Tamarini), and from the Tamar in Britain round to the Severne Sea.

Looking forward now to the days in which we live from these ancient times when Phœnicians, Carthaginians, Greeks, Romans, Moors, and Goths and Vandals were successively attracted to Spain, in no small measure by her mineral wealth, the questions naturally present themselves: "Will the ancient prestige of this country in this respect never again return?" "Is the supply exhausted?" "If it is not, and, if Spaniards

will not develop these resources themselves, are there no enterprising strangers, who, like the Tyrians of old, will find means to work the mines, as a commercial speculation, with sufficient prospect of fair returns?"

The mining industry in the Peninsula seems indeed to have shown unmistakable signs of rejuvenescence of late years. Iron at Bilbao, copper at Rio Tinto have re-asserted their long dormant claims to consideration, with results which speak for themselves. Why should tin be left behind? My answer is, and I speak from personal experience of some of the principal mines upon the belt which I have inspected and the administration of which is committed to my charge, that the mineral has not had fair play. In past times the operations have been carried on both extravagantly and unintelligently: extravagantly—firstly by persons connected with the Mining Department at Madrid early in the present century, and secondly by Companies, French, Dutch and English, generally over-capitalized, at various periods since: unintelligently—often indeed by the parties just named, and invariably so by the farmers, winebuyers, and peasantry who have contented themselves with surface scratchings and small open cuts at points where the outcrop of a lode seemed encouraging. Were fully equipped Companies to attempt to work according to these methods it would cost them, as has been proved by experience, fully 40/- for every 20/- worth of tin produced. The process of dressing the ore, too, adopted by the peasant tributers involves a loss of certainly considerably over a third of the black tin. It may be said, indeed, that none of those simple rules of good-mining which are household words among

Cornish miners, have ever been known to, much less put in practice by those who, unfortunately for the industry, have conducted the operations in Spain.

In the case of the Companies, costly, intricate, and unsuitable machinery has been set up at vast expense for dressing the ore before the prospects have been adequately developed. To put the matter metaphorically, a general's uniform has been bought for the infant, before the infant has been born. Where this is the course pursued in mining, the only persons who can possibly look confidently to a profit are those who supply the machinery. Water-power, where it might have been utilized, has been neglected in favor of steam, involving an outlay for fuel, in some districts very costly. This has naturally had the effect of restricting the paying-ore to such alone as has contained an abnormally heavy percentage of tin, the result being that tons of good general milling ore have been left untreated, which might have been profitably treated, together with the richer stuff, had the process been simple and inexpensive. Experience having pointed out such errors, there can now be no excuse for their repetition. If only miner-like methods, and proper and reasonable economy be employed, there is no reason why a large proportion of the prospects along the tin-belt should not be made handsomely remunerative. There are, at the present moment no fewer than seven distinct prospects between Coruña and Zamora, including two in Portugal, in course of development by English Companies, while several others are about to be started. In the case of four out of the seven the indications of a good return are excellent, while in that of the others

a sufficient depth has not been attained to justify a forecast of their worth.

The statement, sometimes made, that "tin does not go deep in Spain," is an error which carries on its face its own confutation. Not only is there no reason why the conditions under which the mineral occurs here should differ from those which obtain in other stanniferous districts, but in the deep gorges of the Douro, as I have myself had occasion to observe, it occurs both on the tops of the hills and close down to the water's edge, some 500 feet below, while what may lie below the level of the river beds, the most likely depth, be it remembered, at which to find true fissure veins, is still an unknown quantity since no shafts, sunk so deep, exist.⁽²⁸⁾

Tin there is, then, in quantity, and she offers herself to the intelligent miner under the most favorable conditions, being, in general, exceptionally free from those impurities which make the processes of dressing and smelting difficult and costly. Wages are exceedingly low,—2 pesetas, *i.e.* 1/6, per man per diem. Contracts for sinking and driving can be entered into at most advantageous rates. At the risk of burdening these pages with details from my experience I will give the following as an example: To deepen a shaft on a reservation in the Province of Tras-Os-Montes in Portugal, of the approved dimensions of 9 feet by 6, through tough schistose rock traversed by quartz veins cost on contract less than £5 per fathom. A depth of 30 feet was sunk by hand labor alone within 11 days. This is good working, and it is a fact worth mentioning in proof that the native Spaniard is a good miner. The offer of a small bonus, if he completes his contract quickly, naturally

makes him a better one. What is essential, however, is that he should be guided by firm and intelligent supervision.

As to the kind of dressing-plant to be employed on these Spanish mines I speak diffidently, though with confidence. Having shown a sufficient quantity of ore "at grass" to justify the commencement of operations, I would venture to advise, not that an elaborate mill, warranted to save *all* the tin, dealing exhaustively with the slimes, and costing perhaps £30,000 should be set up, but that a simple process for coarse concentration should be considered sufficient at first, leaving the slimes alone, and costing say £3,000, including the freightage, ground-levelling, and the structure containing the machinery, but not including the Pelton Wheel or Turbine, (for it should be worked by water-power), nor, of course, the over-head ropeway which might be required to bring the ore down to the requisite level. For these extra items, according to calculations before me, another £1,000 would be quite enough to add. A dressing plant, obtained as such an one could be, at this comparatively low figure, would be capable of dealing with 50 tons in twenty-four hours, and it could be at any time added to as occasion might require, until the results justified the erection of California stamps, and the treatment of the slimes. We should, in short, proceed from small endeavours to great, and never take another forward step until the one on which we stood was rendered firm and sure.

With far greater diffidence, though I have worked the problem out with care, I now proceed to give very briefly my idea of what the cost should be of developing a given tin-reservation in the Peninsula, and the prospect of its making

a good return if handled on the strictly economical methods I have described, and which, as has been pointed out, may be so sharply contrasted with those which have been previously in vogue. A sum of, say, £6,000 or £7,000 would, according to calculations I have made, sufficiently cover not merely the cost of general development for a period of six months, but of the small dressing-plant, supposing water-power to be employed, which might then be requisite to deal with the ore brought to the surface.

Supposing, then, the initial stages to have been gone through, and the mine to have been placed in the position of a "going concern," with a continuous supply of ore in readiness, and the dressing-plant in place, what profit, it will be asked, can be expected with confidence from the sale of the black tin? Say that the cost of mining and milling the 50 tons of ore which, as above mentioned, the mill could treat per diem, worked out at 7/- per ton: Add to this establishment charges, salaries, insurance, ore bags, and the freightage from the mine to England, for the $1\frac{1}{2}$ ton of black tin which (allowing that

*I here show that ore yielding $2\frac{1}{2}$ per cent of black tin would pay and pay well. The average yield, however, in many known reservations is far above this. I take the San Martinho prospects as an example:—

To July 7th, 1897, the tonnage raised at Codeso showed the following results:—

First class ore (picked stuff) 7 tons; estimated value about 50 per cent.

Second " 2 " ; " " 6 "

Third " 20 " ; " " $1\frac{1}{2}$ "

This would show an average of 14 per cent. The tonnage raised on both Codeso and Raposo to December 1897, shows together an average of from 14 to 15 per cent. This estimate is, as I freely admit, far above the general average, and is phenomenal; but,—given several reservations taken together,—I do not think that 4 per cent would be too high an average.

the ore yielded $2\frac{1}{2}$ per cent*), is what the 50 tons treated per diem would represent, the total expenditure per diem would work out at £24 17 6. There would be received for this $1\frac{1}{4}$ ton of black tin, at £35 0 0 per ton, the sum of £43 15 0, which would leave a profit per diem of £18 17 0 on each $1\frac{1}{4}$ ton of black tin *if sent to England*.

But the black tin produced in the mines of the Peninsula need not and should not, under existing conditions, be sent to England at all. It should be smelted in Spain and sold in Spain, where there would be a sufficient market for all that could be produced, and where an English Company already possesses a well-equipped smelting-house. By selling in Spain the import duty on the white tin coming into that country would be saved, as also the insurance, and freightage to England, and an additional £8 per ton, according to several independent computations which I have before me, would thereby be added to the profit account, bringing it up to at least £26 17 6 per diem, on the $1\frac{1}{4}$ ton of black tin, which would be the product, as above stated, of the daily dressing.

Allowing for the numerous Feast-Days and holidays, a working year in Spain averages 260 days, so that the annual profit, supposing the mill to be receiving a continuous supply, would amount to £6,987 10 0. If instead of 50 tons, 100 tons of ore, carrying $2\frac{1}{2}$ per cent, were passed through the mill per diem, as might well be expected in some cases, this sum would not only be doubled but more than doubled, as the ratio of cost of milling would decrease in a proportion to the quantity dealt with. In about six months hence I hope to be able to speak from established data on these points,—the only

reason that I cannot do so now, and that I have to submit my conclusions tentatively and from paper calculations,—is that, practically speaking, and from the true economic standpoint, there never has been mining and milling, worthy of the name, in existence in Spain. Tin, as I said above, has never had the fair trial it deserves.

As to what should be done in the future, it appears to me that small parent syndicates should be formed, the capital of each one of which need not be large, for the purpose of proving and developing each respective reservation. These should not be wholly out of touch with each other, but under one central and uniform system of management, from which might result the formation of a Tin Corporation for Spain with sufficient capital to work the entire tin-belt I have described, and since Cornish managers, underground captains, pitmen, and tin-dressers would be largely in requisition, it would follow that the two great tin-bearing districts of the Atlantic would once more be brought into contact, as I have shown that they were in days that are long gone by.

In fine, I feel sure, that tin in Spain is a product well worthy of the most favorable attention of the commercial world, and that if only the ordinary rules of economy and good mining, which I have been accustomed to see practised in Cornwall, are applied in the Peninsula also, tin-mining can be made in the latter country not only to pay expenses, but to produce to those who are engaged in it, eminently satisfactory results.

— FINIS. —

NOTES.

- (1) *The two Medinas* : I suppose that Medina de Rioseco and Medina del Campo, both in the Province of Valladolid, and at each of which fairs were held, are intended. The verses occur in *Descripción del Reyno de Galicia* by the Licenciado Molina; edit. 4, Madrid, 1551, fol. xxiv.
- (2) *Valdiorres* : El Barco de Valdeórrias is in the north-eastern part of the Province of Orense.
- (3) The MS. of Boan, or Bohan, is quoted by Murguía in his *Historia de Galicia*, p. 56 seq.
- (4) *The haunted lake of Limia*. For this see the work of S^r. Villa Amil y Castro, "Galicia," *Antigüedades*, Lugo, p. 75, and the writer's *Dolmens of Ireland*, vol. ii, p. 595.
- (5) *Cornide's MS.* Of this I have had a copy made. It is entitled *Memoria sobre las Minas de Galicia y otras producciones del reyno mineral, dirigida al S^r. D. Miguel Bannuelos, su Intendente General: Firmada por D. Joseph Cornide y fechada en Mondego á 28 de Agosto de 1783*. It is a folio MS. of 18 pages, leg. 29, in the Biblioteca de la Real Academia de la Historia (Madrid).
- (6) *William Bowles* : Of the work of this indefatigable naturalist, who was a native of Cork, but who wrote in Spanish, several translations have been made. The ones I have before me are the 3rd edition of the original Spanish work printed at Madrid in 1789, and the Italian translation printed at Parma in 1783, containing a biographical notice of the author. The Spanish edition bears the title "Introduccion á la Historia Natural y á la Geografía Física de España." See 3rd edit. p. 35.
- (7) *Schultz, Don Guillermo* : *Descripción geognóstica de Reino de Galicia, acompañada de un mapa petrográfico de esta país, por Don Guillermo Schultz, inspector de minas por S.M.*, individuo de varias Sociedades científicas: publicada de real orden; Madrid: imprenta de los herederos de Collado; 1835,—4to vi.,—52 pp; 2 hojas grandes plegadas con una Tabla de algunos terminos geognósticos usuales en la mineria, y un Catálogo de la coleccion geognóstica de Galicia. See Don José Villa-Amil y Castro's *Catálogo sistemático y crítico de algunos libros que tratan de Galicia*, Madrid, 1875. See note 13, below.
- (8) *Eschwege* : *Karsten's Archiv*, 1835, p. 221.
- (9) *Phillips, J. Arthur*. F.R.S.; *A Treatise on Ore Deposits*, 2nd edition, re-written and greatly enlarged by Henry Louis, M.A., London 1896, p. 516.
- (10) *Gold-mining in the Peninsula under Phœnicians, Romans, &c.*; Prescott (*Ferdinand and Isabella*, edit. 5, vol. i, p. 338) says:—"Before the discovery of America, Spain was to the rest of Europe what her colonies have since become, the great source of mineral wealth. The Carthaginians, and the Romans afterwards, regularly drew from her large masses of the precious metals. Pliny, who resided some time in the country, relates (*Nat. Hist.* Bk. xxxiii, chap. 21,) that three of her provinces (Asturia, Gallæcia, and Lusitania) were said to have annually yielded the incredible quantity of sixty-thousand pounds of gold. (Prescott here appears to fall into an error. Pliny does not say that each province yielded twenty-thousand, which would make the sixty-thousand, but that the three together yielded *twenty-thousand pounds' weight, the produce of Asturia forming the major part.*) The Arabs, with their usual activity, penetrated into those arcana of wealth. Abundant traces of their labours are still to be met with along the barren ridge of mountains that covers the north of Andalusia; and the diligent Bowles has enumerated no less than five thousand of their excavations in the kingdom or district of Jaen. (Introd. à l'Histoire Naturelle de l'Espagne, Paris, 1776, p. 411)."

It has been observed that the principal reason why the Suevi came to Galicia was its mineral wealth, in gold, silver and other metals.

(11) *Pliny, Nat. Hist.*, Bk. iv, chap. 34.

(12) *Id. id.* Bk. xxxiv, chap. 47.

(13) *Schulz, Guillermo*; *La Ballesterosita*; Memoria sobre el reciente descubrimiento de una pirita estañífera, que se encuentra en los esquistos arcillosos de las cercanías de Rivadeo y de Mondoñedo, por D. Guillermo Schulz y D. Adriano Pallete. (Bol. de la Sociedad Geológica, vol. viii, 2nd series, Paris, 1849, p. 16). Schulz was the Inspector of mines in the Asturias and Galicia; Adrian Pallete or Paillete was a Mining-Engineer. In a letter addressed by Schulz to the Société Géologique de France, May 30th, 1834, that writer gives the best account I have met with of the geology of Galicia. "Three quarters of the surface of the kingdom, that is all the western portion, are composed of primary rocks, the fourth part, lying to the east, presenting intermediary deposits. The valleys and some of the plains are covered with alluvial deposits, ancient and modern, and there is a small number of tertiary basins. With the exception of a single vein of basalt, there are no volcanic rocks.

"The primary formations consist of granite, gneiss, mica-schist, itacolumite, talcose-schist, chlorite-schist, amphibolic and serpentine rocks in great variety, in addition to some masses of eurite, and small quantities of diorite.

"The granite is sometimes porphyritic, and, in that case, the surface is covered with blocks which at once attract the eye,—a feature which occurs principally in eastern Galicia.

"The gneiss is very varied. It often passes into granitoid rock, and very frequently into mica-schist. This latter formation passes in turn into talcose-schist and chlorite-schist.

"The itacolumite and talcose quartzite is very well characterised, and occurs in the north of Galicia. It is either whitish or yellowish in colour.

"The amphibolitic rocks are distributed in four large patches, one of which is near Santiago, and another at Cape Ortegal. They are in places considerably mixed with quartz, feldspath, chlorite, garnets, &c., and form numerous junctions, more especially with chloritic rocks and gneiss.

"Serpentine, capable of being worked, accompanies in many places, the rocks just mentioned, and is associated with beautiful varieties of steatite.

"Euphotite is of great rarity.

"Eurite, partially porphyritic, occurs among the primary and intermediary rock-formations which contain also small portions of diorite.

"Sienite is scarce, and not well characterised. To the south of Cape Ortegal, a serpentine hill contains a vein of close-grained white marble.

"A vein of basalt occurs in porphyritic gneiss to the east of Santiago, in the centre of Galicia. It holds its course without rising into a peak, but the formation is readily distinguished by crystals of peridot and pyroxene. The remarkable cone of the Pico-Sagro, with its elongated crest, measuring a mile and a half in length, and traversed by the river Ulla, is composed of white semi-crystalline quartz, and quartz-hyalin.

"The argillaceous schist is subordinate to the primary rock, and cannot be distinguished from schists in transition.

"The crystalline schists and the gneiss of Galicia have, generally speaking, a north and south strike, with a very marked dip to the west. They are found both under and over the granite.

"The intermediary formation of the eastern part of Galicia is composed of argillaceous schist, greenish or blackish in colour, of stratified quartz, of grauwacke in small quantity, and of ridges of chalk or of marble in considerable numbers. The strike of the intermediary deposits is north and south, and their dip marked but variable."

With regard to the tertiary rocks, the writer states that he had not, when he wrote, finished his researches. "In two large basins belonging to the potamographic system of the Cabe, there is an horizontal deposit of variegated marl, which closely resembles the Keuper, and is superimposed upon a sandy deposit either roseate or greenish in hue. It is partly a marly arkose disaggregated, and partly a green argillaceous marl, covered by ancient alluvial deposits. The upper portion of this bed occurs also in many other places in Galicia, sometimes lying under the alluvial deposits, and sometimes uncovered.

"In the valley of Sarria these deposits are more calcareous, and form in general a white chalky marl. "Schulz adds that he had never been able to discover any trace of fossils in them. [See Barrois, *Les Terrains de la Galice*, Soc. Geol. du Nord: Lille, vol. I.] Speaking mineralogically, he notes that the inferior portion resembles the Keuper deposits, while the upper looks like green sand, but he comes to the conclusion that they are tertiaries bearing some affinity perhaps to certain recognised tertiary beds at the southern foot of the eastern Pyrenees.

"In other places in Galicia there are sands and tertiary clays, containing considerable quantities of lignite, but gypsum has not been found in them.

"There are numerous ancient alluvial deposits in the valleys and on the plains. In the western portion of the district they come into contact with the intermediary formation. In these places it was that the Romans had their gold-washings. Alternating with the alluvial deposits, it is curious to find so many sandy beaches with sides sharply escarped, and, on some rivers, not far from the sea and liable to be covered by the tides, immense deposits of mud. The impulse of the great current of the Atlantic and of the Bay of Biscay should doubtless be connected with the producing cause of such deposits.

"On the Sil there are very rich auriferous deposits. In the transitional formation there occur extensive and extremely rich outcrops of iron-hydrate, as well as some veins of argentiferous galena. The primary rocks, and especially the micaceous gneiss and the granite are traversed by rich veins, and stringers of massive oxide of tin."

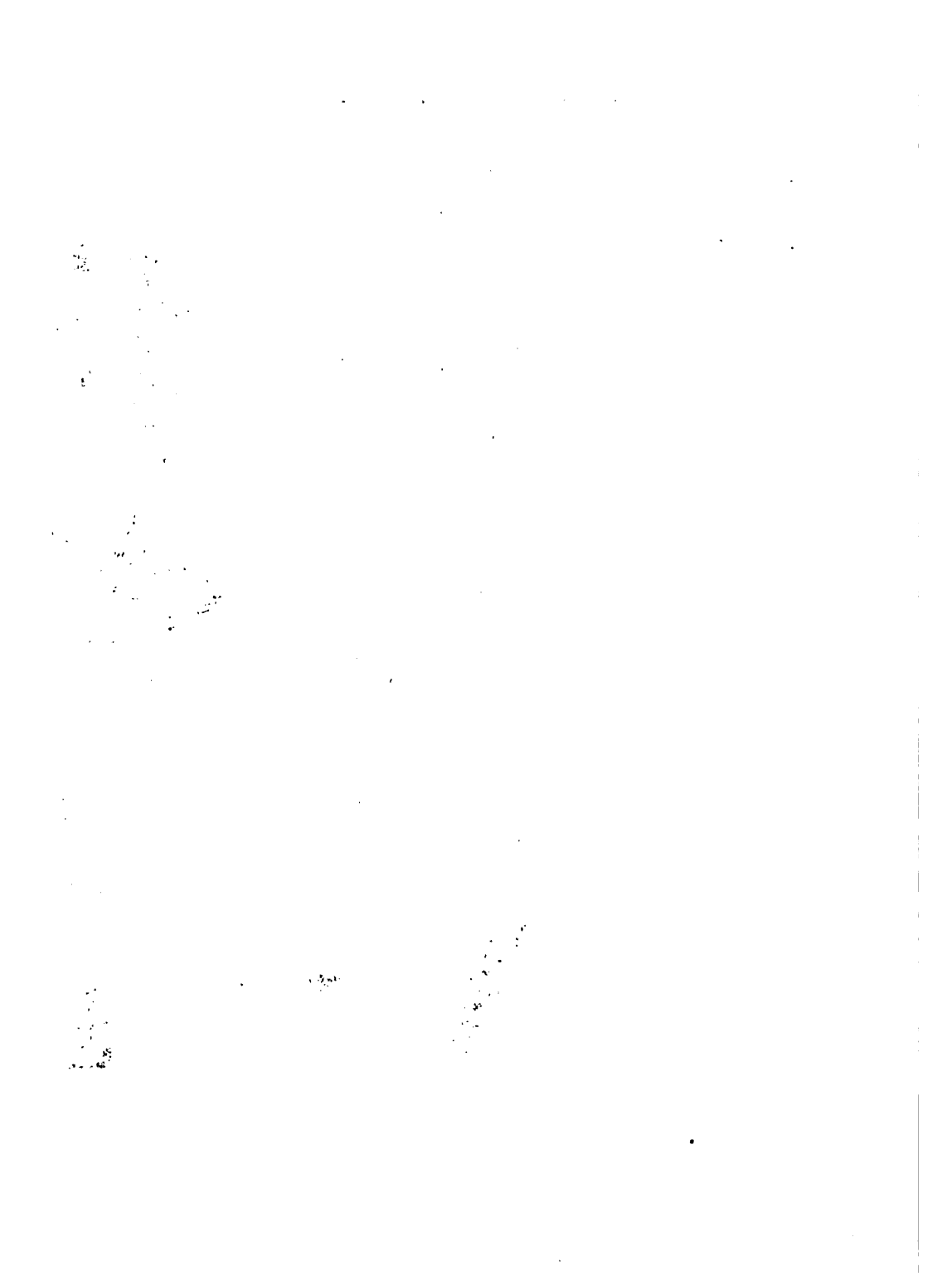
The communication to the French Society, from which I have translated the above embodies all the important points in Herr Schulz's Spanish paper, mentioned in note 7.

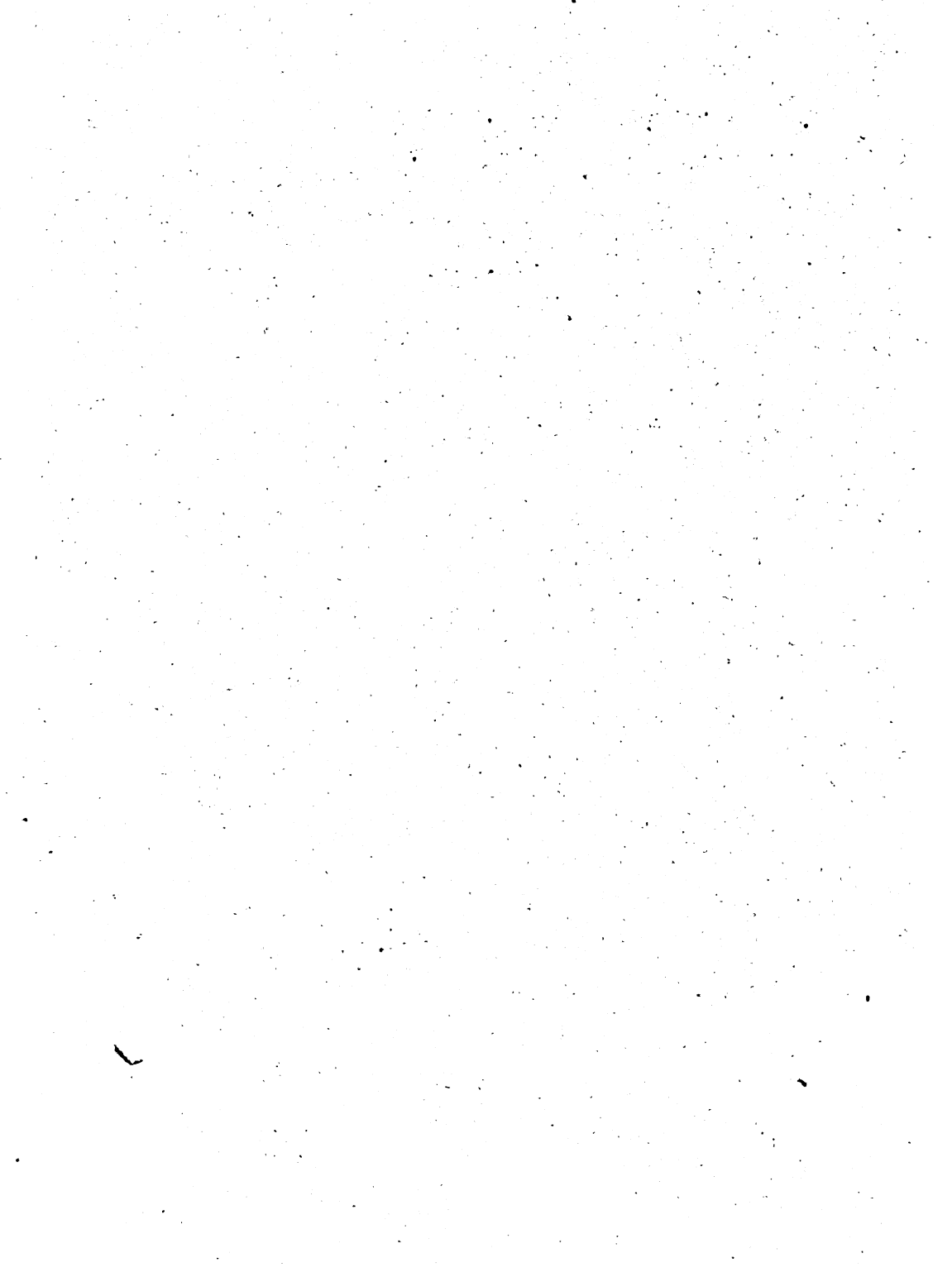
- (14) *M. Paillette*: mentioned in the previous note. He wrote several works, or rather assisted others in writing them, on the carboniferous strata of the Asturias, the iron mines in the same district, &c., &c.
- (15) *Pliny, Nat. Hist.*, Bk. iv., chap. 34.
- (16) *Aristotle*, "Celtic Tin," De Mirab. Ausc. chap. 50.
- (17) *Cortázar*, Daniel de—— See his two articles Datos Geológico-Mineros de la Provincias de Zamora y Orense, (P. 6 under *Zamora*, and p. 14 under *Orense*), in vol. I of the Boletín de la Comision del Mapa Geológico de España.

- (18) *Pliny, Nat. Hist.*, Bk. iv., chap. 34.
- (19) *Itacio*: I have taken the greatest pains to discover any copy either published or in MS. of the original in which Cornide found the name *Islas Casiterides* as that of one of the boundaries of the diocese of Cale [*i.e.* Portucale], in the spurious document attributed to Wamba whose date was 704. *Itacio* is the title of a MS. in a book called *Ovetense* at Oviedo. It appears that it professed to be a continuation of the Chronicle of Idatius with which, however, it has no connection but in name. (See Florez, *Esp. Sacr.* vol. iv, pp. 195-210). Morales had fully described it in a MS., which MS. Florez used. Loayas (Coll. Concill. Hisp., p. 135, seq), who seems to have followed Morales (See *Esp. Sacr.* vol. iv, p. 197) gives the *Divisio Sedium* attributed to Wamba, but in this I do not find the name *Casiterides*. The passage reads "Portucale hæc tenet: de Ibdia usque Losolam: de Olmos usque Solam."
- (20) *Murguía*, Manuel: See his *Historia de Galicia*, vols. 1 and 2, Lugo, 1865-8; and his *Galicia*, one of the volumes of *España sus monumentos y artes*, Barcelona, 1888.
- (21) *Eguilaz*: See *Introdução á Archeologia de Pen. Iberica*, Lisbon, 1878; by Sr A. F. Simões, p. 92: also my "Dolmens of Ireland," vol. ii., p. 647.
- (22) See Wood Martin's "Rude Stone Monuments of Ireland," and my "Dolmens of Ireland," vol. i, p. 141. Both at Eguilaz and Carrowmore the stone which closed the entrance and made the eleventh, is absent.
- (23) *Cells*: See Cartailiac, "Ages préhist. de l'Espagne"; "Evans's Bronze Age," and my "Dolmens of Ireland," vol. ii., p. 673.
- (24) *Montelius*: See my "Dolmens of Ireland," vol. ii., p. 523-526.
- (25) *Islands*: For Atlantis, see Plato "Timæus" and "Critias": for the Islands of the Blessed (Gods) see Homer, *Od.* iv, 563 seq: for the Oestrymnides see Festus Avienus.
- (26) *Historical Sketch of the Tin Trade in Cornwall*; Plymouth, Brendon, 1874.
- (27) *Artabri*; Strabo, lib. ii., edit. Falc. vol. i., p. 159.
- (28) *Depth of Shafts*: The deepest shafts known to me are those of Arcillera (330 feet), and some in the Province of Orense said to be between 200 and 300 feet deep. According to the *Revista Minera*, there were in January 1892, three principal Companies working tin-concessions in the Province of Orense, viz.: The San Francisco at Avion; the Tin-Viso Company, Limited; and the Galicia Tin Maatschappij, the properties of which latter were at Pentes near Guadña which should be placed in my map a little to the south-east of the letters L and M (= Penouta and Ramilo). In the Province of Salamanca, two Companies were then mining for tin,—the Salamanca Tin-Mining Company Limited; and the Deutsche Gesellschaft für Bergbau in Spanien. In 1890, according to the *Manuel de la legislación de Minas*, by D. J. Abella, there were 15 tin concessions at work, representing a total area of 532 hectares, employing 272 workpeople, with an output of 48 tons, valued at 43,099 pesetas.

In addition to the works we have quoted there are at least two which I have not been able to obtain, both of which treat of tin-mining in Spain: (1) *Descripción de las minas de la Provincia de Zamora*, 1846, by D. Luis de la Escosura; (2) *Memoria sobre las Minas de estaño situadas en las Provincias de Pontevedra y Orense*, Madrid, by F. Cutali.

A full list of all works relating to the geology and mineralogy of Galicia will be found in M. Chas. Barrois' *Terrains anciens des Asturies et de la Galice*, which forms vol. II. of the *Mémoires de la Soc. Geol. du Nord*, Lille, 1882.





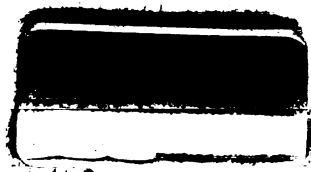


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