equally favourable; however the vineyards are numerous about Orunda and Bilbao, and form the principal revenues of the country gentlemen; but as the prices are fixed, and no foreign wine can be introduced nor ſold by the publicans, while their own vintage is ſelling, they are more eager to increaſe the quantity than meliorate its quality, for which reaſon it is in general bad; beſides, they make their vintage too early, which gives a ſharpneſs to the wine, and deprives it of body; and being unſkilful as well as careleſs, mixing the rotten and ſour grape with the reſt, Chacoli is a very poor wine. Their whole vintage will not ſuffice for four months conſumption, and the deficiency muſt be made up from the province of Rioja, which occaſions a ſaying, "That all the iron of Biſcay is ſwallowed down in foreign wine, by the natives." Even Engliſhmen and Germans, are people of great ſobriety, compared with many Biſcayners, yet drunken men are ſeldom ſeen in the ſtreets, becauſe they are accuſtomed to eat heartily in theſe drinking entertainments; both men and women breakfaſt, dine, eat in the evening, and ſup very plentifully; and yet enjoy excellent health.

Moſt of the mountains of Biſcay, and Guypuſcoa, are of an argillaceous ſubſtance, the ſtone decompoſes very little, or reſolves into earth, though calcareous ſtone is abundant,

abundant, and in many parts they have manured for ages paſt with lime, yet it has cauſed very little alteration; the argillaceous ſubſtance ſeems to abſorb the calcareous, mixed with it, for though lime is the beſt ingredient to looſen the argillaceous particles which cling to the roots of delicate plants, and hinder them from penetrating further, and alſo to correct the acid, and convert it into more tractable land, yet thoſe of Biſcay ſtill preſerve their tenacity; that were it not for extraordinary labour, they would only produce thickets of bruſh wood, and briars: to prevent which, they turn up the earth with iron prongs, which inſtrument they call *laya*. Three or four labourers unite together, for one alone would make no progreſs; by this means they ſeperate large pieces of turf, which are turned upſide down; then another perſon comes, and in the trench which they have made, cuts away the weeds and roots, and the turf is next broke with the ſpade, and the winter froſt detaches it ſtill more. This operation is termed *Layar*.

In ſpring they draw a harrow over it with oxen, then ſeparate it ſtill more with another harrow; if all this will not do, they beat it with wooden mallets; then with a ſpade they dig holes in ſtraight lines, at two feet diſtance from each other. In every one of theſe, they ſow three or four grains of maiz, a few ſeeds of pumpion, ſome kidney beans, and peas, then filling the hole with manure, they cover it over with earth.

Between

Between September and October the ears of maiz are ripe, and they cut the plant close to the ground, leaving the root to serve as manure. The cattle eat the leaves; and the stalks being trod under foot, serve likewise for manure. After the corn is sowed, they slightly turn the earth, during the winter, with a long and narrow spade, to break it more effectually, and loosen the strong substance; this they call *Jallar*. In May or June they do the same once more, to destroy the weeds, which would otherwise stifle the grain. Their harvest time is in August, and they leave the stubble till winter, for pasture, when they again renew the work of the laya. This may be done continually with land contiguous to a farm, which partakes of its manure, or has lime thrown over it; but the lighter soil is generally left fallow, a twelve month; some soils are so soft and flexible, as not to require a stronger plough than is used in Castile; but in such they only sow wheat, and as tractable land is scarce, they break up the sides of the mountains, which, having little depth, will not bear large trees, and are generally covered with furze; for this purpose they inclose, with a hedge, the ground to be broke up, turn up the earth with a spade, cutting turf four inches deep, entangled with weeds and roots; after these roots are thoroughly dried, in July or August, they pile the turf in the form of a pyramid, setting fire to the whole, and covering it with earth to pre-

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vent inflammation, ſo that the earth may be burned in the ſame manner as charcoal. They ſpread out this burned turf, which acquires the colour of brick-duſt, then till the land and ſow their corn; the three firſt years they have a plentiful harveſt of wheat, the fourth they ſow barley, and the fifth flax; then the land begins to wear out, the hedge is taken down and it affords tolerable paſture till its ſurface gets covered with brambles and weeds. All this hard labour is neceſſary to oblige this ſtubborn ſoil to maintain ſuch numbers of people, who like to live well, and ſtand in need of good food, to ſupport ſuch conſtant fatigue; even all this will not do, they are ſtill forced to get corn from Caſtile, or elſewhere, but they always prefer that of Caſtile, as better though dearer. In the ſame manner they depend on their neighbours for other kinds of food, as in ſo cloſe a country, covered with woods, little is left for grazing; nevertheleſs they eat better meat than their neighbours, as their cattle are ſtall fed in the winter.

Game would be plentiful if there were not ſo many ſportſmen, though they do not want for partridges, and their quail are the beſt in all Spain. In marſhy places, they are well ſtocked with wild ducks, woodcocks, and ſnipes. In the plains they have hares, but no rabbets, nor any deer, nor roebucks, which laſt the Spaniards call *corzo*, as coming originally from Corſica; as they give the

the name of *galgo* to a greyhound, having firſt had them from Gaul, as Martial ſays,

" Leporemque læſum Gallici canis dente."

Lib. iii. Epig. 47.

The woods are not without wild boars; and Don Manuel de las Caſas who had been miniſter of Marine at St. Sebaſtians, killed a very large lynx, (lupus cervarius) in that part called *las encartaciones* (*a*); but the common wolf is ſcarce, there being ſo few ſheep to entice them, and the country ſo fully inhabited by which means they are immediately diſcovered and killed. Hardly once in an hundred years one meets with a bear, though ſo common in the mountains of Leon and Aſturias, which form a chain jointly with thoſe of Biſcay; but they have plenty of foxes, to the great annoyance of their houſewives, from the havock they make amongſt the poultry. Their ſea-ports are well ſupplied with fiſh, every ſort being better and firmer in the ocean than in the Mediterranean, ſo that without having a very nice palate, it is eaſy to diſtinguiſh a bream of Biſcay from one of Valencia. Oyſters and other teſtaceous fiſh they have likewiſe in great plenty, and that delicate fiſh called *Sardina*, in ſuch numbers, that you may buy a hundred for the value of a halfpenny.

(*a*) The name of Encartaciones is given to a certain number of villages in the mountains of Burgos near Biſcay, where they enjoy the ſame franchiſes and privileges as the people of that lordſhip.

LETTER XVII.

Reflections on the genius and character of the Biſcayners.

THE Biſcayners give the name of republicks to the different juriſdictions in their provinces, all which, except Orduna, their only city, and a few towns, are compoſed of hamlets, and lonely houſes, diſperſed up and down, according to the convenience of ſituation, in ſo cloſe and interſected a country. However their houſes have every advantage of diſtribution, conſiſting of a principal ſtory, beſides the ground floor, for offices, with an appendage of ſtables, granaries, out-houſes, courts, cellars, and gardens; with orchards, meadows, and often corn-fields, contiguous to the building, with cheſnut groves, and other improvements to the very foot of the mountains. Nothing can be more pleaſant to the traveller, than to ſee houſes and gardens during the whole courſe of his progreſs, particularly from Orduna to Bilbao, an extent of ſix leagues, which ſeems like one continued village. The upper part of the houſes were formerly of wood, but the new ones are of ſtone, and one ſeldom ſees an empty houſe, or any fallen in ruins; on the contrary, many new ones, both large and convenient, are conſtantly building; from whence

whence it appears, that though population cannot well be conſiderably encreaſed, while new branches of induſtry are not introduced, all the land being occupied, it ſeems, rather to augment, notwithſtanding the many emigrations; and though ſome women emigrate likewiſe, few remain at home without huſbands. Theſe diſperſed families may be held as the moſt antient in Spain, and the country is indebted to them, for population and culture. In the Biſcay language they are called *Echejaunas*; that is, lords of tenements, whoſe anceſtors have poſſeſſed them time immemorial, and will probably continue ſo for future ages, as ſelling or mortgaging is held in great diſrepute. Such lands as belong to rich families, are let out to others, and as they lie under their eye and inſpection, the whole is attended to, with the utmoſt activity; the parochial church ſtands in the centre of the pariſh, which, if too extenſive, has a chapel of eaſe, for the conveniency of the pariſhioners; many of whom repair to theſe churches from very great diſtances, in the ſevereſt weather. Their antiquity may be traced from their dedications, which are generally to the Bleſſed Virgin, to St. John, or the apoſtles and ſaints of the Primitive Church; and their livings muſt be comfortable, from the decent appearance of their paſtors.

Not only Biſcay, Guypuſcoa, and Alaba, but alſo the mountains of Burgos, are full of gentlemens ſeats,

known by the name of *Solares*, or *Caſas Solariegas* worthy of much veneration from their antiquity; the owners of theſe are diſtinguiſhed by the title of *Hidalgos de Caſa Solar*, or *de Solar Conocido*—"Gentlemen of known property;" the moſt honourable appellation in Spain. They are generally ſtrong, plain ſtructures, with ſquare towers; but many of the towers have been deſtroyed; and in the modern repairs, they have followed the faſhion of the times.

The head of the family is called *Pariente Mayor*, and is greatly reſpected by all the collateral branches; ſome of theſe are of ſuch high antiquity, as to be thought to have dwelled there before the eſtabliſhment of Chriſtianity, in that country, ſince their anceſtors were the founders of the churches, had the patronage of them, and were known ſo far back as four centuries ago, to have, even then, been time immemorial, in receipt of the tythes; others, without any patronage, are deemed equally antient; many are ſo far reduced as to be obliged to cultivate their eſtates, with their own hands, yet will not yield to the others, in nobility and deſcent, alledging that, though ſome branches have been more enriched by fortunate events, yet they are all equally ſprung from one common anceſtor. Their names have undoubtedly paſſed in a lineal ſucceſſion, from a more antient date than the ages of chivalry, the eſtabliſh-

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ment of coat armour, or of archives, and records; to which they pay little attention, as of no importance to illuſtrate their quality, the poſſeſſion of one of theſe houſes, or the conſtant tradition of being deſcended from a former poſſeſſor, being more than ſufficient to enoble their blood; many ſuch having ſhined in the annals of Spain, by the nobleſt deeds, which have immortalized their names more than their ancient deſcent. Theſe have ſettled in different parts of the kingdom, while the head of the family has continued at home, in a ſtate of ſimplicity, ploughing his fields, and inſpiring his children, with ſentiments ſuitable to the heroical ages: the daughters are brought up in a different manner from moſt other parts of the world; here the moſt opulent do not diſdain the management of houſhold affairs, and every branch of domeſtic œconomy, with a noble ſimplicity, that ſeems to recall thoſe glorious ages of which Homer has ſung. Whoever looks for innocence, health and content, will find it amongſt the inhabitants of Biſcay; and if they are not the richeſt, they may be well deemed the happieſt of mankind (*a*).

It is pleaſing to behold with what affability the rich demean themſelves towards thoſe who are leſs ſo than

(*a*) Mr. Bowles relates, that the moſt opulent families make no ſcruple to bake, brew, dreſs victuals, and waſh linen. For my part I cannot ſay I obſerved theſe circumſtances amongſt the opulent Biſcayners, though I often experienced their open-hearted hoſpitality and benevolence.

themſelves,

themſelves, being obliged to this condeſcenſion from the natural ſpirit, and pride of the people, added to their education and notions of freedom. Unaccuſtomed to brook the leaſt ſcorn, or to comply with that ſubmiſſive behaviour ſo uſual from the poor to the rich, in more refined and opulent kingdoms; yet the common proverb of Caſtile, *Pobreza no es vileza*, "Poverty is not a blemiſh," has no ſway here, for ſuch are their notions of labour, and induſtry, that their ſpirit makes them conſider it, as an indignity to beg; and though the women are generally charitable, which cannot fail to attract mendicants, yet theſe are moſt commonly ſtrangers.

The country people wear brogues, not unlike thoſe of the highlands of Scotland, tied up with great neatneſs, being the moſt uſeful for a ſlippery and mountainous country. When they are not buſy in the fields, they walk with a ſtaff taller than themſelves, which ſerves them to vault over gullies, and is an excellent weapon in caſe of aſſault, with which they will baffle the moſt dextrous ſwordſmen; they wear cloaks in the winter, the pipe is conſtantly in the mouth, as well for pleaſure as from a notion that tobacco preſerves them againſt the dampneſs of the air; all this, joined to their natural activity, ſprightlineſs, and vigour, gives them an appearance ſeeming to border on ferocity, were it not the reverſe of their manners, which are gentle and eaſy,

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when no motive is given to choler, which the leaſt ſpark kindles into violence.

It has been obſerved, that the inhabitants of mountains are ſtrongly attached to their country, which probably ariſes from the diviſion of lands, in which, generally ſpeaking, all have an intereſt. In this, the Biſcayners exceed all other ſtates, looking with fondneſs on their hills, as the moſt delightful ſcenes in the world, and their people as the moſt reſpectable, deſcended from the *aborigines* of Spain. This prepoſſeſſion excites them to the moſt extraordinary labour, and to execute things far beyond what could be expected, in ſo ſmall and rugged a country, where they have few branches of commerce: I cannot give a greater proof of their induſtry, than thoſe fine roads they have now made from Bilbao to Caſtile, as well as in Guypuſcoa and Alaba. When one ſees the paſſage over the tremendous mountain of Orduna, one cannot behold it without the utmoſt ſurprize and admiration.

The manners of the Biſcayners, and the ancient Iriſh, are ſo ſimilar on many occaſions, as to encourage the notion of the Iriſh being deſcended from them. Both men and women are extremely fond of pilgrimages, repairing from great diſtances to the churches of their patrons, or tutelary ſaints, ſinging and dancing, till they almoſt drop

drop down with fatigue. The Iriſh do the ſame at their *patrons*. The *Guizones* of Biſcay, and the *Boulamkeighs* of Ireland are nearly alike: at all theſe aſſemblies, they knock out one another's brains, on the moſt trivial provocation, without malice or rancour, and without uſing a knife or a dagger. In both countries the common people are paſſionate, eaſily provoked if their family is ſlighted, or their deſcent called in queſtion. The *Chacoli* of Biſcay, or the *Shebeen* of Ireland, makes them equally frantic. In Ireland the poor eat out of one diſh with their fingers, and ſit in their ſmoaky cabbins without chimnies, as well as the Biſcayners. The brogue is alſo the ſhoe of Biſcay; the women tie a kercher round their heads, wear red petticoats, go barefoot, in all which they reſemble the Biſcayners, and with them have an equal good opinion of their ancient deſcent: the poor Biſcayner, though haughty, is laborious and active, an example worthy to be imitated by the Iriſh.

So many concurring circumſtances ſupport the idea of their having been originally one people. It cannot be denied, but that the old Iriſh, whether from ſimilitude of cuſtoms, religion, and traditional notions, or whatever elſe may be the cauſe, have always been attached to the Spaniards, who on their ſide, perhaps from political views, have treated them with reciprocal affection, granting them many privileges, and ſtiling them even *Oriundos*

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in their laws, as a colony deſcended from Spain; yet, with all theſe advantages, if we except thoſe gallant ſoldiers who have diſtinguiſhed themſelves in the field wherever they have ſerved, few Iriſh have made a conſpicuous figure in Spain, or have left great wealth to their families (*a*).

The King of Spain has no other title over theſe free people, than that, of Lord of Biſcay, as the kings of England formerly held over Ireland; they admit of no biſhops, nor of cuſtom houſes in their provinces, and as they pay leſs duties than the king's other ſubjects, they were not included in the late extenſions of the American commerce; however, they content themſelves with that renown which they have acquired for themſelves and their iſſue, inſomuch that upon only proving, to be originally belonging to that lordſhip, or deſcended from ſuch in the male line, lawfully begotten, they are entitled to claim public certificates, or executory letters, termed *Cartas executorias*, expreſſive of their being *Hidalgos de*

(*a*) Another inſtance in which the Iriſh ſeem to have cloſely imitated the Spaniſh cuſtoms, is in the taking of ſnuff, of which Mr. Howel, who was in Spain in 1620, and went ſoon after to Ireland, gives us the following account, at an early period, after the firſt introduction of ſnuff into Europe: "The Spaniards and Iriſh take it moſt in powder, or ſmutchin, and it mightily refreſhes the brain, and I believe there is as much taken this way in Ireland, as there is in pipes in England. One ſhall commonly ſee the ſerving maid upon the waſhing-block, and the ſwain upon the ploughſhare, when they are tired with labour, take out their boxes of ſmutchin, and draw it into their noſtrills with a quill, and it will beget new ſpirits in them, with a freſh vigour to fall to their work again".—Epiſtolæ Hoelianæ. London, 1726.

Sangre, or " Gentlemen of blood;" their nobility having been confirmed to them, by the kings of Caſtile and Leon, lords of Biſcay, in the plenitude of their power.

The moſt loſty Caſtilians have conſtant rivals for antiquity and deſcent in the inhabitants of Biſcay, Aſturias, and the mountains of Leon: thus, in Don Quixote, Dona Rodriguez, the duenna, ſpeaking of her huſband, ſays, he was as well born as the king, becauſe he came from the mountains. *Y ſobre todo Hidalgo, como el Rey, porque era montanes* (*a*).

Impreſſed with theſe flattering ideas, the high-minded Biſcayner leaves his native ſoil, and repairs to Madrid. Conſcious that his blood is pure, uncontaminated with mixtures of Jewiſh, or Mahometan race, he raiſes his hopes on honeſt induſtry, and ſobriety, fulfilling his duties with zeal, and ſubmiſſion; he often meets with relations in affluence, and ſometimes riſes to the higheſt employments. It ſhould ſeem that ſome ſuch character muſt have offended the immortal Cervantes, from his pointed reflections in his celebrated romance of Don Quixote, where he ſays that, " an expreſs being arrived " with diſpatches of moment directed to Don Sancho " Panza, governor of the iſland of Barataria, into his own " hands, or thoſe of his ſecretary, which being given to

(*a*) Don Quixote, part 2. tom. 4. cap. ci. Madrid, 1771.

" read

" read to the major domo, by Sancho; the imaginary " governor aſked, Who here is my ſecretary? To which " one preſent anſwered, *I, ſir, am the perſon, becauſe I* " *can read and write, and am moreover a Biſcayner.* With " this addition, replied Sancho, you are fit to be a ſecre- " tary, even to an emperor" (*a*).

(*a*) Don Quixote, part 2. tom. 4. chap. c. Madrid, 1771.

LETTER XVIII.

Deſcription of the town of Bilbao, and the manners of its inhabitants.

THE town of Bilbao, on the banks of the river Ybaizabal, is about two leagues from the ſea, and contains about eight hundred houſes, with a large ſquare by the water ſide, well ſhaded with pleaſant walks, which extend to the outlets, on the banks of the river, with numbers of houſes and gardens, which form a moſt pleaſing proſpect, particularly as you ſail up the river; for, beſides the beautiful verdure, numerous objects open gradually to the eye, and the town appearing as an amphitheatre, enlivens the landſcape, and completes the ſcenery.

The houſes are ſolid and lofty, the ſtreets well paved and level; water is conveyed into the ſtreets, and they may be waſhed at pleaſure, which renders Bilbao one of the neateſt towns in Europe. Coaches are not in uſe, by which means, inequality of wealth is not ſo perceptible, exterior oſtentation is avoided, and the poor man

man walks by the ſide of the rich, with equal eaſe and content.

The air is generally damp, covers iron with ruſt, deſtroys furniture in the upper apartments, extracts the ſalt out of dried fiſh, and multiplies flies beyond meaſure, yet the town is remarkably healthy, and its inhabitants enjoy, to a great degree, the three principal bleſſings of life, perfect health, ſtrength of body, and a chearful diſpoſition, attended with longevity; in proof of which, though the town is very populous, the hoſpital is frequently empty, and in the nine months, that Mr. Bowles reſided there, only nine perſons were buried, four of which were above eighty. Every day one may ſee men above that age walking upright, in chearful converſe with youth. Burning fevers, which the Spaniards dread ſo much and call *tabardillos*, are not known here, and they are ſeldom troubled with agues. What is then the reaſon that Bilbao, on the ſide of a river, in ſo damp a ſituation, and chiefly built on piles, like the cities in Holland, ſhould be ſo remarkably healthy, with every indication againſt it? I ſhall endeadeavour to account for it.

The adjacent mountains ſtop the clouds that ariſe from the ſaline vapours of the ocean, rains are frequent, but they are ſeldom without a ſea breeze, or a land wind; the

the current of the air being thus continually ventilated, never leaves the moiſt vapours at reſt, and prevents their forming thoſe putrid combinations, which heat generally occaſions, on ſtagnated waters; thus the vicinity of the ſea, the rains, and more than all, the ſtrong currents of air, are the phyſical cauſes of its ſalubrity at Bilbao, as on the contrary, the continued heat which rarifies the exhalations of ſuch rivers as have a ſlow motion, as well as the ſtagnated waters in ponds or lakes, where there is great heat in the air, and little wind, will be the cauſes of putrifying the vapours, and bring on fevers and other diſtempers. For this reaſon, the inhabitants of La Mancha are ſo ſubject to agues, and uſe as much bark as in Holland, becauſe the air has little motion in ſummer, notwithſtanding the country is open, and the ſurface is dry. In the ſame manner, a new houſe is dangerous to dwell in, where the damp vapours are confined, though one may ſleep very ſafely in the deepeſt gallery of a mine, if the air has a free circulation.

To theſe favourable circumſtances, the Biſcayners owe their good ſpirits, freſhneſs of complexion, and chearful diſpoſition. In other countries, women are oppreſſed with the ſlighteſt fatigue; here they work as much as the ſtrongeſt men, unload the ſhips, carry burdens, and do all the buſineſs of porters. The very felons, confined to hard labour in the mines of Almaden,

do

do nothing in compariſon with theſe females ; they go bare footed, and are remarkably active, carrying burthens on their heads which require two men to lift up. The wife yields not in ſtrength to the huſband, nor the ſiſter to the brother, and after a chearful glaſs, though heavily loaded, they move on with alacrity, returning home in the evening, without the appearance of laſſitude, often arm in arm, dancing and ſinging to the tabor and pipe.

Their muſic is defrayed at the expence of the town, after the manner of the antient Greeks. On holidays they play under the trees in the great ſquare ; the moment they begin, the concourſe is great, men, women, and children, of all ages, are engaged at the ſame time, down to the very infants. The dances, are active, ſuitable to their ſtrength, but diveſted of indecent attitudes or geſtures. Theſe ſurpriſing women, though conſtantly expoſed to the air, have good complexions, with lively eyes, and fine black hair, in which they pride themſelves greatly, and braid to uncommon advantage. Married women wrap a white handkerchief round their heads, ſo knotted, as to fall down in three plaits behind, and over this the Montera cap. They have a haughty look, and work in the fields like the men; their language is the *Baſcuenſe*, which, without doubt, is original, and as antient as the peopling of the country,

being

being totally diſtinct, and without any connection with any Spaniſh dialect; thoſe who underſtand it, aſſure us it is very ſoft and harmonious, as well as energetic (*a*).

A general neatneſs prevails every where in the town of Bilbao. The ſhambles is a Tuſcan building, in the centre of the town, with an open court and a fountain in the middle; nothing can be more cleanly or better contrived, free from all bad ſcents, or any thing diſguſting as it is copiouſly ſupplied with water to carry away every thing offenſive. The meat is delivered ſo freſh and clean, as not to require being waſhed, as practiſed in other parts of Spain, which deprives it of its ſubſtance and flavour; the veal is white and delicate, and the poultry excellent: the woods afford plenty of birds, be-

(*a*) In the mountains of Biſcay and Navarre, the Spaniſh language, or *romance*, is neither ſpoken or underſtood.

See the following books.

De la antigua lengua, poblaciones, y Comarcas de las Eſpanas en que de paſo ſe tocan algunas coſas de la Cantabria por Andres de Poza ---Bilbao, 1587, 4to.

El impoſible vencido: Arte de la lengua baſconcada por manuel de Larramendi. Salamanca, 1729.

Diccionario Trilingue del Caſtillano, Baſcuenſe y Latin por manuel de Larramendi, 1745.

From whence it is evident that the Baſcuenſe is totally different from the Spaniſh, which is the common language of the two Caſtiles, Leon, Eſtremadura, Andaluſia, Aragon, Navarre, Rioxa, and the mountains of Burgos; and is generally underſtood in Aſturias, Galicia, Valencia, and Catalonia, though not the language of thoſe provinces, where they have a dialect varying more or leſs from the Spaniſh, in proportion to their ſituation and proximity to neighbouring kingdoms.

fides

ſides five ſorts of birds of paſſage, called *Chimbos*, which fatten ſoon after their arrival, and are greatly eſteemed.

Amongſt the different ſorts of fiſh common at Bilbao, there are two peculiar to that river, which the inhabitants are remarkably fond of; theſe are a peculiar ſort of eels in winter, and the cuttle fiſh in ſummer; the eels are ſmall like the quill of a pigeon, of a pale colour, about three inches long, and without a back bone, which they catch at low tides in prodigious quantities. In a word, every thing is in plenty at Bilbao, for beſides a well ſupplied market, their gardens abound in pulſe, and fruit of all kinds; ſo that one can live no where better than here, when we take into the account, the hoſpitable diſpoſition of the inhabitants, which ſoon falls off, if you ſlight their cordiality, or attribute it to motives of adulation or intereſt. Such is the happy life of the inhabitants of Bilbao, free from the luxuries as well as the ambitious paſſions, which agitate the minds of their neighbours, they paſs their lives in tranquility, governed by wholeſome laws; amongſt which they are ſaid, even to have one againſt ingratitude, with a puniſhment affixed to it.

LETTER XIX.

Reflections on the injudicious method laid down in the Spaniſh ordinances, for the propagation of timber, being the ſubſtance of a memorial preſented by Don Guillermo Bowles, to his Excellency Don Julian de Arriaga, Miniſter of State for the department of the Indies and Marine.

TO judge of the quality of oak, fit for building, the four following circumſtances are to be conſidered; Firſt, the ſituation; ſecondly, the nature and depth of the ſoil; thirdly, the age of the tree, when it is felled; fourthly, the manner of laying it down to dry.

In mountainous countries, the beſt timber is from about midway, up to the tops of the mountains; its goodneſs rather decreaſes, in proportion as it approaches towards the valley. In the lower parts, the trees grow quicker, and are more ſightly; but as the roots muſt always partake of a greater ſhare of moiſture, from their ſituation, which expoſes them to the continual flow of water from the heights, the ſtem is not ſo vigorous nor ſolid; thus a tree on the top of the mountain, will not be ſo large nor beautiful at ſixty years of age, as another in the valley at forty; but let the builder be cautious

tious how he truſts to outward appearances, otherwiſe he will certainly be diſappointed,

It appears from various judicious experiments, that oaks arrive at their greateſt perfection, at the period of fifty years, when the ſoil has above two feet depth, and at ſeventy-five years, when the depth exceeds three and a half; if it is above four feet, they then increaſe in vigour and ſtrength for upwards of a century. From whence it is evident, that trees, like animals, have their period of youth, maturity, and decay. When they ceaſe to grow, they are come to maturity, the conductory veſſels are obſtructed, the tubes turn to ſolid timber, the ſap ceaſing to circulate, becomes all ſpine or heart, and the tree remains in a ſtate of perfection, and reſt, for a term of twenty or thirty years. This is the proper time, between adoleſcence and old age, to fell the tree; if it was attempted while the ſap was yet in circulation, the timber would be liable to warp in hot weather, beſides many other defects. We muſt not imagine, that though this operation was performed in the winter, or what might be thought a proper ſeaſon, ſuch as the Spaniards call a good moon, according to the opinion of the antients (*a*), that theſe inconveniencies would be

(*a*) The ancients had a great regard to the age of the moon in the felling of their timber. Pliny orders it to be in the very article of the change, which happening on the laſt day of the winter ſolſtice, the timber, ſays he, will be immortal.

removed. Oaks, reared from acorns, in plantations, prepared for the purpoſe, near villages, with the utmoſt care and attention, though afterwards tranſplanted on a mountain, will never be ſo perfect as thoſe that have grown ſpontaneouſly or even originally ſown there. Theſe two allegations will ſhew, that the Spaniſh ordinance of 1748, for the planting of mountains, committed two capital errors in its decrees; for it ſays, "That near every village, a nurſery ſhall be eſtabliſhed for the ſowing of acorns, manuring them every year; and when they are tranſplanted, the length of a foot is to be cut off from the root of every plant, while two or three feet of earth is laid round them, to make them grow faſter(*a*)!" This may do very well to obtain a fine avenue in a park, or form an agreeable grove, but will never anſwer the end of yielding good ſolid timber, proper for the building of houſes or ſhips; for, though it is certain that a tree tranſplanted, pruned, and well ſupplied with manure, may flouriſh, and have a beautiful appearance, yet this is obtained at the expence of its conſtitution, by a precipitated vegetation. The intention of the ordinance was to leſſen the original defect, by tranſplantation on a mountain; but this expe-

(*a*) The words of the ordinance are as follows: "Que en cada lugar ſe ſenalara un vivero para ſembrar las bellotas, beneficiandole con eſtiercol cada ano, y en el miſmo acto del traſplante ſe cortara a cada arbol un pie de ſu planta, y para que creſcan con brevedad, ſe les arrinara dos o tres pies de tierra."----Ordenanza. De la cria y plantio de los montes. Del ano de 1748.

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dient has not power enough to correct the error ariſing from its firſt propagation; and what is ſtill worſe, a further law contributes more fully to its decay, ſince it ordains that "they ſhould be pruned, in order to ſhoot up more vigorouſly, and that the ſtraight trees, which might be converted into beams or knee timbers, ought to be improved, by cutting the points of their principal ſhoots (*a*)." This regulation produces the reverſe of what was intended, and is the original cauſe of ſo many hollow oaks obſerved throughout Spain. For this reaſon the white mulberry trees of Valencia, and Murcia, are generally hollow, while the black ſort in Grenada is ſolid and healthy, becauſe the ſhoots are not pruned. On the road from Tortoſa to Valencia, I meaſured three monſtrous olive trees, entirely hollow, having ſcarce any ſubſtance beyond the bark, and yet they bore fruit. One of them was forty-one feet in circumference. I ſaw others, as large, at Villavicioſa, in Portugal, which were ſtout and ſolid, becauſe they had not been ſo barbarouſly treated: in a word, every tree uſed in the manner the king's ordinance directs, may thrive and grow for many years, but it will not attain to that criſis of time, between life and death, when it ought to be in a ſtate of perfection. Cedars and firs I allow, may be excepted from

(*a*) The ordinance ſays, "Que las podas de los arboles ſon para que creſcan ſanos: y que los arboles derechos que pueden convertirſe en vaos, quillas y codaſtes, deben beneficiarſe cortando las punta de la guia principal."

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this rule, as their interior parts do not run any riſk from ſuch an operation, there being a great difference between trees, whoſe fibres are impregnated with a balſamic and incorruptible oil, and thoſe which draw their nurture from ſap, the ſuperabundance of which, tends to putrefaction; for the root of a tree increaſes, and grows, in proportion as the ſtem and principal branches require a greater ſupply of nurture. It is equally known, that the juices ſucked in by the roots, are annually diſtributed from the ſtem to the branches, affording life and ſupport to the leaves, flowers and fruit. For this reaſon the mulberry trees in Valencia, which are pruned every two or three years, begin to decay in five or ſix years, and the oak and cheſnut of Biſcay, which are uſed in the ſame manner for the purpoſe of charcoal, begin to decline, the former in ten years, and the latter in twenty, when they ought to be in their prime. On the contrary, thoſe oaks which grow in their natural ſtate, never tranſplanted nor pruned, nor receiving other ill-treatment, neither rot, nor become hollow, except by ſome particular accident, but puſh on to a venerable old age, till the courſe of nature has at laſt brought them to their final decline.

It is nevertheleſs allowed, that the ſmall portion of ſap diverted from its courſe by caſual pruning, which falls back into the ſtem, is not ſufficient to rot the tree, or cauſe any eſſential prejudice, provided the wound is

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ſoon healed, which cannot be done when the branch is large; and if the operation is often repeated, it will infallibly occaſion a caries. Let us admire thoſe beautiful elms planted by Charles Vth. at Aranjuez, about two hundred years ago, which now have a moſt amazing trunk, ſurpriſing by their height and bulk, ſome near ſix feet diameter, without the leaſt appearance of decay; when the trees of the Prado, at Madrid, from having been pruned, were rotten in leſs than a century; but at Aranjuez, when any of the trees are pulled up, though the tops are decayed from old age, they afford beams as ſolid as a walnut-tree, while the old trees of the Prado ſerved only for fuel; the ſame will happen with thoſe in the walks of the Delicias, near Madrid, though planted only thirty years ago, which from being repeatedly lopped, are already in a ſtate of decay, and will ſoon totally periſh.

The mulberry trees of Valencia yield a ſecond leaf, of equal ſtrength with the firſt that was ſtripped off. I once aſked a peaſant why he did not avail himſelf of this ſecond leaf, for the uſe of the ſilk worms? he anſwered me, that it would be of infinite prejudice to the tree, and drain it of its ſubſtance. He was right as to the fact, though his reaſon was bad, becauſe the roots with their juices, ſupport the ſtem, branches, leaves, and fruit. If the branches are lopped, the ſtem grows hollow; if the

firſt leaves are taken off, the ſap reverts, and mixes with what comes forth at a ſecond ſhoot; but if you take this off likewiſe, then the ſap recoils on the bark, and the heart, and the tree will be glutted by repletion, rather than ſtarved by inanition, as the labourer imagines. With reſpect to the method of falling of timber, it ſhould be done with particular attention to the trunk, ſo as to prevent a further effuſion of the ſap, otherwiſe a great part of that ſtrength, which it affords to the tree, when it condenſes, would be loſt. When the tree is felled, it ſhould be carefully placed in ſuch a manner, that the two extremities may reſt upon a prop of wood or of ſtone, two feet, at leaſt, from the ground, that the air may have a free circulation. If it lies on the ground, the moiſture would penetrate on one ſide, and it would dry on the other. Even in its raiſed ſituation, it will ſuffer in ſome degree, as its own ſhade will cauſe ſome alteration, for which reaſon the tree ſhould be turned two or three times in the year, concerning which there are excellent inſtructions laid down by Mr. Duchamel de Monceau, and Mr. de Buffon, the reſult of philoſophical obſervations and repeated experiments (*a*).

(*a*) While we are buſy in finding fault with Spaniſh ordinances, let us for a moment diveſt ourſelves of prejudices, and examine the glaring impropriety of ſome of our acts of parliament at home. The cutting down of the oak timber in the ſpring of the year, when the bark will eaſily part from the wood, as it is now generally practiſed in England, is alſo, according to Mr. Miller, a very great abſurdity, for the ſap of the trees being at that time in full motion in all their veſſels, the timber ſoon after cutting is cracked and torn in many places when

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Many conſiderable advantages will enſue from a due obſervation of theſe principles, and may be applied to the purpoſe of ſhip builders and carpenters; from theſe premiſes we may conceive the reaſon, that, of two houſes built by the ſame architect, one ſhall be ſolid, and remain in a due perpendicular, while the walls of the other ſhall give way by the dilation or contraction of the beams; from hence we may perhaps be able to reſolve that curious problem, which has been propoſed to all the geometricians in Europe, to find out, why two ſhips, built by the ſame perſon, on ſimilar principles and menſuration, with timber from the ſame place, and cut at the ſame time, one ſhall go like the wind, and the other ſhall be the dulleſt of ſailers. One ſhall come home tight, and in good condition, from a long voyage, and the other ſo leaky, that the pumps muſt be kept conſtanly going. For my part, as I conceive that the dilatation of a beam, may throw a wall out of equilibrium, I imagine that the ſame effects, acting upon various bodies of

expoſed to the air, and will not laſt a fourth part of the time, as that, which is cut in winter, when the ſap is thickened, and at reſt; yet there is an act of parliament to oblige every one to cut their timber at that ſeaſon for the ſake of the bark. ---See Miller's Gardener's Dict. preface to folio edition, London, 1759.

Does not the following paſſage from the ſame author, ſpeaking of the French, breathe the ſpirit of a true patriot, as well as a philoſopher. "They do not neglect the culture of their own uſeful timber trees, particularly the oak, for as they ſeem to be very much in earneſt to improve and increaſe their marine, they are purſuing ſeveral ſchemes, which in time will enable them to carry their point. Surely then this ſhould not be neglected in Great Britain, as the welfare of this country principally depends on its ſhipping and commerce."

timber, of different ſhapes and dimenſions, united together, and their action upon one another (*a*), may give a new poſition to all the conſtituent parts, and a certain flexibility or inflexibility, which may have an effect on the ſwiftneſs, or ſlowneſs of its motion, through the water; and what is ſtill worſe, ſtrain particular parts, in ſuch a degree, as to make a ſhip very leaky. It perhaps may be objected, that theſe obſervations are only of moment in the northern, and moiſt diſtricts, and that they are of no ſignification with reſpect to the warm and dry air of the ſouthern provinces of Spain; but I beg leave to aſſert, that they will hold good in every climate, with more or leſs effect, and are of courſe worthy of the notice of the public at large, as well as thoſe individuals whom they may more particularly concern.

(*a*) The late learned Spaniſh Admiral, Don George Juan, publiſhed a very elaborate and ſcientific treatiſe on this ſubject, intitled, "Examen maritimo Teorico, Pratico, o Tratado de Mecanica aplicada a la conſtruccion, conociemiento y Manejo de los Navios, &c."---Madrid 1771.

LETTER

LETTER XX.

Deſcription of the iron mine, and forges, at Somorroſtro, in Biſcay.

THE famous iron mine at Somorroſtro, in Biſcay, has all the appearance of being alluvial, and originally compoſed by the congelation of ſome fluid matter, increaſing by inſenſible degrees, and reduced into a lamellated ſtate, ſucceſſively forming plates, or ſcales, one over the other, thinner than paper; as is evident from the many concavities and crevices, covered over by theſe plates; which ſuppoſing to be the caſe, we need not be ſurprized, at what has been advanced by ſome of the workmen, who aſſure us, that they have often found broken pieces of pickaxes, mattocks, and other inſtruments, in places that had been worked centuries ago, and are now replete with new ore; if this is a fact, we may further believe them, when they aſſert, that the mine increaſes, though the ſlow progreſs of nature, in this operation, does not permit us to calculate its gradation, or determine the number of ages ſufficient, to fill up a cavity of any given ſize.

From the above, it reſults, that a ſolution, evaporation, alluvion, and depoſition, all exiſt in this mine; its ſituation is an undulated hill; which, viewed from the neighbouring mountains, ſeems almoſt a plain; its form is regular, and one may go round it in about four or five hours. The ore forms an uninterrupted ſtratum, whoſe thickneſs varies from three feet to ten, and is covered with a coat of whitiſh calcareous rock, from two to ſix feet thick. I now proceed to their method of working this mine, where every one is at liberty to dig at pleaſure, and tranſport it by land or water, without being ſubject to duties or any formalities. The people being generally ignorant, and carrying away whatever comes uppermoſt, often take ore, which has its matrix of quartz, and is of a brittle kind, full of cracks; but the iron maſters, who are the purchaſers, are more verſed, and know what to buy, and what to reject. It is generally allowed, that no iron in Europe is ſo eaſy to fuſe, or ſo ſoft as that of Somorroſtro. When the ore is firſt taken out of this mine, it has the colour of bull's blood, and when wetted becomes purple; great quantities are carried away by water, to the neighbouring provinces, where they fuſe it by itſelf, or mix it with ore of their own, which generally yields a harder iron; I ſhall only ſpeak of their proceſs with that ore which is fuſed without any mixture.

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The firſt operation is to roaſt it (*a*) in the open air, by piling ſtrata alternately of ore, and wood, in order to divide the ore, repel the moiſture, and diminiſh its weight, that it may be more eaſily fuſed, and the ferruginous parts ſeparated from the ſlag: when it is ſufficiently roaſted, they put it in the forge, with the due proportion of charcoal, and when it appears to have fuſed, by leaving on the hearth, a maſs of four or five arrobes, they lay hold of it with tongs, and place it on an anvil under an immenſe hammer, of about ſeven hundred to a thouſand pounds weight, and there by force of blows, and moving it about, they ſquare it, and reduce it into bars. The numerous ſparks which fly off from the blows of the hammer, are no more than the ſcoriæ of the metal. The bar thus ſhaped, may be doubled or lengthened in a leſs forge, if they pleaſe, and even beat cold as if it was ſilver. In this manner the ore is fuſed in a few hours, and the bars formed, and ſold to the blackſmiths.

(*a*) No general rule can be given, concerning the duration, or degree of fire, for this purpoſe, theſe being various, according to the difference of the ores; a few days, or even hours, is ſufficient for ſome ores, while others, ſuch as the ore of Rammelſburg, require that it ſhould be continued for ſeveral months. Shlutter enumerates five methods of roaſting ores; viz.

Firſt, By conſtructing a pile of ore and fuel, placed alternately in ſtrata, in the open air.

Secondly, By confining ſuch a pile within walls, but without a roof.

Thirdly, By placing the pile under a roof, without lateral walls.

Fourthly, By placing the pile in a furnace, conſiſting of walls and roof.

Fifthly, By roaſting the ore in a reverbatory furnace, in which it muſt be continually ſtirred, with an iron rod.

Formerly,

Formerly the iron was beat by mere ſtrength of arm, a proof of which may be gathered from the names of many places in Biſcay, ſituated where there is neither river nor brook, and begin, or end, with the termination *ola*, or *olea*, either of which in the Biſcay language, ſignifies iron works, ſuch as *Mendiola*, that is, "iron works of the mountain."

According to appearance, a quintal of ore will produce about thirty-five pounds of good iron, and the reſidue about thirty pounds of ſlag, and dead earth. As this mine neither contains ſulphur, nor acids, it is not neceſſary to mix any calcareous ſubſtance to fuſe it, in order to abſorb thoſe matters, ſo troubleſome in mines, that have the misfortune to be loaded with them, as is often the caſe in France. However, it would not be amiſs to uſe a little of it, were it only to aſſiſt the fuſion of the ferruginous earth, accelerate the proceſs, and leſſen the ſlag, as well as the quantity of fuel. Theſe workmen, by conſtant experience, have acquired the proper method of managing the ore, as well as to know the quantity of coal for the forge, which is ſeldom larger than that of a conſiderable blackſmith; ſo that little improvement can be made on their labours; though by ſeveral experiments, made in 1773, by the *ſociedad Baſcongada*; or Biſcay ſociety, it appears that it would anſwer better to roaſt the iron, in a cloſe chamber, than in the

the open air. A good forge, well conducted, will yield to the owner above five hundred ducats a year (*a*); ſome indeed, hardly produce three hundred, after paying all charges. It is neceſſary for them to be good œconomiſts, with reſpect to fuel, and to uſe ſmall forges; for if they were to have ſuch large ones, as are common in moſt parts of Europe, with all the apparatus of hammers and other implements, they would ſoon ſtrip their mountains of wood, and the forges would be at a ſtand for want of materials.

Beſides the mine of Somorroſtro, there are ſeveral others, ſome of which are worked, and others not. In one near Bilbao, the ore is ſeen above ground. About a mile from the town, there is a mine in a hill, of a quite different nature from that of Somorroſtro, being loaded with vitriol; it is an enormous maſs of iron ore, that attracts the vitriolic acid, which penetrating through the ferruginous rock, diſſolves the metal, and exhibits on the ſurface, ſmall laminæ of green, blue, and white vitriol. Oppoſite to this hill, on the other ſide of the river, another ſimilar rock produces a quantity of vitriol ſolely of a pale yellow, and though the colours green, blue, and yellow, may exiſt without any vitriolic acid, chemiſts are very well apprized from experience, that the common iron diſſolved in this acid, cryſtallizes into green

(*a*) A Spaniſh ducat, worth about four ſhillings and eight pence, Engliſh money.

vitriol,

vitriol, which we call copperas, forms blue cryſtals, with copper, and white cryſtals, or allum, when united with argillaceous earth, and of the ſame colour when it diſſolves zinc, and produces yellow, when it coagulates with the phlogiſton of common ſulphur, which abounds ſo frequently in the three kingdoms of nature. The moſt remarkable circumſtance, is to meet theſe colours in the Biſcay mines, which neither contain copper, allum, zinc, nor ſulphur; nor is it an eaſy matter to account for it, without ſuppoſing that the pure elementary water, has a part in compoſing theſe cryſtals, and that its evaporation, either by heat, or air, alters the conſiſtency, and deſtroys the green colour of the vitriol of the iron, taking away that proportion of water, which conſtituted it, and that as ſoon as it loſes it, it begins to change colour, and paſſing through the various tints of green, and yellow, terminates in white, when all the water is gone: when it is come to that ſtate, and has a reſemblance to flour, it is called ſympathetic powder, on account of its ſtyptical quality, ſo readily ſtaunching the blood, in hemorrhages, and curing of wounds. Whoever chooſes to verify this theory, need only to pour water on this white powder, and he will find that it cryſtallizes anew into green. If it be aſked, why theſe matters do not unite, and form ſulphur, when there is ſo much acid, and iron in theſe mountains, and the iron contains ſo much phlogiſton? I anſwer, that for this event to take

place,

place, the vitriolic acid, and the phlogiſton, ſhould be perfectly concentred, and dry; whereas the reverſe happens in theſe mountains, where they are ſo overwhelmed with moiſture, that the abundance of this acid, has perhaps been the cauſe, of many of the mines about Bilbao, being neglected, as of courſe they would yield ſo brittle an iron. This then would be the time to uſe a calcareous ſubſtance, to correct this defect. It is for this reaſon, the Swediſh iron is preferred to the Spaniſh, as the latter is ſo apt to redſear, that is, to crack, between hot and cold. At a ſmall diſtance from this great ferruginous rock, an engineer lately cut away a conſiderable part of the hill, to improve the public walks, near the town of Bilbao, and as he made a perpendicular cut of about eighty feet depth, he diſcovered a vein of iron ore, lying in perfect ſtrata, which, at times, dipped in a direct line, and at others, obliquely, bearing ſome ſimilitude to the roots of a tree, occaſionally of an inch diameter, or the ſize of one's arm, with infinite variety of ramification, according to the more or leſs reſiſtance of the earth, to the paſſage of water; there being no doubt of this mine being alluvial. Here the very circumſtance has happened, which Don Antonio de Ulloa, judiciouſly imagined, would follow in the great hill of Potoſi, were it poſſible to lay it open and examine its contents.

It appears therefore, that the mines of Biſcay are in veins, ſtrata, and maſſes. The *Hematites* (*a*), ſo frequently ſeen in the hollow parts of the veins, are remarkable for their different ſizes and forms; when broken, every grain was found to have the ſhape of a ſtar, which proves ſolution, depoſition, and a ſlow cryſtalization. Theſe hematites are exceedingly heavy, and if calcined give proofs of containing two or three times more iron, than the ore of Somorroſtro, but of a brittle and intractable nature. Beſides theſe hematites, there are in this mine, many cavities of different ſizes, from two inches to two feet, lined with a great deal of ferruginous matter, from one to three fingers thickneſs; this coating appears to be a true emery, and from hence, iſſue cylinders of ſtriped hematites, as large as the feathers of a pigeon, two or three inches long, not unlike a hedgehog; others have various and fanciful appearances, that would make objects of ſingular curioſity in the collection of a mineralogiſt, or in a cabinet of natural hiſtory. I deduce from the whole, that iron is ſoluble by pure water, and its vapour, as much as by ſalts. There-

(*a*) Hematites, or blood-ſtone, is a hard mineral ſubſtance, red, black, or purple, the powder of which is always red, ſometimes of an intermediate figure, and ſometimes ſpherical, ſemiſpherical, pyramidical, or cellular, that is, like a honeycomb, conſiſting of pyramids generally ſmall, the apices of which, appear in a tranſverſe ſection in the centre. It contains a large portion of iron; forty pounds of this metal have been extracted from a quintal of the ſtone, but the iron is obtained with ſuch difficulty, and is of ſo bad quality, that this ore is not commonly ſmelted. The great hardneſs of hematites, renders it fit for burniſhing and poliſhing metals.--Dictionary of chemiſtry, tranſlated from the French. London, 1777.

fore,

fore, we need not be ſurprized at meeting even pure iron in ſome mineral waters. Iron ores vary ſo much in their forms, that more properly they have no determinate one, as ſometimes they are earth, ſtones, or grains; accordingly thoſe naturaliſts, who attend only to the external forms and appearances in claſſing of minerals, have been obliged to multiply the names of the ores, calling them ores in the form of peas, beans, coriander ſeeds, pepper corns, cinnamon, &c. which Mr. Cramer, not without reaſon, treats as ridiculous trifles (*a*).

(*a*) Dictionary of chemiſtry.—As in Navarre, and ſome of the ſouthern parts of France, they ſmelt iron ore, in ſmall furnaces, after a method ſimilar to that of Biſcay, a deſcription of their works by the ingenious tranſlator of the dictionary abovementioned, may perhaps not be unacceptable.

"The furnace conſiſts of a wide mouthed copper caldron, the inner ſurface of which is lined with maſonry a foot thick. The mouth of the caldron is nearly of an oval or elliptic form. The ſpace or cavity contained by the maſonry, is the furnace in which the ore is ſmelted. The depth of this cavity is equal to two feet and a half. The larger diameter of the oval mouth of the cavity is about eight feet, and its ſmall diameter about ſix: the ſpace of the furnace is gradually contracted towards the bottom, the greateſt diameter of which does not exceed ſix feet. Eighteen inches above the bottom there is a cylindrical channel in one of the longer ſides of the caldron and maſonry, through which the nozzle of the bellows paſſes. This channel, and alſo the bellows pipe, are ſo inclined, that the wind is directed towards the loweſt part of the furnace. Another cylindrical channel is in one of the ſhorter ſides of the furnace at the height of a few inches from the bottom, which is generally kept cloſed, and is opened occaſionally to give paſſage to the *Scoriæ*; and above this is a third channel in the ſame ſide of the furnace, through which an iron inſtrument is occaſionally introduced to ſtir the fluid metal, and to aſſiſt, as is ſaid, the ſeparation of the ſcoriæ from it. The greateſt height of the channel is at its external aperture on the outſide of the furnace, and its ſmaller height is at its internal aperture, ſo that the inſtrument may be directed towards the bottom of the furnace; but the ſecond channel below it has a contrary inclination, that when an opening is made, the ſcoriæ may flow out of the furnace into a baſon placed for its reception. When the furnace is heated ſufficiently, the workmen begin to throw into it alternate charges of

LETTER XXI.

Obſervations on the Copper Mine of La Platilla, in the lordſhip of Molina.

THE remarkable hill of La Platilla, which name it has had time immemorial, is about two leagues to the north weſt of the city of Molina, capital of the lordſhip of that name, on the river Gallo, thirty-one leagues from Madrid. The mountainous country in which it is ſituated, forms a chain of hills, where an intenſe cold reigns nine months of the year. Here the waters of rivers divide; the Gallo runs towards the Tagus on one ſide of the hill of La Platilla, and on the other, the waters fall into the Ebro.

charcoal and of ore previouſly roaſted. They take care to throw the charcoal chiefly on that ſide at which the wind enters, and the ore on the oppoſite ſide. At the end of about four hours a maſs of iron is collected at the bottom of the furnace, which is generally about ſix hundred weight. The bellows are then ſtopped, and when the maſs of iron is become ſolid, the workmen raiſe it from the bottom of the furnace, and place it while yet ſoft under a large hammer, where it is forged. The iron produced in theſe furnaces is of the beſt quality; the quantity is alſo very conſiderable, in proportion to the quantity of ore, and to the quantity of fuel employed. In theſe furnaces no limeſtone or other ſubſtance is uſed to facilitate the fuſion of the ore. We ſhould receive much inſtruction concerning the ſmelting of iron ore, if we knew upon what part of the proceſs or circumſtance the excellence of the iron obtained in theſe furnaces depends; whether, on the quality of the ore, on the diſuſe of any kind of flux, by which the proportion of vitreous or earthy matter, intermixed with the metallic particles, is diminiſhed; on the forging while the iron is yet ſoft and hot, as the Marquis de Courtevron thinks, or, on ſome other cauſe not obſerved."

The

The ſummit of this hill conſiſts of whitiſh rock, marked with blue and green ſpots, and is about half a league to croſs over from one valley to the other, the aſcent being equally ſteep on both ſides. It appears on further examination to have been formerly a maſs of vitrifiable rock, that has decompoſed into ſmall ſtone, pebble, ſand, and earth, which with decayed leaves, and roots of plants, form that cruſt of earth which now covers the rocky part of the hill.

In the mine, there are pieces of white quartz, which riſe above ground from thirty to fifty feet, full of fiſſures in every direction; they gradually decay towards the bottom, and form into fine ſand and earth. If any one compares the decompoſition of this quartz, with the phenomena of its transformation under ground, it is clearly diſcovered, that new bodies are formed there; for in the galleries of the mine, perpendicular fiſſures are not found in any uniform order, but a multitude of them, dividing the rocks without regularity, each diviſion afterwards ſubdivided into numberleſs ſmaller fiſſures, ſome of which are ſcarcely perceptible. The copper ore is formed in the interſtices, between theſe fiſſures, being blue, green, and yellow, mixed with a white limy earth. The largeſt fiſſure I ſaw was about three inches, and others only the breadth of a hair. Some have the ſuperfices only, covered with a thin blue, or green lamina,

others

others are ſpotted, partly blue, partly green, with all the gradations and tints from the ſky blue to the lapis lazuli, and from a light, to the deepeſt green. In ſome parts the aperture of the ſtone is totally filled, and forms a body equal to the breadth of the fiſſure; but whatever be the ſize, it is always compoſed of parallel lamina, as thin as an eggſhell, and ſucceſſively depoſited one over the other, by the water, which makes it indubitable, that this mine is alluvial; firſt formed by the decompoſition of the rocks, their recompoſition and moiſture.

This lamellated metal is compoſed of various plates, which I call primeval, ſome are chequered with ſmall hollow round grains, hardly ſeen with the lens, which I conceive are formed by bubbles of air, at the time of the decompoſition of the rock, and the forming the drivel of the metal. Theſe bubbles impreſs their figure on the lamina above, and occaſion thoſe beautiful grains, from whoſe variegated waves in the concentrical lamina, reſults that beauty of colour in the ſtone, when poliſhed, which ſurpaſſes thoſe of the eaſt, and would ſtand unrivalled, were its hardneſs, equal to the peculiarity of its ſhades.

Having examined one of theſe lamina, of a line in thickneſs, I found it to conſiſt of three and twenty leaves, the white calcareous earth was formed by the drivel of the

the copper, at the inſtant of decompoſition, and always follows it, covering the ore, as well in the green, as in the blue, and yellow, and when this white earth abounds, then the green ore is of a very pale hue. Breaking a piece of the ore, fiſſures are ſeen in the centre full of a green or yellow matter, and if there is any cavity, there are ſmall blue cryſtals, like fragments of ſapphires; others, green like emeralds, and true rock cryſtal, blue, or green (*a*). I broke one of theſe cryſtals that was fixed in the hollow part of a rock, and was ſolid without. It was as green as an emerald, in the centre, without the leaſt appearance of crack, or crevice, exteriorly; which I put into an acid, when all the green matter diſſolved, and the cryſtal remained perfect and entire, except a ſmall cavity in the centre. To explain the forming of this cryſtal, it is neceſſary to ſuppoſe, that the copper and calcareous earth were formed by the decompoſition of the rock, by ſome interior labour, and that the limy part mineralized the copper, and covered its atoms, without any communication of acids, fixed or volatile alkali, ſulphur or arſenic, for the matter being calcined does not yield any ſmoak, neither emit a ſulphurous ſmell, and expoſed to the air many years, does not decompoſe, acquire taſte, or change colour.

(*a*) Mr. Bowles ſays, that they are not ſapphires, nor emeralds, as thoſe two ſtones will diſſolve in acids; (*a fact which cannot be admitted*) like the green or blue colouring parts of rock cryſtal, and that thoſe of this mine will not diſſolve.---Introduccion a la hiſt. nat. &c. page 197.

When

When I find this calcareous earth cloſed within the fiſſure of any ſolid rock, and any part of it mixed with the mineral, while the remainder ſerves for its matrix, and that there is no other ſimilar earth thereabouts, I conclude that the aforeſaid calcareous earth is formed by the decompoſition of the rock which it is in. I ſay the ſame when I meet quartz mixed, and united with the rock, for on breaking it, the ſtone may be perceived half decompoſed, with ſome part of clay in the centre. Various ſtalactites are found in the excavations from this mine, which if well conſidered, prove the origin and diurnal formation of the copper, and decompoſition of the rock; one evidently perceives the mineral begins to be diſſolved, and fluid, or at leaſt in a mucilaginous ſtate, as its waves demonſtrate its flowing in a very gentle manner; but when rain water has forced a paſſage through the crevices, and meets with that kind of metallic drivel, before it is thoroughly dry, or acquired a ſufficient conſiſtence, it carries it forward, till it comes to ſome cavity, and there, drop by drop, it depoſits it, and forms the ſtalactite, ſometimes like a hollow reed, with bubbles in it, occaſioned by the air, but more frequently ſolid, from the viſcoſity of the matter. I obſerved, by analyſis, that thoſe ſtalactites of the moſt perfect green, contain ſix eighths of pure copper, and two eighths of calcareous earth; they are ſmooth, hard, and without ſmell, and do not decompoſe either in the air or boiling water;

water; but the green, blue, and yellow ſtones, found here, are the reverſe of the ſtalactites, diſſolving in the weakeſt acid. I do not call theſe blue, and green ſtones, cryſtals, becauſe they are not ſo, though they have that appearance, as is proved by experiments; nor do I ſay, that the green is a *malachite* (*a*), it not being yet decided, whether this is a green vitrifiable ſtone.

In the cracks formed by the decompoſition of the rocks, there is a great deal of cinereous and yellow clay, particularly where there is the moſt mineral. Theſe clays ſeem to precede the formation of the white and yellow calcareous earth, whoſe quantity is always equal to that of copper; ſo that if one is abundant, the other is ſo likewiſe, and vice verſa. This yellow earth deceived me at firſt, having a notion that its mixture with blue, formed the green ore, remembering to have ſeen the dyers compoſe their green colour, by an aſſemblage of yellow and blue, and that the phyſical cauſe of the greenneſs of leaves, proceeds from the mixture of thoſe two colours; and finally, that there are ſeveral plants, indigo, for example, whoſe juices are deſtroyed by fermentation, and the blue colour remains in the *feculæ*; but in all this I was miſtaken, as the blue ore does not mix with the green, they being of different natures; for

(*a*) Copper mixed with gypſum, or plaſter, Green. Is found at Ordal, in Norway, and there called Malachites.---Cronſted, ſect. cxcvi.

the blue appears, by experiments, to contain a little arſenic, ſilver, and copper, which, when fuſed, forms a kind of bell metal; but the green ore has not the leaſt atom of arſenic, and the copper mineralizes with the white earth abovementioned, without having the leaſt part of iron. This mine of Platilla, being of an adventitious nature, has no great depth, and lays in ſtrata. If the miners go deep, they are deceived; for though the mine may dip, in a ſlight degree, which perhaps in a thouſand years might form a rich vein, the ore is diſcovered, at preſent, from three, to forty feet depth at furtheſt.

Many have thought that mines are only found in barren diſtricts; but this is an error, that of La Platilla is a proof of it; for though the ore is ſo near the ſurface, the ground is covered with plants. The ſame happens in the quickſilver mine at Almaden, where they ſhoot up even within the precincts of the furnaces, in the ſame manner as in other places, where no mines are to be found. In that of La Platilla, where the veins are arſenical, and not above a foot of earth over the ore, the following trees and plants are conſtantly ſeen; the oak, holm, ciſtus, hawthorn, juniper tree, ſage tree, dwarf ciſtus, baſe horehound, bell flower, ragwort, cornflag, orchis, Bethlem's ſtar, *muſcari*, or fair haired hyacinth, milkwort, and above thirty other ſpecies,