An essay on the oryctography of Derbyshire, [...].

AN ESSAY ON THE ORYCTOGRAPHY OF DERBYSHIRE, A PROVINCE OF ENGLAND, BY THE CELEBRATED MINERALOGIST, M. FERBER. TRANSLATED FROM THE GERMAN.

Preface of M. Ferber.

MY chief object in publiſhing this work is to preſent to the public a ſeries of mineralogical obſervations, which I have made on one of the moſt intereſting counties of England.

My readers will, perhaps, cenſure me for not having quoted a great number of Engliſh authors, who have written before me on the natural hiſtory of their country, and for not having availed myſelf of ſeveral memoirs contained in the Philoſophical Tranſactions, which relate to the ſubject on which I treat; but all theſe works, which I had overlooked at London before I undertook the journey to Derbyſhire, afforded me but feeble aſſiſtance, and appeared in general of ſuch little importance, that I thought it would be rendering a ſervice to naturaliſts, only to preſent to them what I had myſelf beheld and examined.

I lie under great obligations to Mr. Whitehurſt, watch maker, at Derby, to whom Mr. Franklin was ſo good as to addreſs me. This ingenious man, who, by an unexampled aſſiduity, has obtained the moſt accurate phyſical knowledge of his county, not to mention the talents he poſſeſſes as a mathematician, was of the greateſt ſervice to me. It is to his advice and inſtruction that I am indebted for a great number of facts which probably would have eſcaped me, if he had not himſelf taken the trouble of directing my obſervations.

He alſo introduced me to Mr. Burdett*, a learned geographer, from whom I received the moſt exact ideas relative to the poſition of the places I intended to viſit, and every information I could wiſh concerning the natural geography of Derbyſhire.

I frankly confeſs, that without the aſſiſtance of theſe two perſons, I ſhould frequently have been at a loſs to account for a great number of phœnomena which were new to me. I was not aware, till then, that homogeneous mountains, and all the ſtratified mountains which I had examined, the internal ſtructure of which I was perfectly acquainted with from the inſpection of the mines, did not afford any example ſimilar to what I, for the firſt time, ſaw in Derbyſhire.

The great diverſity of the beds, and their diſpoſition often capricious, which I had not obſerved in any country, very frequently perplexed me, and I am convinced that the moſt ſkilful mineralogiſts will experience the ſame ſenſations.

The ſurface of Derbyſhire is not leſs affected by this ſingular organization of the ſoil; the Peak, the moſt elevated part of this county, affords ſome pictureſque views of great beauty; many authors have ſpoken of them in terms of admiration; and well executed engravings have been given by ſeveral Engliſh artiſts.

Liſt of the principal Works which treat of the Natural Hiſtory of England.

THE Natural Hiſtory of Lancaſhire, Cheſhire, and the Peak of Derbyſhire, by Charles Leigh. Oxford, 1700, folio.

* Among other excellent maps, Mr. Burdett has publiſhed a map of Derbyſhire, entitled, "Survey of Derbyſhire," 3 ſheets, 1762—67.

New Deſcription of England and Wales, with the adjacent Iſlands, &c. by H emann Moll, folio, plates. London, 1735.

A Tour through Great Britain, by a Gentleman, 5th edition, 4 vols. London, 1753, 8vo.

Geographia Magnæ Britanniæ, or correct Maps of all the Counties in England, Scotland, and Wales; and of the ſeveral Iſlands. London, 1748, 8vo.

A View of England, Scotland, and Wales, &c. London, 1769, 8vo.

A Deſcription of England and Wales. London, 1769, 8vo.

England illuſtrated, or a Compendium of the Natural Hiſtory, Geography, &c. of England and Wales. London, 1764, 4to.

England Diſplayed, by a Society of Gentlemen, reviſed by P. Ruſſel, Eſq. folio, 1769.

John Webſter, *Metallographia Anglica*, or an Hiſtory of Metals, 4to. London, 1676.

Sir John Pettus; *Fodinæ Regales*, or the Hiſtory, Laws, and Places, and the chief Mines and Mineral Works in England, Wales, and Ireland. London, 1670, plates.

An Eſſay towards a Natural Hiſtory of Cumberland and Weſtmoreland, by Thomas Robinſon. London, 1709, 8vo.

The Natural Hiſtory of Cornwall, by W. Borlaſe, folio. Oxford, 1758.

The Natural Hiſtory of Oxfordſhire, by Robert Plot. Oxford, 1677, folio.

The Natural Hiſtory of Staffordſhire, by Robert Plot. Oxford, 1679, folio.

The Natural Hiſtory of Northamptonſhire, by Thomas Morton, 1752, folio.

The Natural Hiſtory and Antiquities of Northumberland, and of ſo much of the county of Durham as lies between the Tyne and the Tweed, by John Wallis. London, 1760, 2 vols. 4to.

An Inquiry into the original State and Formation of the Earth, &c. by John Whitehurſt. London, 1778.

ESSAY ON THE ORYCTOGRAPHY OF DERYSHIRE.

Natural Geography of the Country.

The ſurface of England is, in a great meaſure, compoſed of various beds of earth and ſtones, which riſe in hills of very gentle acclivity, and every where cover the primitive mountains. There are very few ſummits of granite or ſchiſtus breaking through this natural cruſt of the earth, particularly in England, properly ſo called.

The higheſt mountains of primitive formation are ſeen in the northern parts of Scotland; but they will bear no compariſon with the lofty Alps of Swifferland.

Every thing ſeems to indicate that the level country ſurrounding theſe mountains, owes its origin to beds of earth depoſited by the waters which formerly covered its ſurface; the marine ſubſtances, diſcovered within theſe beds, clearly prove that the liquid, capable of depoſiting ſuch conſiderable bodies, can only have been the ocean itſelf.

Now if it were poſſible to lift up at once the various beds of which the level country is compoſed, in order to diſcover the primitive mountains on which it reſts, we ſhould ſoon behold the greateſt part of England inundated by the ſea, ſince the primitive mountains are in fact below its level; this country would then appear in its primitive ſtate, and the works in which nature has employed ages, would in a moment be annihilated.

Let us, in other reſpects, account for the formation of ſecondary mountains in the manner which beſt ſuits us, or date their exiſtence from the creation of the world; let

us argue whether their various beds owe their exiſtence to the inſenſible decreaſe of the ſea, or to ſucceſſive depoſitions; we ſhall always be compelled to acknowledge, that, wherever we find a vaſt extent of land diſpoſed in beds, it has been effected by the water which formerly covered the ſurface. Tranſient and local inundations may waſh away portions of mountains, and convey them into the vallies; but ſuch an operation will never give riſe to beds of ſufficient extent to form the ſurface of a whole country. The marine ſubſtances, which are almoſt always found in theſe beds, preſent no difficulty to me; on the contrary, their preſence and ſtill more their poſition ſerve to ſtrengthen my opinion.

According to our idea of the precipitation of earthly particles contained in any liquid, ſuppoſing the liquid always in a ſtate of perfect repoſe, beds produced by this means ſhould aſſume a poſition perfectly horizontal, even when the foundation or the primitive mountains, upon which theſe particles are depoſited, are of an inclined and rugged ſurface; the beds will only differ in bulk*.

In fact we ſee many ſtratified mountains, of which the various beds are perfectly horizontal; they commonly appear under the form of hills of little height, with rounded ſummits, and of tolerable extent: of this deſcription are the mountains in great part of Germany, Brabant, Flanders†, and thoſe on the coaſt of France oppoſite to England‡: in the latter country, the mountains of Staffordſhire§, Oxfordſhire‖, Yorkſhire¶,

* Nothing better explains this phenomenon than the operation of chemiſtry called waſhing; the veſſel uſed for this purpoſe may gradually ſwell out, or terminate like a cone; the earthly particles will always be precipitated in equal beds, be the liquid in ever ſo ſmall a degree of reſt.

† All the mountains I obſerved in my journey from Holland to France, through Brabant and Flanders, are merely hills, ſuch as I have deſcribed above. The environs of Bruſſells appear hilly; but theſe heights are only calcareous hills, or heaps of ſand, which the waters have depoſited in beds. Near Valenciennes are conſiderable beds of pit-coal, reſting on a black argillaceous ſchiſtus. In the country of Namur, the ſame ſubſtances are obſerved; a bog iron-ore in beds is alſo worked there. In the environs of Paris the hills are compoſed of calcareous ſtone, free-ſtone, or gypſum.

‡ From Paris to Amiens, I met nothing but hills of ſand, and an argil of a bright yellow: beyond Amiens, near Flixcourt, and thence to Calais, in the defiles between the hills, underneath the argil, which is about four feet thick, there is obſerved a calcareous earth, of a greyiſh colour and very friable, in beds nearly horizontal. Silex, in pieces of a kidney form, is found in great quantity in this earth; their poſition is likewiſe nearly horizontal; but a circumſtance that clearly proves this arrangement to be only owing to water, is that the largeſt pieces of ſilex, and conſequently the heavieſt, are found in the lower beds, and the leſſer in the upper. Moſt of them are round, ſome of an oval form; they have all a whitiſh cruſt, which is another proof that they had not their origin in the place where they are actually found. It is, however, a fact, that, at a very great depth below this friable earth, a calcareous ſtone is often found, compact, of tolerable hardneſs, and frequently chalk, full of ſilex in kidney-form pieces, which, according to every appearance, have had their origin in the chalk itſelf. Having croſſed the channel, on the whole coaſt of England, and from Dover to London, I obſerved the ſame organization in the beds.

§ Staffordſhire is remarkable for conſiderable beds, which are either calcareous or argillaceous; they are full of petrifactions, among which the *entomolithus paradoxus*, which is found near Dudley, is worthy of obſervation. This county alſo poſſeſſes valuable coal mines. The copper mines of Ecton belong to the duke of Devonſhire. At Utcheſter, or Utoxeter, there are forges which deſerve attention.

‖ In Oxfordſhire the vegetable earth, which is very argillaceous, reſts on a bed of calcareous earth, of a grey or white colour, which contains a great quantity of ſilex in kidney-form pieces, diſpoſed in horizontal beds. In proportion to the depth, this earth becomes more ſolid, and is inſenſibly changed into white chalk: beſides petrified ſhells, which are here found in great number, I have obſerved prickles of the ſea hedge-hog, and pieces of the ſkull of this worm. The chalk mountains of Graveſend, in the county of Kent, have the ſame conformation with reſpect to their beds as thoſe of Oxfordſhire; but to the preſent time we are unacquainted with the ſubſtance ſerving them for baſe.

¶ The metallic veins of Yorkſhire, which are rich in lead and copper, are met with in calcareous ſtone, black argillaceous ſchiſtus, or in free-ſtone, (*greet*) which ſeems in this part to be compoſed of ſmall grains of quartz; the veins running through free-ſtone are the richeſt.

the duchies of Cumberland, and Northumberland*, conſtantly preſent the ſame form.

But if, in many ſtratified mountains, we find the beds to have an inclined or oblique poſition, if we obſerve ruptures in the different banks, or conſiderable derangements in the interior of theſe mountains, we muſt naturally attribute it to poſterior cataſtrophes, among which muſt be reckoned the gaps or clefts to which the beds, left uncovered by the retreat of the waters, and drying up, were expoſed; earthquakes, partial inundations, changes in the courſe of rivers, which, hollowing out new channels in the lower beds, naturally occaſioned the upper ones to ſink in.

In Derbyſhire the poſition of the beds is ſeldom horizontal; they nearly all loſe themſelves obliquely, and ſcarcely ever preſerve the ſame direction. There are ſome parts where a portion of the beds has preſerved its original poſition, while the other part is ſunk in the valley. The beds which remain firm, and which appear to have been ſeparated by a violent convulſion, are not unlike ſteep rocks; ſo that the elevated part of Derbyſhire, which is called the Peak, may appear to an obſerver of little ſkill, rather as a country of granitic mountains, than a country of ſecondary formation. Notwithſtanding, upon a cloſer examination of the beds which compoſe theſe mountains, we ſhall eaſily diſcover that their primitive poſition was horizontal, and that it is to poſterior derangements alone that they owe their preſent figure.

From the city of Derby northwards, towards Lancaſhire and Yorkſhire, the land gradually riſes, and forms the upper part of the country, called the Peak†, where the winters are longer and more ſevere than in the plain. Following theſe apparent mountains on the Peak, we may eaſily perceive that they anciently formed a continual chain, which has ſince been broken off in ſeveral places; this obſervation will become more evident on deſcending into the ravines, where we find all the beds uncovered, and we ſhall be ſtruck with the perfect analogy between the beds which are ſunk down, and thoſe which are elevated. The Derwent, one of the moſt rapid rivers of England, together with the ſea, has moſt probably contributed to the revolutions which this country has anciently undergone, and of which hiſtory does not afford the ſlighteſt trace. We are therefore compelled to have recourſe to hypotheſes, which might be formed on this ſubject, the more ſo as the preſent ſtate of the country will afford ſufficent to ſatisfy the curioſity of the obſerver.

The ſuperior beds, in nearly the whole of England, are calcareous, and this ſubſtance is found under different modifications; it is found in the form of earth or ſtone; its variations are infinite, both in reſpect of colour and ſize, and the manner in which it is found blended with other ſubſtances.

In order to form a clear and accurate idea of the beds of Derbyſhire, it is neceſſary to divide them into two claſſes, a diviſion which nature herſelf ſeems to have eſtabliſhed.

* In the duchies of Cumberland and Northumberland, the hills are formed by beds of free-ſtone, black ſchiſtus, and lime-ſtone, which is alſo in this part the deepeſt bed. The copper mines of Cumberland are remarkable for native dentritical copper, which is ſometimes found. This country alſo poſſeſſes iron mines; the mineral is found under the form of argillaceous ore.

† The Peak is conſidered by the people of the country as a miraculous object, and many authors have ſpoken of ſeven wonders belonging to this mountain; the celebrated Hobbes has deſcribed them in the following verſe:

Ædes, mons, Barathrum, binus fons, antraque bina.

A very accurate deſcription of the Peak may be found in the following work; *a Tour through Great Britain*, vol. iii. p. 98, &c.

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The firſt claſs comprehends the beds which are common to the whole country, and which might be called *ancient* or *univerſal beds:* they are found every where in the ſame order, with the exception of ſome of the ſuperior beds, which have undergone a ſlight alteration.

The ſecond claſs comprehends the accidental beds, that is to ſay, the beds which are always found above the ancient beds, and which are conſequently of poſterior formation: they differ in nearly all the provinces. The ancient beds are found in the following order:

1. Freeſtone* (*greet* or *grit*). Its thickneſs is ſubject to great variation. It is commonly white or reddiſh, of a cloſe grain, and tolerably hard; ſmall grains of quartz are obſerved in it, which appear to be cemented by an argillaceous ſubſtance. This ſtone is employed in the making of highways, and for grind-ſtones. I obſerved, in the high road between Wirkſworth and Crumford Moor, in a heap of this free-ſtone, groups of vitreous ſpar, in ſmall cubes, in a matrix, which I conceive to be a gypſeous indurated earth; this ſpar probably came there by accident, perhaps from one of the neighbouring lead-mines; for the free-ſtone did not appear to contain any extraneous ſubſtance.

2. Black argillaceous ſchiſtus or ſlate†, (*ſhale*). Its thickneſs is from 140 to 150 yards, meaſured in the mine of Yateſtoop near Winſter. They could not inform me whether this ſchiſtus contained petrifactions or impreſſions of plants, although it perfectly reſembled that which covers the pit-coal throughout Derbyſhire, and which abounds with them. The miners call this ſchiſtus by different names, according to the difficulty they find in working it; they term it *ſhale*, *hard-beds*, *penny-ſhale*, and *black-beds*. In the midſt of this ſchiſtus, there are ſometimes found conſiderable fragments of lime-ſtone, black, and of a fetid ſmell, which is commonly beneath the ſchiſtus: I verified this obſervation near Wenſley, in the environs of Winſter, where the high road is cut through this ſchiſtus, and where all the beds are uncovered.

3. Firſt calcareous bed (the firſt lime-ſtone). Its thickneſs is from 35 to 50 yards. In the environs of Aſhford this ſtone is of great hardneſs, and does not contain any petrifaction; it is uſed as black marble. The ſofteſt parts of this ſtone, particularly thoſe expoſed to the air, exhale a diſagreeable ſmell when rubbed, and conſequently are a true ſtink-ſtone. I ſaw the ſame ſtone worked between Snitterton and Winſter, which contained no petrifactions, although it commonly abounds with them, particularly in bivalves‡. Near Wenſley, the common ſilex is found in kidney-form pieces, and in little fragments about two inches thick, as alſo at Aſhford, where theſe fragments are of a

* Mr. Whitehurſt calls it *millſtone-grit*: according to this author, the thickneſs of the bank is 120 yards; he ſays that it is compoſed of rounded grains of quartz, and ſmall fragments of the ſame ſubſtance, where the irregularities of the fracture are ſtill very viſible. See Inquiry into the original State and Formation of the Earth, &c. by John Whitehurſt. London, 1778, 4to. p. 147. (Note of the French tranſlator.)

† Mr. Whitehurſt calls it ſhale, or ſhiver, and the thickneſs of the bank, according to him, is 120 yards; he confirms what M. Ferber ſays concerning the impreſſions of vegetables. The ſprings which riſe in this ſchiſtus are all of a ferruginous nature. P. 148. (F. Tr.)

‡ Among the petrified bivalved ſhells, which are found in great quantity in this bed, are obſerved many anomias, the originals of which no where exiſt in the ſeas ſurrounding England.

Near Aſhford, Mr. Henry Watſon has diſcovered in the ſame ſtone, an impreſſion of a crocodile, in a good ſtate of preſervation.

Mr. Whitehurſt moreover tells us, that this ſtone is often interſected by very thin beds of ſlate. P. 149. (F. Tr.)

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more conſiderable bulk. It ſhould be obſerved that the ſilex of Wenſley, which is found in the midſt of black lime-ſtone, adheres ſtrongly to it, while that obſerved in the chalk of Oxfordſhire and on the ſea ſhore, has no adheſion to this ſubſtance. The ſilex which ſerves for ſtone-ware, of which there are ſeveral manufactures in Derbyſhire, comes from the coaſt of Norfolk.

4. Firſt bed of toadſtone (*toadſtone*, *dunſtone*, *blackſtone* in England, *whinſtone* in Scotland.) The name of toadſtone has been given on account of its black colour, ſpecked with white*. This ſtone, like thoſe of the ſame ſpecies, which we ſhall mention hereafter, does not contain any ore, and throughout Derbyſhire cuts the veins of metal†: the baſe is argillaceous, more or leſs indurated, for ſome pieces appear to be only an indurated argil, while others approach the jaſper in hardneſs. This ſtone is overſpread with little grains or globules of calcareous ſpar, the ſize and form of which vary; ſome are ſo ſmall, that to the naked eye they are loſt in the black ſubſtance of the ſtone itſelf; ſome are as large as a pea, and even as a bean. I have aſſayed this ſtone with acids, which diſſolved with ebullition, the parts of calcareous ſpar, without altering the ſubſtance of the ſtone itſelf, which after the aſſay was of ſufficient hardneſs to ſcratch glaſs, although being ſtruck with a ſteel, only emitted ſome faint ſparks. The ſubſtance of this ſtone, being ſtripped of all its calcareous parts, appeared to me refractory before the blow-pipe; with the aſſiſtance of ſalt of tartar, I converted it into a blackiſh ſcoria; which ſeems to indicate a ſiliceous principle, though it does not poſſeſs the hardneſs of ſiliceous ſtones‡.

The thickneſs of the firſt bed of this ſtone is commonly from 14 to 16 yards; but what proves the great variation in the thickneſs of theſe beds is, that in *Blackhillock*, a very conſiderable mine near *Tideſwall*, a well has been dug of 160 yards in depth, in this ſtone, without paſſing through it. In the ſame mine, about 800 fathoms in the principal well, towards the ſouth, the thickneſs of the *toadſtone* has been found to be of 40 yards, and towards the north, about 300 fathoms from the ſame place, it was only three yards.

5. The ſecond calcareous bed (the ſecond or the grey lime ſtone). Its thickneſs is 33 fathoms; there are two kinds, the one ſoft, which being rubbed, yields a fetid ſmell; it is uſed for the moſt part to make lime; the other harder, which is uſed for

* M. Jars ſays becauſe it is pretended that living toads have often been found in it. Voyage Metall. tom. i. p. 546.

† M. Faujas de St. Fond, who has juſt publiſhed an excellent work on trapp, has proved that certain ſpecies of toad-ſtone contained metallic veins; as the ſpecies cited by M. Faujas is known under the name of *cat-dirt* at Caſtleton, and as he has been in the mine himſelf, there remains no doubt whatever of the fact. (F. Tr.) This is a miſtake, for cat-dirt is not toad-ſtone, being on the contrary a ſoft blue lime-ſtone, impregnated with ſulphur, as the very name *cat-dirt* (*merde du chat*) muſt imply to an Engliſh reader. J. P.

‡ Mr. Whitehurſt gives us the following deſcription of the toad-ſtone:

"It is a blackiſh ſubſtance, very hard, and full of little cavities like metallic ſcorias, or the lava of Iceland; chemical analyſis proves that it poſſeſſes the ſame principles. Many of theſe cavities contain ſpar (calcareous); others are empty. It is not compoſed of layers like many other ſtones, but it always preſents a ſolid and uniform maſs, which breaks in all directions, and which never contains either ore, nor mineral or vegetable productions. The beds of toad-ſtone are not met with every where, as the calcareous beds, and the variation in the thickneſs of the ſame bank, clearly prove its origin to be volcanic."

Another reaſon which induces Mr. Whitehurſt to think that the toad-ſtone is a volcanic production, and of a later formation than that of the calcareous beds, and others, is that the perpendicular clefts which are obſerved in the calcareous beds, are filled with toad-ſtone; conſequently the calcareous beds exiſted perfectly formed and cleft before the toad-ſtone. (F. Tr.)

many

many domeſtic purpoſes, like marble*. Theſe two varieties of ſtone are full of all kinds of petrifactions, beſides a great number of madrepores, among which may be diſtinguiſhed the *madrepora flexuoſa* of Linneus; and there are found a great number of cameas of a ſurpriſing bulk. In ſeveral places I found this grey calcareous ſtone changed into grey ſilex, which contained handſome entrochites, larger, but in other reſpects ſimilar to thoſe ſeen at Cubach, in the duchy of Blanckenbourg.

6. Second bed of toadſtone†; it perfectly reſembles the firſt; the thickneſs of the bed is 46 yards. In the mine of Hubber dale, this ſtone had loſt its ordinary hardneſs to ſuch a degree, that it perfectly reſembled ſoft clay.

7. Third calcareous bed‡; it is grey and analogous to the ſecond; the thickneſs of the bed is 70 yards.

8. Third bed of toadſtone; it commonly reſembles the firſt and ſecond, and its thickneſs is 22 yards. In the mine of Hubber-dale, this ſtone was of the conſiſtence of ſoft clay, of a greeniſh colour; it was full of ſmall pieces of black argil and calcareous ſpar, in veins; it is here called *channel*.

9. Fourth calcareous bed (the fourth lime-ſtone); it is grey like the preceding, and is found at the greateſt depth. Its thickneſs is at preſent unknown, though in many places attempts have been made to paſs through it: at Gorſey-dale, Bacon-Rake, Maſſon, and Middleton, in the environs of Wirkſworth, it has been pierced to 40 fathoms without finding the bottom.

The different beds of limeſtone and toad-ſtone, which we have juſt deſcribed, are often interſected by beds of argil, from one to four feet in thickneſs; but as this argil appears to be formed in the horizontal cracks or clefts of theſe ſtones, it cannot be placed in the rank of ſubſtances which form regular beds. The quantity of pyrites in pieces of kidney-form, found in theſe argillaceous beds, has perhaps ſome ſhare in the heat obſerved in all the ſprings that riſe there; or elſe, do the calcareous beds contribute towards it§?

Before proceeding to the deſcription of the accidental beds, I conceive it neceſſary to ſpeak of the veins which are found in the ancient beds.

The direction of metallic veins in the ancient beds, is generally very regular in all the mines in Derbyſhire; the ſalband of theſe veins is diſtinct; its thickneſs is from one to ſeven ells. I found that the greater part of the veins proceed between the 8th and 9th hour, or according to the Engliſh compaſs between the 12th and 2d. They are either perpendicular or inclined; very few are horizontal. I here confirmed what I have ſaid in the *Memoirs on the Mineralogy of Bohemia, with reſpect to the Veins of Metal*, that they were not met with in primitive mountains alone, but alſo in ſecondary mountains, and that conſequently the name of *veined mountains* did not belong excluſively to primitive mountains. It is eſſential to remark in this place, that the veins of Derbyſhire vary in almoſt every bed. In a freeſtone and argillaceous ſchiſtus, when theſe two ſubſtances met together, the veins which commonly riſe to the ſurface are conſtantly without ore; the contrary is obſerved in the four calcareous beds, which, under

* Mr. Whitehurſt obſerves, what M. Ferber has perhaps forgotten, that the calcareous ſtone which compoſes the beds of Derbyſhire is generally foliated; which ſufficiently indicates the manner in which it has been formed. The thickneſs of the ſecond bed, according to Mr. Whitehurſt, is 25 fathoms. F. Tr.

† Mr. Whitehurſt informs us that the toad-ſtone of the ſecond bed is more compact than that of the firſt, and that there are no cavities in it. P. 150.

‡ The thickneſs of this bed, according to Mr. Whitehurſt, is 30 fathoms; this ſtone contains fewer petrifactions than the former, and ſeems of a white colour. F. Tr.

§ See Ferber, Letters on Mineralogy, p. 187, of the German edition.

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the ſame circumſtances, are almoſt always extremely rich. The three beds of toadſtone*, though they always accompany limeſtone, never contain ore; and as I have remarked before, always cut the veins. The following is an example: When a vein has been worked in black calcareous ſtone, the ore is loſt ſo ſoon as the toadſtone is approached, and the ſame vein does not re-appear till the whole bed of toadſtone has been cut through; the vein is again worked, and if it prove of ſufficient richneſs, it is purſued, under the ſame circumſtances, to the fourth calcareous bed, which has never yet been paſſed through. This phenomenon is without doubt, one of the moſt extraordinary and ſingular of its kind, and to account for it, is not leſs difficult. To enquire whether the three beds of toadſtone exiſted before the formation of the veins, or to attempt to determine whether they have always preſerved the ſame ſolidity, would be engaging ourſelves in hypotheſes which would lead to nothing; what I have ſaid above, may be confirmed every day in the lead-mines of this country. My opinion is, that the toadſtone has only choaked up the veins, which conſequently have ramified, and probably re-united in one of the lower beds; this ſuppoſition will not appear venturesome to perſons concerned with the working of mines; for experience proves, that veins which fork off, leaving their former direction, very often unite at a great depth, and then reſume their former courſe. Another ſingularity with reſpect to beds of toadſtone, which ſeems to contradict my opinion, is that this ſingular ſubſtance divides the different beds, ſo that a gallery inundated in the firſt bed, will not be of the leaſt prejudice to the works carried on in the ſecond; and the labourers in a lower gallery will be perfectly dry, while all the upper galleries are under water.

The accidental beds, or thoſe found above the accidental beds, differ extremely throughout Derbyſhire, and each diſtrict preſents ſome particularity. The following came under my obſervation:

1. Red marl reſting on ſtriated gypſum, in a quarry of Chellaſtone, three leagues from Derby.

2. A mine of argillaceous iron, that is, a ferruginous argil of a reddiſh colour, more or leſs indurated; it is commonly found above the pit-coal. I ſaw ſome at Stanſley, in a coal-mine, which appeared under the form of a very weighty bluiſh argil, and ſeemed to contain much iron; it is called *ironſtone*. As far as I could learn, no uſe is made of it; and at the time I was in Derbyſhire, there was not one foundery, nor even forge throughout the whole country. What is there called *iron-work*, or *iron-mill*, conſiſts of eſtabliſhments, where, by means of cylindrical machines, bars of iron are flattened, which are afterwards cut into very narrow fillets for the different manufactures at Birmingham. Theſe eſtabliſhments are at Derby, Cheſterfield, Godnor, Barton-fields, Newmills, Pleſtly, Stavely, &c.

3. Manganeſe in kidney-form pieces, in the clay above the pit-coal, in ſeveral places.

4. Pit-coal. It is found in very great quantity in the flat country ſurrounding the Peak, and is worked in ſeveral places. This coal is commonly found at a little depth beneath the vegetable earth, which, in theſe parts, is rather marly; the roof is a black argillaceous ſchiſtus, which in colour and compactneſs much reſembles the ſchiſtus which forms the ſecond layer of the ancient beds. Yet, on a little examination of this ſchiſtus, we find that it differs materially from that of the ancient beds; for it is always found above free-ſtone which forms the firſt bed, and between the dif-

* It is very ſurpriſing that ſo ſkilful a mineralogiſt as M. Ferber ſhould make no mention of the great reſemblance between toad-ſtone and trapp. F. Tr.

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ferent banks of coal; and this position alone indicates a formation posterior to that of the ancient beds. Independent of this, it contains a great number of impressions of plants and other vegetables, while in the ancient beds none are ever discovered. Most of these vegetables are of the class of ferns, and they have a great analogy with the ferns of America, described by father Plumier. The same impressions of vegetables are sometimes observed in the marly beds which cover the coal in several places.

5. Foliated free-stone, (*slate*) of an extremely fine grain, and of a greyish yellow colour. I saw this stone worked in an open quarry near Matlock; it is found in large flags, which are used to pave the interior of houses, especially brew-houses. I am not quite certain whether this free-stone belong to the accidental beds, or if it should be regarded as a simple variety of the free-stone which forms the first bank of the ancient beds, although it be of a finer and more compact grain. I have the same doubts with respect to a soft free-stone of a grey colour, which is found in beds of little thickness above coal, in Derbyshire, Staffordshire, and at Newcastle, and which is there called *free-stone* or *sand-stone;* it is very probable that this stone owes its origin to particles which have been detached from the ancient free-stone, and carried by the waters to this place.

6. *Rotten-stone;* it is a kind of tripoli, full of calcareous particles; it is of a brown colour, of a very fine grain, and is particularly used for polishing tin, crystal, &c.; it is always found above coal. In M. Davila's catalogue, this substance is described under the name of *creta fusca*.

7. Stuff-stone, stuff or tuff. This name has been given to a bank of calcareous stone of little thickness, and of very fine grain, though porous, which is found at the surface, in the environs of Winster. This stone must not be confounded with the stuff-stone of Hubber-dale mine, which belongs to the ancient beds.

8. In the environs of Matlock-Bath, there is observed a considerable bed consisting of vegetables incrusted with a calcareous matter, which has been deposited by the warm springs issuing from the mountains. In some places this substance is eight yards thick, and of sufficient solidity for buildings, in which I have seen it employed. This bed which daily increases in thickness, covers all the hills of black calcareous stone, in the environs of Matlock. In the interior of this bed, the most beautiful incrustations are found, as well as mamellated stalactites of a very handsome form; I have even seen petrified shells, and lithophytes which were probably detached from one of the neighbouring calcareous banks, and which consequently came there only by accident. I observed the same productions in the channels formed by the water flowing from the mountain, and in which it is often seen of the height of three feet; the bed of these channels was full of mamellated stalactites in the form of cauliflowers. The hot baths of Matlock are much celebrated; they also possess the property of incrustrating whatever is exposed to them.

Such is the order in which the ancient or universal beds, and those which I call accidental, appear in Derbyshire. It remains for us to fix our attention upon the consequences which have followed their sinking obliquely, and the violent ruptures, which is the more necessary, as it is the only means of explaining a great number of phenomena, which are peculiar to all countries, of which the organization is similar to that of Derbyshire, and since we shall thence be enabled to conceive how the inferior layers of certain beds, are sometimes found above, while the superior layers of the same bed are observed in the vallies. But as throughout Derbyshire the beds are seldom horizontal, but nearly all lose themselves obliquely under ground, or termi-

nate at the ſurface, there ſhould naturally follow a very great variety in the ſtones found above the ſurface, particularly in a country of no conſiderable extent.

In ſome parts the oblique beds are covered by accidental beds, which increaſes the ſpecies of ſtones or earths found on the ſurface. The effect of a violent rupture is obſerved near Matlock High Tor, where a portion of the beds is ſunk to a depth of more than 40 yards; there is every appearance that the Derwent, which at preſent paſſes over the place where the rupture happened, was the cauſe. This falling in has, however, produced a great advantage to the country, ſince the valley which formerly was frequently expoſed to the inundations from the river, is now more elevated, and is become a very fertile country.

We can eaſily imagine that the portion of the beds which remains regular, muſt be more elevated than that which is ſunk, as we may be convinced, by the calcareous beds which are ſeen uncovered; but without admitting of a rupture, the mere ſinking may always occaſion the ſame phenomenon, if the place which ſerves them for a baſe affects a ſurface more or leſs unequal.

At the ſummit of the mountain called the *High Peak*, the two firſt ancient beds, that is, the reddiſh free-ſtone and the black ſchiſtus are altogether wanting, and on the middle height the ancient beds are uncovered; but in the low part of this mountain, the *Low Peak*, between Wirkeſworth and Winſter, the free-ſtone and ſchiſtus re-appear of conſiderable thickneſs, and ſtill lower towards the town of Derby, they are obſerved at a conſiderable depth, again covered by accidental beds. At Moneyaſh there is no indication of the four firſt ancient beds. The grey calcareous ſtone, which in the natural order, forms the fifth bed, there is near to the ſurface. In Hubber-dale mine, which is a league and a half from Moneyaſh, the pits are dug through grey calcareous ſtone; and the ore worked there, which is principally lead, is only found in the third calcareous bed. Near Aſhford, a little town a league from Moneyaſh, and which three hundred fathoms higher than the latter place, the firſt calcareous bed upon whi c the black ſchiſtus reſts, is terminated at the ſurface.

Of the Natural Caves of the Peak.

THE calcareous covering of the Peak, which traverſes the greateſt part of Derbyſhire, contains a great number of caves of different ſizes. Theſe caves, which are all in the ſecond calcareous bed, moſt probably owe their origin to the filtration of water from without, or to ſubterranean ſprings; moſt of them abound with calcareous ſtalactites, of various forms and colours; their ſize is alſo very different; thoſe moſt eſteemed are of a beautiful white, or have lively-coloured veins; theſe latter are ſtreaked with yellow, grey, and milk-colour: they are worked at Aſhford, and I have ſeen vaſes made of ſome of the moſt beautiful pieces.

There are many deſcriptions of theſe caves, in which are fancied, in the different forms which theſe ſtalactites have aſſumed, reſemblances oftentimes ridiculous, with human figures, or animals, of which perſons in many parts of Germany, eſpecially at the Hartz, in the celebrated grotto called *Baumannſhohle*, would have perſuaded me. Without farther notice of theſe wonderful deſcriptions, I ſhall content myſelf with mentioning the moſt remarkable caves of the Peak.

Poole's Hole.—This cave is near Buxton, and is rich in ſtalactites; it is ſaid to be half an Engliſh mile in length, and is traverſed by a rivulet, which makes a great roaring.

The Great Cave of Caſtleton, called the *Devil's A—e* in Engliſh.—The diameter of this cave is computed at 150 feet. It is pretended that it communicates with *Elden Hole*,

Hole, another cave, ſix or eight leagues from Caſtleton, which is nearly perpendicular, and which, as it is ſaid, enlarges conſiderably towards the bottom.

Hoſen's Hole and *Burmforth Hole* are two caves near Stony Middleton.

Lath-Kill Arſe.—This cave is obſerved at the diſtance of a league from Moneyaſh, in the valley of Lath Kill, at Moneyaſh Moor; it is not far from the quarry of grey marble, an appellation given to the grey lime-ſtone forming part of the ancient beds. This cave is not ſo large as that of Caſtleton, yet, after heavy rain, there flows from it ſuch a prodigious quantity of water, that the whole valley of Lath Kill is often overflowed.

Of the Hot and Intermitting Springs of the Peak.

THE Peak abounds in hot ſprings, which take their riſe in the gaps of the mountain; moſt of them are unknown, becauſe they are found in parts little frequented, and remote from the high road. The moſt remarkable are,

The Hot Baths of Matlock, on the ſide of the calcareous hill. There are two; the firſt is *Matlock Old Bath*, of which the temperature is 68 degrees of Farenheit, and Matlock New Bath, the temperature of which is one degree hotter: the water of both theſe baths contains calcareous particles, which incruſt any objects expoſed to the water, as well as the parts over which it runs, as I obſerved ſpeaking of the accidental beds. During the fine weather, the baths of Matlock are much frequented.

Quarn, or *Quarnden*.—A ſmall place, known by its acidulated waters, which attract many perſons to it in ſummer.

Buxton has a warm bath, the ſmoke iſſuing from which ſeems to indicate a ſtronger degree of heat than it really poſſeſſes. Near the bath I obſerved many other chalybeate ſprings, of which no uſe is made.

Tideſwell.—Here is one of thoſe intermitting ſprings, where the water only iſſues by intervals: when the baſon which receives all the water has nearly loſt the third part by the continual flowing out, which is done in ten minutes, the water is ſeen to flow again from the oppoſite ſide with ſo much force, that in five minutes the whole of the baſon is filled. Some authors, without reaſon, have imagined a ſubterraneous communication between the refluent ſource of Tideſwell and the ſea, and would, by the effect of the flux and reflux, account for this phenomenon. I am inclined to think, that in the interior of the mountain there are great cavities, the air of which acts on this ſpring.

Of the Quarries of Derbyſhire.

THE ſtones uſed for the conſtruction of buildings and high roads, are taken from the calcareous beds; ſometimes the reddiſh free-ſtone is employed for the ſame purpoſe; this depends upon the ſituation and means of the proprietor. The houſes in general are built of brick, and covered with ſlate. In many parts I ſaw the foliated free-ſtone employed, which is often obſerved between beds of pit-coal, and which is particularly uſed for the paving of magazines, cellars, and other ſimilar conſtructions.

The manner by which grinding-ſtones are here procured, appeared to me remarkable enough: the ſize is firſt traced on one of the beds of free-ſtone, and all the ſtone about it removed; when the general form is obtained, ſeveral horizontal holes are pierced, half a foot into the ſtone towards its baſe, according to the intended thickneſs; dry pieces of wood are driven into theſe holes, and in a few days ſwelled by humidity, they cauſe the ſtone to ſplit.

The quarries of lime-ſtone employ a great number of workmen, particularly in the environs of Buxton: grey and black calcareous ſtone are indifferently uſed, principally

thoſe pieces which are not handſome enough for ornament like marble. Lime made from black calcareous ſtone, containing a vaſt quantity of ſhells, is here preferred to that made from the grey.

The black marble obſerved near Aſhford, is procured from the firſt calcareous bed, of which it is only a variety; it is diſtinguiſhed by a greater ſolidity, and a beautiful black. The grey marble, which is derived from the ſecond calcareous bed, and the quarry of which is near Lath Kill-Dale, two leagues from Bakewell, contains a great number of entrochites; it ſometimes has red veins, which gives it a pretty appearance. Theſe marbles are worked in conſiderable quantities in the mills eſtabliſhed near Aſhford, where, by the means of water, the marble is ſawed and poliſhed. Near the ſame place I ſaw a manufactory where the beautiful fluor ſpar, of the colour of the amethyſt, was worked. It is found in almoſt every lead mine, and the largeſt and handſomeſt pieces are uſed to make vaſes. I have ſeen the ſtalactites which I mentioned above, uſed for the ſame purpoſe, which employs a great number of workmen in the towns of Derby, Winſter, Matlock, &c.

At Chellaſtone, about three miles from Derby, I obſerved a quarry of plaſter of Paris. The ſurface of the fields near this quarry, was covered with a greyiſh argil, full of fragments of a fetid ſtone, and a ferruginous oker in indurated pieces of a kidney-form. Below this argil there was a bed of reddiſh marl, three yards thick, the beds of which neareſt to the ſurface were friable, and ſerved for manure; but the remainder only preſented a marly ſtone of tolerable hardneſs, of which no uſe was made. Under the marl was a bank of plaſter ſtone, nearly horizontal, eight ells in thickneſs. In ſeveral places, this ſtone was tolerably hard, and reſembled a white tranſparent alabaſter, which took a very fine poliſh: ſome pieces were ſpotted with red, and traverſed by marly veins, from the ſuperior bank; the remainder of the bank was a ſtriated gypſum, which is particularly uſed for moulds in ſeveral porcelain manufactories.

Derbyſhire abounds with coal, which is every where worked. The mine of Alferton is the moſt remarkable; it is furniſhed with a good ſteam engine, to carry off the ſubterraneous water; this mine is ten leagues from Aſhford: that of Stanſby and Simonfield, had two ſteam engines; one was of the ordinary form and conſtruction; the other the invention of Mr. Barber, the proprietor of the mine, differed a little*. The pits to deſcend into this mine are perfectly round, and wholly built of brick; they are deſcended by means of a ſmall caſk, in which the perſon ſupports himſelf upright, or elſe ſeated on the chain. I obſerved in this mine four layers of coal not interſected with ſlate, as were nearly all the others, but with very thick beds of indurated argil; this ſubſtance was variouſly coloured, and often foliated; what is here called *iron-ſtone*, is only an argil of a dark brown, very heavy, and ſeems to contain much iron. The two upper layers of coal at Stanſby are not worked, becauſe it is generally believed here, that they are of inferior quality to thoſe found at a greater depth.

The mine of Stanſby is one of the deepeſt that are known, and I found the depth to be 95 yards; the lower beds of coal were only four feet thick, and all the gaps were

* The ſteam engine of Mr. Barber, differs principally from others, by the ſteam acting horizontally, while in the others it only acts vertically; it is the ſame with reſpect to the cold water which is introduced into the boiler by the ſide. Almoſt every coal mine in England is provided with one or two ſteam engines, and every proprietor has attempted ſome improvement. The *Dictionary of Arts and Sciences, fol. London*, 1763, may be conſulted on this ſubject, in which the moſt ordinary ſteam engines are well repreſented.

Steam engines are certainly of great utility in a country where coal is abundant; but in countries wanting this combuſtible, and where wood muſt ſupply its place, as I have obſerved at Schemniz, in Hungary, it generally becomes too expenſive.

filled

filled with pyrites; I was even aſſured that a conſiderable heap of galena had been found in the midſt of this coal.

Near this mine I ſaw the method employed to reduce the coals to what is called coak; but as the method here followed is well enough known, and even well deſcribed in the Journals of the Arts and Trades, publiſhed by the Royal Academy of Sciences, I have conſidered it ſuperfluous to detail it.

Lead and calamine Mines, which I obſerved in Derbyſhire, aſcending the Peak.

Aſhborn.—The mines of this little place, which is twelve miles from Derby, are of no importance, and I did not viſit them.

Wirkeſworth.—A ſmall town between Derby and Matlock Bath; in this place are a great number of lead mines extending as far as Matlock-Bath; in all theſe mines the ſlate has been cut through, to arrive at the veins of metal which interſect the firſt and ſecond calcareous bed; the labour is performed in galleries which have been excavated in this ſtone. In general at the ſurface there is found cellular calamine*, more or leſs ferruginous, of a brown or dark grey colour; ſometimes mixed with ferruginous oker. At a greater depth the ore is found under the form of compact galena, or *bleyſchweif:* there is one inſtance of calamine having been worked, at the depth of 60 yards; for theſe two minerals are never found in the ſame vein. The ordinary gangart in the mines of Wirkeſworth is the calcareous ſpar, and the different ſpecies of calamine found there, contain calcareous particles; hence ariſes the effervescence which they make with acids. Near Wirkeſworth is a mill for the purpoſe of refining calamine, for the braſs manufactures of Birmingham, where the greater part of the Derbyſhire calamine is uſed. The ore of white lead is ſeldom found in this mine. The mineral is extracted here as in other countries, by the means of a machine with horſes, the conſtruction of which we ſhall hereafter give.

Middleton or *Manny Middleton.*—At a little diſtance from Wirkeſworth, in a vein of this mine, ſome hepatic copper has lately been diſcovered, containing calcareous particles; this mineral is covered with malachid in little ſtars.

Maſſon.—Near Wirkeſworth, in a lead-mine, called Bacon-Rake, the miners have actually worked into the fourth calcareous bed, and have already penetrated to the depth of 30 fathoms.

Crumford.—A ſmall town in the neighbourhood of Wirkeſworth: its lead mines are of little importance; but its juriſdiction *(Wapentake)* extends over all the preceding mines.

Matlock.—This place poſſeſſes many lead-mines; the moſt conſiderable are *Hag-mine*, near Matlock New-Bath, and Old Dimple-mine, near Matlock Old-Bath. The mines of *Lady-gate* and *High Tor Rake*, preſent nothing remarkable.

I deſcended into *Hag-mine* by a pit which reſts on the gallery which has been excavated in the ſecond calcareous bed, to the depth of 150 yards. The principal vein, the direction of which, according to the Engliſh compaſs is between the eighth and ninth hour, varies very little from the weſt to the eaſt; it is about two feet thick, but it often ramifies, which renders its working rather difficult. The water is drawn off by a very ſimple pump, which conveys it to the gallery, whence it is carried off by

* M. Jars ſays, that the beſt calamine of Wirkeſworth is full of little cavities, reſembling thoſe of a bee-hive.—F. Tr.

channels to the Derwent. In all the mines in the environs of Matlock, the firſt calcareous bed and toadſtone are conſtantly obſerved; the actual labour is performed in the ſecond calcareous bed: the gangarts which accompany the mineral of the principal vein of Hag-mine, are as follow:

1. White calcareous ſpar, tranſparent, with rhomboidal fracture.
2. White calcareous ſpar, tranſparent, in hexaedral cryſtals, or boar's-tooth. (*Dog-tooth ſpar.*)
3. Compact calcareous ſpar, of a milky white, of little or no tranſparency. This ſpar is the ordinary gangart of the lead mines.
4. Calcareous ſtalactites (*Water Jerl*, *Dropſtone*) of a milky white, or with yellowiſh ſtreaks; found in nearly all the galleries, commonly attached to the roof, but of little thickneſs.
5. White fluor ſpar, cryſtallized in tranſparent cubes, ſometimes with a yellowiſh ſurface.
6. Fluor ſpar, of the colour of amethyſt, in compact fragments, or cryſtallized in cubes, in a gipſeous earth. Many of theſe cubes are hollow, and open at top.
7. Caulk, which is alſo called *calk*, *cawk*, *kewel*, *keble*, &c. It is a kind of gipſeous earth, very white, heavy, extremely fine grain, and as eaſily cut as chalk; this earth is one of the moſt common gangarts in the mines of Derbyſhire: in Hag-mine it is commonly found in ſmall groups compoſed of ſpherical leaves, like the heavy ſpar of Tſchopau, in Saxony, and the ſurface of which is mamellated; it is uſed in the manufactures of braſs at Birmingham, where, probably, it ſerves for moulds; it is alſo pretended that *caulk* renders the regulas of antimony more ductile, and of a cloſer grain.
8. Compact galena in tolerably large pieces, ſometimes found in caulk or white calcareous ſpar.
9. Polyedronal galena, often reſembling ſmall buttons.
10. Octaedronal galena; this ſpecies is uncommon.
11. Compact galena. (*Bleyſhweif* by the Germans), *ſteel ore* by the Engliſh.
12. Blende, in the form of buttons.

The pit by which I deſcended into *Old Dimple mine*, and which joined the vein, was 15 fathoms in depth: the direction of the vein was almoſt perpendicular, and proceeded between noon and the firſt hour; it branched forth two narrow veins. The miners work in the ſecond calcareous bed, as in *Hag-mine*, and the ſuperior beds were exactly the ſame. The following are the gangarts of this mine:

1. Milk-white calcareous ſpar.
2. Tranſparent calcareous ſpar in cubes.
3. Calcareous boar's tooth ſpar, in hexaedronal cryſtals, hollow, in conſiderable groups.
4. Calcareous ſtalactites.
5. White fluor ſpar, in cubes, covered with pyrites.
6. Caulk.
7. Pyrites upon fluor, or encloſed in galena.
8. Ferruginous oker, of a brown colour, containing lead and calamine.
9. Black-blende, compact, and in buttons on groups of ſpar. This blende was formerly employed for the manufacture of braſs at Briſtol; but ſince calamine has been found ſo abundant in nearly all the mines, it is ſcarcely ever uſed.
10. Compact galena, in pieces of a tolerable ſize.

Snitterton.

Snitterton.—The lead mines in the neighbourhood of this ſmall town, are found in the firſt calcareous bed.

Aſhover.—*Gregory-mine* is the moſt remarkable; it contains compact galena, accompanied with *bleyſhweif* on calcareous ſpar, and a ſingular cryſtallization of pyrites in very thin plates, notched on the edges like a cock's comb.

Wenſley.—The mines of this place are under the juriſdiction of Winſter.

Winſter.—Seven miles from Wirkeſworth. The thickneſs of the ancient beds at this place, was as follows:

1. Free-ſtone. The thickneſs is variable; ſometimes it is found covered with a calcareous ſtone of a yellowiſh grey, which is here called *Stuff-ſtone*, &c.

2. Slate	- -	74 fathoms.
3. Firſt calcareous bed	-	17
4. Firſt toadſtone	-	17
5. Second calcareous bed	-	18
6. Second toadſtone	-	24
7. Third calcareous bed	-	40
8. Third toadſtone	-	10
9. Fourth calcareous bed		
Thickneſs unknown.		200 fathoms.

Moſt of the mines of Winſter were overflowed when I viſited them; thoſe which merit ſome attention, are,

Yateſtoop or *Yateſtock*: the galleries of this mine are in the firſt calcareous bed; the thickneſs of the ſlate reſting on this bed, was about 140 yards In all the galleries I obſerved the white calcareous ſpar to be the moſt common gangart.

Placket and *Plato.* Theſe two mines are in the ſecond calcareous bed; in the latter I obſerved, within the vein, a kind of heavy ſpar, of a white colour, ſometimes reddiſh, encloſed in *caulk*; it appears that the caulk owes its exiſtence to the decompoſition of this ſame ſpar. It was thought for ſome time, that this ſpar contained lead; but the aſſay I made with the blow-pipe did not give the leaſt indication.

Portway or *Portaway.* The principal vein of this mine is found in the ſecond calcareous bed; its direction is very inclined, and is, therefore, according to the language of the Engliſh miners, at *pipe*, or *pipe-work.* In this vein I found a vitreous lead ore, white, a little tranſparent, cryſtallized in ſmall priſms; theſe little cryſtals had the taſte of ſalt of lead, they effervеſced with nitrous acid, and by the aſſiſtance of the blow-pipe, were reduced to lead glaſs.

Mill-cloſe. This mine has nothing very remarkable; a ſmall piece of lead in *caulk* was given me here, ſaid to be native lead.

Elton.—In the mine of *Lordſwood-Dome*, green lead, in ſmall priſmatic cryſtals, was formerly found, accompanied with a whitiſh earth; the lead cryſtals, as well as the earth, which ſeems to contain a ſmall portion of this metal, were eaſily reduced to glaſs.

Bakewell.—Poſſeſſes ſeveral lead mines.

Aſhford.—The mines of Aſhford preſent nothing remarkable.

Moneyaſh.—I viſited the two following mines; *Lathgill-Dale mine.* Among ſeveral ſpecies of galena, I remarked one which was in polyedron, with a bright luſtre, on pyrites, accompanied with a brown blende in buttons, and a white earthy lead ore; theſe ſubſtances were eaſily vitrified by the blow-pipe.

Hubberdale.

Hubberdale mine, a mile and a half from *Moneyaſh*, near Bakewell; this mine is 43 fathoms deep. The firſt calcareous bed is here wholly wanting, as well as the firſt bed of toadſtone, which is replaced by a bed of argil. The ſecond calcareous bed, or the grey calcareous ſtone, which is found immediately under this clay, in this part is full of ſhells and petrified entrochites. The principal pit of Hubber-dale-mine is cut through this ſtone; it is often croſſed by veins of calcareous ſpar, which are much inclined: in the place of the ſecond bed of toadſtone, I alſo found a bed of argil. The vein which was then worked is in the third calcareous bed; it proceeds between the 12 and ſecond hour, according to the Engliſh compaſs; and as the inclination is very ſmall, it is conſequently at *Pipework*. In this mine a ſtone, which was called Stuff-ſtone, was given me; but I found that it was only a variety of that which forms the third calcareous bed; it was ſoft and friable between the fingers. The ſubſtance which here follows the third calcareous bed, and which in the natural order ſhould be toadſtone, is only a bank of greeniſh argil, ſpotted with white; it is called *channel*. This bank of argil has not been pierced through, and the quality of the lower bed is therefore unknown. The gangarts accompanying this vein, are,

Ferruginous oker of a brown colour, often mixed with caulk or calcareous earth.

Cellular iron ore, containing pyrites; this ore is of a dark brown, ſometimes changed into hematite.

White calcareous ſpar.

Pyrites in ſmall quantity.

Caulk in ſpheroidal plates, containing different ſized pieces of very compact galena, of a kidney form: all theſe gangarts are diſpoſed in thin layers or lamina, in the oppoſite direction of the vein. When the galena is incloſed in ſmall pieces by calcareous ſpar, or caulk, it is called *troſſel-breaſt*.

Baſlow.—In Calver-mine I found galena or vitreous white ſpar.

Foſlow.—The lead mines of this ſmall place are of little importance.

Eyam.—*Lady-waſh* is the name of one of the principal mines of this place; the richeſt vein, the direction of which is much inclined, proceeds in the firſt calcareous bed, which is commonly covered with a ſlate of forty fathoms thickneſs; calcareous ſpar, more or leſs ſolid, and *caulk*, which is here called *keble*, are the moſt common gangarts. The moſt remarkable mineral of *Lady-waſh* is galena with a ſpecular ſurface (ſlikon ſides,) which is moſt commonly found in very large pieces. This mineral poſſeſſes the ſingular property of detaching itſelf ſpontaneouſly from the vein, particularly in places where the vein begins to grow narrow; the violence with which this operation takes place, is incredible; it is often accompanied with a very great exploſion, which may even be heard at a conſiderable diſtance from the mine, and is compared to an earthquake; the effect it produces on the ſcaffolding, which it not only ſhakes, but alſo breaks, is often fatal to the workmen; and it is only by ſtregthening the principal ſupporters, by the refuſe with which they fill the void ſpace between the rock and the ſupporters, that they are enabled to prevent the total deſtruction of the galleries. I ſaw this practiſed in *Haycliffe-tille*, one of the galleries of *Lady-waſh*, when threatened with this accident. The miners could not account for this terrible phenomenon; but I think it may be attributed to the air, which, being greatly compreſſed, eſpecially where the vein grows narrow, forces a paſſage. The ſpecular galena is commonly found in double veins, about eight or nine inches diſtant from each other, having in the middle a bed of caulk of the thickneſs of three lines; each vein is compoſed of two halves, which unite ſo well on the ſmooth ſurface, as to appear a work of art. The miners

in

in order to remove tolerably large pieces of this galena, make uſe of a ſharp iron, which they drive vertically into the bed of caulk, ſeparating the two halves of the mineral; this done, they all retire, for in a few minutes all the vein looſens itſelf with a great noiſe, and the workmen would endanger their lives, were they not to ſecure themſelves. I was told that each exploſion was preceded by a dull noiſe, like the ſound of a bell, which was heard in the galleries, and which enabled the miners to retire in ſafety.

Tideſwell.—This town is four miles from Buxton; here I ſaw ſeveral ſmall quartzoſe cryſtals, which preſented two pyramids joining at the baſe, and which had been found in one of the lead mines.

Buxton.—Thirty-five miles from Derby, ſome pits have been cut to the ſecond calcareous bed; the veins in great part are filled with white calcareous ſpar, which contains very little coarſe-grained galena. No machines are made uſe of to deſcend into theſe mines, but the workmen enter and retire by climbing. The ſmall cryſtals known in England under the name of *Buxton diamonds*, which are uſed for ſeveral articles of jewelry, are found detached in the environs of this town; they are ſmall quartzoſe cryſtals, very clear, and often coloured with red.

Caſtleton.—The mines of this little town are generally poor in ore, and employ only about 50 perſons. I obſerved at the foot of Mam Torr*, a very ſteep calcareous mountain near Caſtleton, ſome galleries which directly led to a vein which terminated nearly at the ſurface. The gangart of the vein is calcareous ſpar, of a milky colour; containing very little coarſe grained galena. The chief productions of the mines of Caſtleton, are different vitreous ſpars, which are uſed for vaſes or other objects of ornament, according to their ſize and beauty of colour. The purple ſpar is the moſt common, and by way of ſalband, accompanies the white vitreous ſpar; in Engliſh it is called *Derbyſhire blue John*, *blue-ſtone*, *Johnſtone*. The labourers who work theſe ſpars, dwell at *Derby*, *Winſter*, *Matlock*, &c. in other parts of the county. All the pieces of workmanſhip are tranſported to Birmingham, where they are mounted in gilt copper, and other metals. The largeſt pieces of vitreous ſpar found at Caſtleton, are about a foot in length; artificial colours are ſometimes applied to theſe ſpars, to increaſe the luſtre and variety of the natural ones.

Oden-mine, near *Caſtleton*, is celebrated for the exploſions of the ſpecular galena, ſometimes obſerved there, which are quite as dreadful as thoſe of Lady-waſh at *Eyam*.

Political and Economical Conſtitution of the Mines of Derbyſhire.

ALL the mines of Derbyſhire are ſituated in the higheſt part of the county, called the *Peak*, which is commonly divided into the *High* and *Low Peak*. Each part is ſubdivided into ſmall diſtricts, known under the names of *Liberties*, *Wapentakes*, *Manors*, which are called after the names of the towns they contain; for example, *Winſter-liberty*, *Aſhford-manor*, &c. The ordinances and ſtatutes of all theſe liberties, relative to the working of the mines, are every where the ſame, with the exception of ſome particular cuſtoms, and the right which each diſtrict poſſeſſes of chooſing an inſpector

* The earth and ſtones which fall down, from this mountain, form, in ſeveral parts, ſmall hills, which daily increaſe in ſize, and are regarded by the common people as one of the ſeven wonders of the Peak.

of the mines*. This inſpector, or director, who is called the *Barmaſter*, or *Deputy Barmaſter*, partly depends on the proprietor of the land in which the mine is, and ſometimes alſo on the farmers of the mine, who may diſmiſs him at pleaſure; his only profit ariſes from the emolument of his employment. The *Barmaſter* does not direct the labour of the miners; but his principal occupation is to attend to the meaſurement of the mineral which is ſold to the founders, and to exact the tribute which belongs to the lord of the eſtate; he alſo grants permiſſion to perſons wiſhing to work a mine, and in fine ſettles the little diſputes occaſionally ariſing among the miners. Every important ſuit is decided by the tribunal of the mines, of which we ſhall ſpeak hereafter.

In the *High Peak*, the right of working mines, belongs excluſively to the king, and the *Barmaſter*, or director, is elected, and confirmed in his ſituation by the king's farmers. All the mines of the Peak are beſides inſpected by a director general (*the head Barmaſter*) who has allowances, but is equally dependant on the farmers of the king, and the proprietors.

The director general alſo preſides in the grand council of mines, which is here called the *Barmote court*, and is generally compoſed of the *ſteward* and 24 *jurors*; the latter, when aſſembled, form what is called *the grand jury*. In the royal mines the farmers are at the ſame time the jurors. The grand council of mines (*the great Barmote court*) aſſemble twice in the year, at Eaſter and at Michaelmas; the leſſer council (*court of trial*) alſo aſſembles every three weeks, and even oftener, if requiſite.

The grand council poſſeſſes abſolute juriſdiction over all things relating to the mines; as, for example, diſputes concerning boundaries, miſunderſtandings between the proprietors and others; it judges according to a printed code, which is generally followed; but it can even in caſe of neceſſity alter the laws. The king has a thirteenth of all the mineral worked; in the mines granted by conceſſion, the ſame benefit belongs to the proprietor of the land. In exchange, the worker of the mines has the privilege of cutting the neceſſary wood from the neareſt royal foreſt, and employing, for his purpoſe, the neareſt water. According to an Engliſh author†, the king's thirteenth, in the diſtrict of Wirkeſworth alone, is valued at a thouſand pounds ſterling annually.

Individuals are not permitted to work a vein on the land of another, without conſent of the proprietor, excepting perſons immediately dependant on the king, or particularly attached to him (the king's liege people); theſe have the liberty of working a vein wherever they think proper, and they are only obliged to reſpect houſes, gardens, and orchards; but their works muſt be carried on within rule, and according to the laws of the mines; in breach of theſe, the proprietor may choak up the work. *See Jars, tom. 3, p. 541, art. 16.*

The proprietor of the land has always the right of the firſt market, in the ſale of the mineral, unleſs he has arranged otherwiſe with the worker; but no ſale can take place without the conſent, and unleſs in the preſence of the *Barmaſter*, and his meaſure muſt even be uſed; at every ſale he receives a recompenſe, depending on the liberality of the vender.

The old and abandoned mines, as well as the newly diſcovered veins, cannot be worked without a grant from the Barmaſter. To perſons wiſhing to work the old or aban-

* On this ſubject a work may be conſulted, entitled, *The Miner's Guide, or a complete Miner, by W. Hardy, of Sheffield*, 1748, 8vo. and Jars, *Voyage Metallurgique*, tome, iii. p. 538; the juriſprudence of the mines of the county of Derby.

The relation between the ordinances of the mines of Derbyſhire, and thoſe of Saxony and Germany, renders it probable that the ancient Saxons introduced the art of mining into England. F. Tr.

† *A Tour through Great Britain*, vol. iii. *London*, 1773, 8vo. p. 73.

abandoned mines, a certain portion (*meaſure of ground*) is granted; 32 yards in the *High Peak*, and 29 in the *Low Peak*; that is, half of the portion on each ſide of the pit. For a new vein, a double portion is allowed; 58 yards for the *Low Peak*, and 64 for the *High Peak*, according to the direction of the vein. The proprietor of the land, in like manner, receives a half meaſure on each ſide of the pit, for all the new veins: the Barmaſter alſo grants, to every worker of a mine, a place without it, neceſſary for waſhing and ſeparating the ore, as well as for refuſe, and a path to his work. The emoluments of the *Barmaſter* are fixed at a diſh*, or about 70 pounds weight of ore, which he always takes from the firſt produce. In an old and abandoned mine, the proprietor of the land receives nothing.

The portions granted by conceſſion, are marked at the ſurface by holes, in which a kind of wooden croſs is fixed, called *ſtowes* or *croſſes*, ſerving as a boundary. The removal or alteration of this limit, is ſeverely puniſhed; and thoſe who work the mines, are bound to guard their preſervation; in default of which, they forfeit their right of grant.

The mines of Derbyſhire are worked by companies or ſocieties. The members of theſe ſocieties are commonly wealthy people, who work ſeveral mines at once, and divide the ſhares† at their will. The ſuperintendance of theſe mines, is generally entruſted to an honeſt and able perſon of the diſtrict, who acts, at the ſame time, in the capacities of a geometrician, juror, and ſecretary to the ſociety; and who alſo ſells the mineral. It may eaſily be conceived, that a ſingle man cannot beſtow the neceſſary attention on ſo many occupations; every thing is in conſequence carried on with negligence, and the working of the mines is in general ſo little within rule, that it is only the extreme richneſs of the mineral which can counterbalance the loſſes of the proprietors, ariſing from an unſkilful adminiſtration.

The covenants with the workmen are renewed every ſix weeks; at the ſame period the ore is ſold to the founders, who then aſſemble there in great numbers.

There are actually three lead founderies in Derbyſhire, belonging to very wealthy merchants‡. The lead is generally conveyed to London through Derby, or elſe, ſent to Hull in Yorkſhire, whence it paſſes to foreign countries. The ore is ſold to the founders at the rate of ſeven or eight pounds ſterling, the ton§; the melted lead is, in fact, worth 15 guineas per 24 hundred weight.

The miners of Derbyſhire are, in general, robuſt and enterpriſing people; they are called, in Engliſh, Peakrills; their ſalary is very ſmall, as is that of all miners, when the laborious and dangerous nature of their employment is conſidered.

Working of the Mines of Derbyſhire, and the Machines employed.

THE mountains of Derbyſhire preſent to the naturaliſt a great number of curious objects; but they are much leſs intereſting to thoſe who only regard the working of the mines, for, in general, this branch of induſtry is in a deplorable condition‖. The

* A diſh is a meaſure for the mineral, commonly weighing 60 or 70 pounds, more or leſs according to its quality. *See Jars, tom. 3. p. 539.*

† Theſe ſhares are called *Kuxe* in German.

‡ The number of founderies has increaſed ſince M. Ferber was there. F. Tr.

§ The ton contains twenty hundred weight, each hundred weight, a hundred and twelve pounds, Engliſh weight.

‖ All authors agree as to the bad adminiſtration of the mines of England, and the defective method of working them; we may read what Mr. Kirwan ſays on this ſubject, in the preface to his Mineralogy. F. Tr.

number and richneſs of the veins are, perhaps, the cauſe of the want of that attention which is ſo much admired in the other enterprizes of that enlightened nation, and I am led to think that the conſiderable revenues, which the proprietors conſtantly derive from theſe mines, render them inſenſible to further profit. It is pretended, that it is for political reaſons that the general adminiſtration of the mines is on ſo bad a footing as we ſee it. My knowledge of the conſtitution of England is too limited to decide whether a better arrangement would be dangerous; but I am well convinced, that this branch of induſtry will never arrive to a high degree of perfection, unleſs a ſupreme council be eſtabliſhed over the mines, with unlimited power to reform all abuſes.

It is but a very few years ſince the Engliſh began to pay attention to the ſtudy of mineralogy*, while in moſt other parts of natural hiſtory, they have long poſſeſſed learned men of very great merit. I think I may, with ſome reaſon, ſay that mineralogy in England is ſtill in its cradle, and it is not long ſince the Corniſh miners threw away the bizmuth with the refuſe, as a ſubſtance perfectly uſeleſs; and they would have remained in the ſame error, had it not been for Dr. Schloſſer of Amſterdam†. What I am about to relate of the internal conſtruction of the mines and founderies, will qualify my readers to judge of the reſt.

In almoſt every part of Derbyſhire, the veins are ſufficiently rich, and the rock ſo ſolid, that they are relieved from the expence of ſcaffolding; but it will appear ſurpriſing to learn, that even ſteps and ladders are neglected. Every overſeer directs the labour of the mines according to his ability; and as economy is ſought as much as poſſible, the timber of the mines is every where in ſo bad a condition, and the pits ſo ill conſtructed, that it is impoſſible to form an idea of it. In a great number of the mines, the labourers aſcend and deſcend, by climbing on bad ſteps at the riſk of their lives. In ſome pits near Winſter, ſteps are managed in the four corners of the pit, without order, and too diſtant from each other; in others, the pieces of wood ſerving for the ladder-ſteps are ſo badly faſtened, or ſo near the ſide of the pit, that the foot cannot be fixed; in fine, I have ſeen ſloping ſteps and almoſt rotten, which is certainly a proof of extreme negligence. Conceive the danger of deſcending a pit more than 40 fathoms in depth, and perpendicular, like that of Hubber-dale, on ſteps of ſuch little ſolidity!

Fire was formerly uſed in the working of the mines, as appears from the ordinances: at preſent *pick-maws* and *boring-maws* alone are uſed; ſometimes gunpowder is employed.

The miners work by the day, or according to a certain rate. The day is of ſix hours; but thoſe who work at a certain rate, can only be diſcharged at the end of every ſix weeks; they receive three, four, and five pounds ſterling the fathom, according to the quality of the rock, but they are obliged to furniſh the powder themſelves, and to cleanſe the ore.

The ſeparation of the ore is performed without the mine, by means of a large hammer or *bucker*; women and children are generally employed for this purpoſe.

The mineral is extracted by means of a windlaſs, and by machines with horſes: in mines of great depth, the latter are generally eſtabliſhed in an elevated place without any

* I am well acquainted with the works of Woodward, Hill, and Mendez da Coſta. M Forſter, a learned German, has alſo publiſhed an Eſſay on Mineralogy in Engliſh; in like manner I might cite the Engliſh tranſlation of the mineralogy of Cronſtadt, executed by my friend and countryman M d'Engſtrom; but it is to be lamented that the perſon to whom the edition was entruſted has been allowed to make alterations which are nowiſe favourable to the work.

† See *Borlaſe, Natural Hiſtory of Cornwall*, Oxford, 1758, fol.

covering,

covering, ſurrounded with a little wall. One of the beſt machines of this kind, was that of Hubber-dale; all the others I ſaw, were conſtructed on nearly the ſame model, except that they were too maſſy, and the circle was of too large a diameter, and too narrow: I have ſeen ſome of theſe engines made with two boards nearly circular, on the edges of which ſome bad planks were nailed.

To carry off the water, hand pumps and water engines are generally uſed. Steam engines are only employed in coal mines: it is true that in mines of little depth, theſe machines are ſufficient, and it would even be imprudent to eſtabliſh more expenſive ones; but I believe that in general the uſe of theſe machines is continued here, becauſe they have been once introduced, and that too little attention is paid to the improvements theſe works require.

Preparation of the Ore.

THE mineral containing the lead is either compact or incloſed. The compact needs no other preparation than to be broken, by means of a large hammer, into pieces of a moderate ſize. The ore encloſed by, or mixed with, other ſubſtances, requires to be ſeparated from its gangart; in this labour, which employs women and children, there is ſo little care, that a great part of the metal is thrown away with the refuſe. Stamping and waſhing* are not yet introduced, but a particular method is employed to ſeparate the ore from the gangart and earthy particles, which is a very imperfect kind of waſhing, and as defective as the labours of theſe mines in general.

Lead Founderies.

THREE principal founderies are reckoned in Derbyſhire, belonging to wealthy individuals: the ore melted here is purchaſed from the mines in the environs, perfectly cleanſed. The teſt kiln is generally introduced throughout Derbyſhire and is perhaps the beſt invention of this country. This furnace has been deſcribed, though very imperfectly, by M. Juſti, in the third volume of his chemical works, and it is impoſſible to form a preciſe idea of it after ſo bad a deſcription; that given by M. Jars (tom. ii. Voyages Metallurgiques) is infinitely ſuperior, and executed with the greateſt care; the plates accompanying the deſcription of M. Jars leave nothing wanting on the ſubject.

As the methods purſued in the founderies of this country are alike, I ſhall only mention what I obſerved at Wirkeſworth. The ore is not broiled before being introduced into the furnace, but a certain quantity of quick-lime is added. I cannot applaud this method, becauſe it is evident, that great part of the metal is exhauſted by the arſenical and ſulphureous particles which volatiliſe it; beſides, the quick-lime which is added, produces, with the ſulphureous particles, a kind of hepar, which diſſolves the lead, and probably converts a very great proportion of this metal into litharge or ſcoria; for this reaſon it is neceſſary here to melt their ſcoria a ſecond time in a ſmall blow furnace.

Though in general the lead of Derbyſhire does not appear to contain much ſilver, it is wrong not to have the matter aſcertained by good aſſays; for nothing varies ſo much as the contents of ore.

* According to the method followed in Germany and Hungary.

Copper Founderies.

THE copper ore melted at *Derby*, two leagues from Simonfield, is worked at *Eſton-hill*, in Staffordſhire*. There is nothing remarkable in the proceſs; the ore being broiled, is melted in furnaces. Among the ores melted here, I obſerved ſome laminated pyrites of cryſtallized copper, ſome in the form of buttons, others of a bright luſtre, upon a mamellated gypſeous ſpar†.

Preparation of Calamine.

THE lead mines between *Wirkeſworth* and *Matlock Bath*, afford the greateſt quantity of calamine; the colour is commonly white, yelloviſh, or brown, of a cellular or compact texture. The ore is firſt reduced to pieces of a moderate ſize by means of a large hammer, then ſifted, in order to ſeparate it from the ferruginous and other extraneous bodies; it is afterwards broiled in a kind of ſmelting furnace, at the top of which is another little furnace, which ſerves to dry it. The calamine being broiled is taken to the mill, where by means of two horizontal ſtones, it is reduced to a very fine powder; but as this preparation cannot take place without humidity from time to time, it is neceſſary to dry it in the little furnace I have juſt mentioned. Nearly the whole of the calamine prepared here is tranſported in caſks to Birmingham, where a very great quantity is employed in the different braſs manufactures.

In ſeveral lead mines there is found a calamine in powder, moſt commonly very impure; it generally contains argil and much ſand, which are ſeparated by waſhing in *German cheſts*. Another proceſs formerly uſed in England, has been communicated to me by M. Cramer, a celebrated German chemiſt; this proceſs conſiſts in broiling by the fire of flame, in a ſmall furnace of calcination, the calamine which contains lead; by this means the lead is melted, and the calamine becomes very friable. The broiled calamine is then placed on planks, the poſition of which is a little oblique, where children, with ſmall boards faſtened to the feet, cruſh it by treading on it. The water, which is conveyed over the whole ſurface of the calamine, waſhes away the fineſt parts, which are received in little boxes, but the lead remains on the planks, where it is retained by little borders fixed at the extremities.

Formerly blende broiled was employed as calamine, particularly in the environs of Briſtol‡, where are a great number of braſs manufactures. The blende uſed, was brown and compact, but broiling was ſufficient to render it friable; this was performed in a ſquare furnace with a conical chimney, in which the ſulphur contained in the ore was ſublimated; the remainder was then reduced into very fine powder in a common mill.

Manufacture of Minium.

SEVERAL proceſſes are known to make minium§, particularly that deſcribed by M. Juſti, in his Chemical Opuſcula; but this author is miſtaken when he ſays, that in

* A more detailed account of theſe founderies is given by M. Jars. See *Voyages Metallurgiques*, tom. iii. p. 75.

† M. Forſter's Catalogue, 1783, p. 2.

‡ M. Jars has deſcribed with his uſual accuracy the reſults of his own experience relative to this ſubject, Voyage Metallurgiques, iii 106.

§ The beſt work which has been given on the preparation of minium, is the German work of M. Noſe, under the title, *Abhandlung von Mennigbrennen*, Nuremburg, 1779, 8vo.

England galena is employed for this purpoſe; I have been in a manufacture of minium at Wirkeſworth, and I can affirm that the pureſt lead is there employed. The furnace of Wirkeſworth, to reduce the lead to minium, is very well deſcribed by M. Jars; the plate he has annexed to his deſcription is very accurate, and enables the reader to form a very exact idea of this operation, which has always been carefully concealed from travellers.

At Wirkeſworth there are always two furnaces under the ſame roof; in each furnace 2240 pounds of lead are calcined, with the aid of pit-coal, and by ſtirring the melted lead continually during 6 or 7 hours, while the firſt calcination laſts. The calx of the lead appears, after this firſt operation, under the form of grey powder, bordering in a very ſmall degree on the yellowiſh. To give a red colour, this powder is pounded by an horizontal mill-ſtone, moiſtening it from time to time; after the whole maſs has been well pounded, and again diluted with a ſufficient quantity of water, it is paſſed through a very fine ſieve, in order to ſeparate all the groſs particles. This powder, well waſhed and ſifted, is a ſecond time calcined in a furnace perfectly reſembling the firſt. Minium ſells, free of carriage to Hull, at the rate of 16 pounds the ton, or 2240 pounds weight. The greateſt part of the minium manufactured here, paſſes to Holland, where great uſe is made of it in the glaſs houſes.

Manufacture of Porcelain at Derby.

THIS muſt not be confounded with the manufacture of earthen-ware, which is alſo in the environs of the town. As the manufacture of porcelain is kept ſecret in England, I could not obtain all the information I wiſhed on this ſubject. The following is the account I have gathered. I was aſſured at London, that in all the manufactures of this kingdom, as at Chelſea, Worceſter, Derby, &c. the ſteatite of Cornwall (*ſoaprock**) was employed, mingled with a good apyrous argil. I was alſo informed with reſpect to the porcelain of Derby, by Dr. Small of Birmingham, that calcareous ſubſtances, mingled with others extremely fuſible, were only employed, and that the kind of enamel or paſte which reſulted from this mixture, was ground afreſh, and furniſhed the paſte for the Derby porcelain. I have reaſon to think this information not without foundation, on account of the great number of calcined oyſter ſhells which I ſaw employed in that manufacture.

Mr. Cookſworthy, an apothecary of Plymouth, has obtained the privilege of eſtabliſhing a manufacture of porcelain in that town. The ſubſtance ſerving for baſe to this porcelain, is a granite found at St. Stephen's near Plymouth†. This granite, of which I have ſeen ſpecimens, was compoſed of a reddiſh felſpar, in pieces of a tolerable ſize, quartz in ſmall grains, and black ſcaly mica.

Manufacture of Earthen-ware.

THIS ware of which there are manufactures at Derby, Burſlem, and Worceſter, is every where known; the Engliſh call it ſtone ware. All the manufactures employ nearly the ſame materials and purſue the ſame courſe: the baſe is either a white argil, extremely fine, or pipe-clay, which is found in Cornwall, near Tinmouth. When by

* This ſteatite is found near Cape Lizard, in the county of Cornwall.

† This granite is actually worked on the account of Mr. Wedgwood, an ingenious artiſt, and known by the maſter pieces of earthen-ware from his Etrurian manufacture in Derbyſhire. F. Tr.

means

means of waſhing this earth is reduced to an impalpable paſte, it is mixed with a fifth part of its weight of common ſilex, calcined, and reduced to a very fine powder. As the excellence of this ware depends in great meaſure on the intimate mixture of theſe two ſubſtances, great care is taken that they are well diluted in a ſufficient quantity of water, the only means of mingling them well. The method of working this maſs for the different kinds of earthen ware, is known, and therefore needs no deſcription: the moſt common ſort of this ware, or the white ware, receives no other gloſs than that it receives from ſea-ſalt, which is thrown into the furnace when the baking is nearly completed; but the fineſt, which is the yellow, receives a yellowiſh varniſh, after which, it is a ſecond time put into the furnace.

The ſilex employed in the manufactures of Derbyſhire, is never found in that county, and is generally brought from the coaſt of Norfolk*.

* The information M. Ferber has given us concerning the different Engliſh manufactures, is very imperfect, compared with what M. Jars has ſince publiſhed in his *Voyage Metallurgique*. For this reaſon we entreat our readers to conſult this work whenever they are anxious to be more particularly informed on many ſubjects which M. Ferber has but ſlightly touched upon. In the ſame work of M. Jars, there are ſome very exact engravings of ſeveral machines and furnaces, of which M. Ferber was not able to procure ſatisfactory intelligence, and which for the ſame reaſon have been omitted in this tranſlation. (Note of the French Tranſlator).

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