III. *Experiments on ſome Mineral Subſtances.* *By* Peter Woulfe, *F. R. S. Communicated at the Deſire of* William Hunter, *F. R. S. and Phyſician extraordinary to the Queen.*

Read Nov. 19, 1778.

On cryſtal, quartz, and flint.

MONS. BEAUMÉ, a member of the Royal Academy of Sciences of Paris, has aſſerted, that he obtained allum from cryſtal, quartz, and flint. His method to obtain allum from theſe ſubſtances was to make a *liquor ſilicum*, by melting them in a crucible with fixed alkaly, and letting the mixture run *per deliquium*; any acid added to this *deliquium* precipitates the cryſtal, quartz, or flint, which, by means of acid of vitriol, he diſſolved, and obtained allum. I have often repeated this operation on all theſe ſubſtances, but could never obtain a ſingle grain of allum: in lieu thereof I got a ſelenite, and was on that account convinced, that the baſis of theſe ſubſtances was a calcareous earth. Mr. BEAUMÉ's miſtake was, I am certain, owing to the Paris crucibles which he

made uſe of, and which, for want of being well burnt, retained yet their clayey nature; conſequently a portion, and that not a ſmall one, of the clay, is diſſolved by the alkaly; allum muſt therefore in his manner be obtained, as clay is the matrix, or at leaſt contains the earth of allum. It is rather a tedious operation to make the *liquor ſilicum*, and eſpecially in any quantity; for the mixture is very ſubject to froth and boil up in the crucible, and the operation is not compleat until this boiling up ceaſes, and the mixture melts thin. Hence it is natural to conclude, that a large portion of the clay of a Paris crucible is diſſolved by the alkaly during this long operation.

In order to diſcover whether the cryſtal, quartz, or flint, contained any acid, I put in practice the method which I publiſhed in my laſt paper on mineral ſubſtances, to diſcover the acids of horn ſilver and horn mercury; but I could not find they contained any.

On the change of cryſtal into ſelenitical ſpar.

The cryſtal on which I tried the following experiments, and which is partly changed into ſelenitical ſpar, is to be found in that moſt excellent muſeum collected by Dr. HUNTER. This cryſtal comes from near Freyberg in Saxony, and is called in German *nieren-formiger cry-*

ſtal (kidney-formed cryſtal). It is in the form of an uneven cruſt, with ſmall protuberances; a part of it retains all the appearances of cryſtal, but the reſt is opaque, ſomewhat of an aſh colour, and is eaſily powdered: the underpart retains marks of *galena* or potter's lead ore, and in ſome ſpecimens the greateſt part is coated with it.

I took three drams of the opaque part of this cryſtal finely powdered, and mixed it with an equal quantity of fixed alkaly of cream of tartar, and in order to facilitate the union, the mixture was made into a paſte with diſtilled water, then dried and calcined for an hour as in my experiments on horn ſilver (ſee Phil. Tranſ. vol. LXVI. p. 604.). The mixture was then taken out of the phial powdered, and, by digeſtion with diſtilled water at three different times, deprived of its ſaline part: theſe three ſolutions were mixed together, ſaturated with diſtilled vinegar, evaporated to dryneſs and waſhed well with rectified ſpirit of wine. By this means ʒj. and gr. vi. of tartar of vitriol was obtained. The undiſſolved part, remaining after digeſtion with water, when dried weighed ʒ ij. and gr. xxiv.; this was mixed and digeſted with pure acid of nitre, and effervеſced ſtrongly. After this digeſtion the undiſſolved part here remaining, being well waſhed and dried, weighed ʒj. and gr. xv. which I take to be cryſtal, for no ſaline matter was obtained by treating

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it with acid of vitriol; and hence it appears, that nearly two-thirds of the cryſtal is changed into ſelenitical ſpar. The ſolution which was obtained by the acid of nitre mixed with acid of vitriol, but eſpecially with a ſolution of tartar of vitriol, precipitates copiouſly, and forms a ſelenite. This evidently proves the exiſtence of the calcareous earth, and the tartar of vitriol mentioned above, that of the acid of vitriol in this altered cryſtal.

The unaltered part of this cryſtal, treated in the ſame manner as the altered part, afforded no marks of ſelenitical ſpar.

The change of this cryſtal is, I ſuſpect, owing to the lead ore which adheres to it; the ſulphur of the lead ore furniſhing the acid of vitriol, and the cryſtal the calcareous earth.

I have in the above manner treated a variety of the heavy ſpars, commonly called ſelenitical or gypſeous ſpars, and found them all, as I firſt judged by their appearance and great weight (without being once miſtaken) to conſiſt of acid of vitriol, with calcareous earth and ſome clayey matter. In ſome, the calcareous earth was combined with a larger portion of this acid than in others; and in ſome, the clayey matter was predominant. Among theſe were the following, ſome of which were not before taken for ſelenitical ſpars.

The Derbyſhire and Eckton cauk, which is commonly covered with copper marcaſſite.

Ditto from Saxony, which is found growing like knobs or protuberances on the yellow phoſphoric ſpars.

The *ſpathum ericæ forme* of Woodward from Derbyſhire.

The ſtellated ſpar, which is found on the *ludus helmontii* from the iſland of Sheppy.

The ſpar from Saxony, reſembling lead ore, and which by many is ſuppoſed to be one, called in German *ſtangen ſpath*. This ſpar is by Baron BORN claſſed with the baſaltes; he has no doubt taken it for a ſhirl, which is claſſed with the baſaltes, but I never found them to have any affinity.

Another ſpar from Saxony, called alſo *ſtangen ſpath*, compoſed of large interwoven priſms, partly red and partly white, and ſemi-tranſparent.

Compact ſemi-tranſparent Auvergne ſpar, ſaid by M. MONET to contain ſulphur; but I could never find an atom of it in this or in any of the other ſpars I tried, and ſuppoſe his miſtake to be owing to a portion of charcoal, flame of charcoal, or duſt, that got into the crucible. Native ſulphur is frequently found growing with calcareous ſpar and gypſum, but it ſhould be conſidered as heterogeneous.

Flaky milk-white ſpar, found with Cobalt and copper ores from Saalfeld.

Two

Two ſpars from the Hartz, compoſed of flakes and cryſtallized.

Ditto from Saxony.

Striated ſpar from Scotland, brought here by Mr. GOAN.

Spar intermixed with cinnabar and ochre of iron from Obermoſchel in the dutchy of Deux Ponts.

Red ochry compact ſpar from Derbyſhire.

I ſhall give a few of my experiments on theſe ſubſtances compared with the common Paris montmartre plaſter ſtone; all theſe were deprived of their humidity before they were ſubmitted to trial.

Two drams of the Paris plaſter ſtone, treated as in the former experiment, with an equal quantity of alkaly of tartar, produced ℥ jſſ. and gr. viii. of tartar of vitriol[a].

The inſoluble part remaining after being deprived of its ſaline part by water, was digeſted with diſtilled vinegar, which effervеſced and diſſolved the whole of it, except a ſmall portion, which, when waſhed and dried, weighed gr. vi. and had the appearance of tobacco-pipe clay. Had I taken a pure white tranſparent gypſum, I believe that no ſediment would have been left. From

(a) The tartar of vitriol, of all the trials I make mention of in this paper, was diſſolved in diſtilled water, and mixed with a ſolution of calcareous earth in acid of ſalt, which cauſed a copious ſelenitical precipitation, a clear demonſtration of the exiſtence of the acid of vitriol.

this

this experiment it appears, that gr. xcviii. of vitriol was produced by gr. cxiv. of pure gypſum, for the gr. vi. of clayey matter muſt be deducted.

The like quantity of Derbyſhire cauk, treated in the ſame manner, produced gr. lix. of tartar of vitriol, and the clayey matter, which exactly reſembled the former, weighed gr. xxiii.

The ſtellated ſpar from the iſland of Sheppy, ſubmitted in the ſame proportion to the ſame trials as the foregoing, produced gr. lviii. of tartar of vitriol, and gr. xxii. of clayey matter, which was whiter than in the former.

WOODWARD's *erica* formed ſpar in the like proportion and manner as the former, afforded gr. xxxviii. of tartar of vitriol, and gr. xlii. of clayey matter.

To ſhew that the calcareous earth in the gypſum contained a greater portion of acid of vitriol than that in the ſelenitical ſpars, I reaſoned thus, having previouſly ſubtracted the clayey matter of each.

If 114 grains of plaſter (the 6 grains of clay being deducted) afford 98 grains of tartar of vitriol, how much ſhould 97 grains of the gypſeous matter contained in cauk afford (for the clayey ſubſtance muſt alſo here be ſubtracted). From this rule it ſhould produce $83\frac{12}{57}$ grains of tartar of vitriol, and nevertheleſs the quantity

was only 59 grains. Hence it is clear, that the calcareous earth of the gypſum contains a greater proportion of acid of vitriol than that of the cauk.

According to this rule, the ſtellated ſpar from Sheppy ſhould have afforded $84\frac{14}{57}$ grains of tartar of vitriol, but it produced only 58 grains.

The *erica*, formed ſpar by the ſame rule, ſhould have afforded $65\frac{17}{57}$ grains of tartar of vitriol, but the quantity was only 38 grains.

As I ſuſpected that the ſelenitical ſpars contained ſome calcareous earth, not united to the acid of vitriol, I digeſted ſome of them with rectified pure acid of nitre, and afterwards well waſhed and dried them; but the loſs of weight was very trifling, except in the cauk and *erica* formed ſpar; the firſt probably containing ſome marcaſſitical particles of copper, and the laſt an ochre of iron.

Dr. LEWIS, in his tranſlation of NEWMAN'S Chemiſtry, quotes from the Philoſophical Tranſactions ſomewhat remarkable about cauk, that when wetted with antimony it gives it a ſhining ſurface like ſteel.

I repeated the experiment as follows: I powdered and mixed ℥ ſſ. of cauk with ℥ iij. of antimony, and put the mixture into a red hot crucible; and when melted, which readily happens, I ſtirred it with an iron rod, and poured

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it into an iron mortar. This matter in its fracture has appearances of RULANDUS's falſe liver of antimony.

I have alſo tried, in the ſame proportion and manner, the following ſubſtances, and found the effects ſo much alike, that they could be ſcarcely diſtinguiſhed one from the other.

Stellated ſpar, from the iſland of Sheppy.

Auvergne compact plated ſpar.

Erica formed ſpar.

Whited plated gypſum dried.

Dried whiting.

Fixed alkaly of tartar.

Hence we may conclude, that the calcareous earth of theſe ſpars and gypſum act on the antimony like fixed alkaly, forming a ſort of liver of antimony.

Of ſome mineral ſubſtances which contain the earth of allum.

Tobacco-pipe clay, of all ſubſtances I know, would be the fitteſt to make allum with, was it neceſſary; but nature has ſupplied it abundantly in other bodies, from which it is obtained with little art and expence.

Two drams of dried tobacco-pipe clay, treated with an equal quantity of fixed alkaly of tartar, as in the laſt ex-

periments, produced no tartar of vitriol; nor have I been able to obtain any from the other clays, which I ſubmitted to the ſame trials: ſuch were the porcellane clay from Cornwall, the porcellane clay from Saxony, Sturbridge clay, fuller's earth, as alſo the blue argilla from Paris, which M. BEAUME ſays is replete with the acid of vitriol[b], and to that he attributes its property of ſetting free the acids of ſalt petre and of ſea ſalt; but of this more fully hereafter.

The tobacco-pipe clay, having been deprived of its ſaline part after the calcination, was as white as chalk, and had loſt its tenacity[c]. It increaſed in weight gr. viii. and the alkaly was not only diminiſhed in weight, but was alſo combined with a portion of the clay; for, on ſaturating it with diſtilled vinegar, a gelatinous ſubſtance was ſeparated. I have often obſerved the formation of this gelatinous matter on the ſurface of the Vauxhall ſtone bottles, in which I had kept for ſome months

(*b*) M. BEAUME, in order to demonſtrate the acid of vitriol in the clay, has boiled it for a conſiderable time with fixed alkaly, and thereby obtained tartar of vitriol: had he made uſe of a pure alkaly, I would take upon me to ſay, that his experiment would have failed. The alkaly he uſed contained already tartar of vitriol, which became more manifeſt by long boiling, as a portion of the alkaly combines with the clay.

(*c*) Might not this be ſubſtituted in the room of white lead for painters uſe, the white lead having many bad qualities, and being very injurious to ſome other colours?

oil

oil of tartar, *per deliquium.* This ware is made with tobacco-pipe clay and ſand, and when well burnt is not acted on by either acids or alkalies.

This ſhews the union of clay with alkalies, and that may be the chief reaſon why it ſhould, when helped with heat, be ſo uſeful in obtaining the acids of nitre and of ſea ſalt. I have alſo obtained this gelatinous ſubſtance by mixture of tobacco-pipe clay and oil of tartar, *per deliquium*; for after ſome months, the alkaly being diſſolved with water and evaporated, had in great part a gelatinous conſiſtence. This mixture was ſtirred now and then, and had a remarkable volatile alkaline ſmell. Mr. BOYLE ſays, that clays diſtilled with ſea ſalt produces a *ſal ammoniac*, and I found it to be always true when the diſtillation is at firſt ſlowly conducted.

I have often made allum with tobacco-pipe clay calcined with oil of vitriol, but kept no notes of the quantity I obtained; and as for the *reſiduum* uſed in this experiment, it was loſt. I can, however, tell the quantity of allum which the porcellane clay from Cornwall affords. Two drams of this clay, which had been treated with its weight of fixed alkaly, and deprived of its ſaline part, then calcined four different times, with a freſh portion each time of oil of vitriol, produced ℥ ſſ. and gr. xxiv. of good

good cryſtallized allum[d]. The fourth calcination afforded no allum, and what remained, after being dried and waſhed, weighed gr. lv. What this matter is I have not yet tried; perhaps it may be of the quartzy kind. Hence it appears, that this clay contains half its weight of earth of allum, which, by its union with the acid of vitriol and the water that enters into its cryſtallization, produces better than four times its weight of allum, and therefore this clay treated with acid of vitriol affords more than double its weight of allum.

Of Feld ſpar.

The honourable Mr. GREVILLE, a member of the Royal Society, and remarkable for his taſte and ſkill in natural hiſtory, as well as for his judicious remarks on the nature, growth, and formation of minerals, has in his travels made ſome very intereſting obſervations on the formation of Feld ſpar; the ſpecimens which he collected on the ſpot ſhew evidently the change of clay into this ſpar, and alſo the different gradations of the change.

(d) The celebrated Mr. MARGRAF, to whom the diſcovery of making allum with *argilla* and acid of vitriol is due, could not obtain the allum in a cryſtallized ſtate without the addition of ſome fixed alkaly. His miſtake was owing to the exceſs of acid of vitriol, which the alluminous earth of the clay retained for want of ſufficient heat, and which he corrected by ſaturating it with an alkaly.

The

The Feld ſpar I made uſe of was given me by that moſt excellent chemiſt, M. ROUELLE of Paris, and I think he told me it came from Alençon.

In order to make allum of it, I melted ℥ j. of it with ℥ j ſſ. of fixed alkaly of cream of tartar, and let the mixture run *per deliquium*. This operation is as tedious and as troubleſome to perform as the *liquor ſilicum* made with flint, quartz, or cryſtal, for it is as liable to froth and boil over. No neutral ſalt was here obtained. The *deliquium* with its dregs were mixed with diſtilled vinegar, which precipitated the ſpar: this precipitate, after edulcoration and exſiccation, was calcined four different times, with freſh parcels each time of oil of vitriol, and afforded ℥ vij. and gr. xvi. of good and regularly cryſtallized allum; the part which afforded no more allum, when waſhed and dried, weighed ʒ j. and ℈ ij.

The Labradore ſtone [e] is alſo a Feld ſpar, though not ſo hard as the former. The like quantity of this, treated as the foregoing, gave no marks of neutral ſalt; the quantity of allum was ℥ j. ʒ j. and gr. xii.; and the un-

(e) This ſtone is only found on the Coaſt of Labradore, and was brought here by the direction of the Rev. Mr. LA TROBE, remarkable for his piety and zeal in propagating the goſpel among the ſavage Indians. This ſtone reflects a variety of fine ſhining colours, ſuch as blue, green, yellow, &c. I doubt not but that ſeveral other ſtones, which reflect various and changeable colours, upon trial will be found to be Feld ſpars.

diſſolved part weighed ℥ v. and gr. xxxvi. This ſpar does not boil up in its fuſion with the alkaly near ſo much as the other, and therefore the loſs in the operation is trifling compared to it, and on that account it affords a greater proportion of allum.

Shirl frequently, though erroneouſly, called baſaltes.

The ſhirl I tried is of a brown colour, forms a maſs of long minute priſms cloſely adhering together, and comes from Bohemia. Its brown colour is owing to iron. This ſhirl, treated in the ſame proportion and manner as the Feld ſpar, afforded no neutral ſalt. The quantity of allum was ℥ ij. ʒ j. and gr. xxiv.; but I muſt obſerve, that the two laſt cryſtallizations contained iron, and the mother water that remained was of an oily conſiſtence, had a ſtyptic taſte, and reſembled that obtained in making green copperas. The earthy matter here remaining weighed ʒ ij. and gr. lii ; was light and of a grey colour. Hence it is evident, that ſhirl contains nearly as much earth of allum as the Corniſh porcellane clay.

Mr. ILSEMAN, an ingenious apothecary and chemiſt at Clauſthal in the Hartz, has aſſured me, that he obtained from pumice ſtone and ſhirl a *ſal catharticus amarus*. He has, I preſume, made his trials on ſhirl

which is found with lava, and is the product of a volcano. I had none of it to try, but judge it, from its appearance, to be of a different nature from that found in mines.

Allum is commonly obtained from ſlate, which for that purpoſe is calcined for a conſiderable time. I know no ſubſtance ſo replete with it as the Iriſh ſlate, *lapis Hybernicus* of the druggiſts; for this, without any calcination, affords allum.

Allum is likewiſe obtained from the earth or clay of Solfatara, and from the red ſlate found near Saarbruck; but theſe have been expoſed, no one can tell how long, to the heat of volcanos. Iron always accompanies allum, and thence the uſe of ſome alkaly, by which means the red chalk *(rubrica fabrilis)* is obtained.

Of jaſper.

Many of the jaſpers, ſo called, owe their origin to cryſtal or quartz coloured with iron; perhaps in a few inſtances to copper. Theſe, I dare ſay, treated as the former, would produce no allum; but I have only tried one of the Oberſtein jaſpers, and this had viſible marks of cryſtal. Others of the jaſpers, and theſe I call the true ones, are formed by clay and afford allum; ſuch is the

Saxon jaſper, called ribbon agate, as alſo a red one, which was given me as coming from Johngeorgenſtadt. From thoſe I obtained very good allum, but can give no account of the particulars, having loſt the paper which contained the reſult of my experiments.

Yellow pitch ſtone, and wood like dale, petrified with pitch ſtone, both from Hungary.

The reſult of my experiments on theſe ſubſtances was ſet down on the ſame paper with that of the jaſpers which was loſt; but I recollect to have only obtained a ſmall portion of allum, and for that purpoſe was obliged, before I obtained the allum well cryſtallized, to waſh away the exceſs of acid with rectified ſpirit of wine.

Tin ſpar of the Germans, *commonly called white tin ore.*

It has a ſparry appearance; but by its lamellated texture and great ſpecific gravity, which is equal to that of tin grains, is eaſily known. This is ſuppoſed by ſeveral to be rich in tin; but the Saxon mineralogiſts aſſert, that it contains none. The only experiment I made with it was to digeſt it in a powdered ſtate with acids, by which means it acquires a rich yellow colour, like turbith mi-

neral; the acid of ſalt anſwers beſt for this experiment. This is the only ſubſtance I know of which has this property.

Norway zoolite.

This ſubſtance, treated with fixed alkaly, as in the former experiments, afforded no neutral ſalt; and what remained, after the alkaly was waſhed away, treated with acids, formed the like gelatinous matter as it does in its crude ſtate.

An account of ſuch ſubſtances as have a ſparry appearance, and how to diſtinguiſh the one from the other.

Cryſtal and quartz are eaſily known by their great hardneſs, and by the copious ſparks of fire which they afford when ſtruck with ſteel.

Feld ſpar is frequently ſo hard as to ſtrike fire with ſteel, and to give copious ſparks of fire; but its laminated texture, as well as its breaking into rhombs, makes it eaſily diſtinguiſhed from cryſtal and quartz.

Phoſphoric ſpar is eaſily known by the luminous appearance it has when heated, and alſo by the ſmell it

affords when added to oil of vitriol made hot, which exactly reſembles that of acid of ſalt. It is found of various colours, as green, blue, purple, crimſon, white, and alſo yellow. When cryſtallized it forms perfect cubes; the only exception I ever met with was a ſpecimen of the green ſort, which was ſent me by Mr. SOPER, of St. Columb in Cornwall, who has diſtinguiſhed himſelf by his ſkill in natural hiſtory and mineralogy. This ſpecimen was compoſed of two quadrangular pyramids united together at their baſis.

Selenitical ſpar is found cryſtallized in a great variety of forms; is heavier than the foregoing ſubſtance; does not efferveſce or diſſolve with acids, nor is it ſo hard as the phoſphoric ſpar.

Calcareous ſpar is eaſily diſtinguiſhed from other ſubſtances by its efferveſcences and ſolution in the acids of nitre and ſea ſalt. Acid of vitriol, added to theſe ſolutions, cauſes a ſelenitical precipitation: this ſpar is neither ſo hard nor ſo heavy as the foregoing ſubſtances, and cryſtallizes in a great variety of forms.

Gypſum is lighter than any of the foregoing ſubſtances, and is ſo ſoft as to be eaſily ſcratched with one's nail; it does not efferveſce nor diſſolve with acids, and is the only ſubſtance that forms plaſter when burnt; it cryſtallizes in a great variety of forms.

Mica or Glimmer. This is lighter than any of the ſparry ſubſtances; is compoſed of very thin flexible flakes, more or leſs large. Many of this kind are found in form of ſmall coloured ſcales of various colours, and very much reſemble the bronzes.

Tin ſpar, or white tin ore, ſee its deſcription heretofore.

White lead ore is found of a great variety of forms; is very heavy, effervesces with the acids of nitre and ſea ſalt, and totally diſſolves in them, with the help of heat. With the acid of ſalt it forms cryſtals much reſembling a ſilver coloured glimmer, juſt as common lead would have done, and with the acid of nitre it forms regular cryſtals.

The ſpathoſe iron ores, when powdered and put on a red-hot iron or ſtone, inſtantly become black, and look like a black, ſhining, micaceous iron ore.

Zeolite is lighter than the calcareous ſpars: ſee its properties already deſcribed.

Of a ſet of ſpars whoſe properties were not hitherto known, and experiments made on one of them.

This ſpar cryſtallizes in form of flat, and alſo of ſolid, rhomboidal cryſtals, and is found of a great variety of colours, ſuch as white and ſemi-tranſparent, of a pearl colour,

colour, reddiſh, and of different ſhades of brown and yellow, ſome of them being like gold, braſs, and copper. It has always a peculiar gloſs or brightneſs. May not the green and yellow glimmers from Johngeorgenſtadt be of this kind?

The ſpecimen I made uſe of for the following experiments is in Dr. HUNTER'S collection, and ſeemed to be well adapted for this purpoſe, it being perfectly free from any matrix or heterogeneous matter. The whole ſubſtance of it is a cruſt compoſed of rhomboids, which grow out of one another, and form a variety of cavities: its colour is white and ſemi-pellucid, and on one ſide there was a ſlight marcaſitical coating. This ſubſtance comes from Joachimſthal, and is harder than any of thoſe mentioned before, except the cryſtal, quartz, and feld ſpar.

EXPERIMENT I.

Three drams of this ſpar, with an equal quantity of fixed alkaly of cream of tartar, melt with a moderate degree of tin; but the mixture ſoon becomes thick and cakes. It was after an hour's calcination ſuffered to cool, then was powdered and deprived of its ſaline part with boiling diſtilled water. This ſaline part, treated as in the other

other experiments with diſtilled vinegar and rectified ſpirit of wine, gave no marks of neutral ſalt. The undiſſolved part after this operation dried, weighed ʒ ij. and gr. l.: this was mixed with oil of vitriol, which cauſed a ſtrong effervescence, and then calcined, to be deprived of its exceſs of acid. It was now digeſted, at three different times, with diſtilled water, which diſſolved a portion of it; what remained undiſſolved after this operation, being dried, weighed ʒ j. and gr. lii. and was a ſelenite, as will appear by further experiments. The three portions of water, with which this matter was digeſted, mixed together, then evaporated and cryſtallized, produced ʒ ij. and gr. xlv. of a white ſalt, moſtly conſiſting of rhomboidal priſms, ſome lying flat and ſome erected ſideways. This I judged, by its ſtyptic taſte, to contain iron, and by its white colour to contain a *ſal catharticus amarus*, or at leaſt a new earth, which with the acid of vitriol forms a ſoluble ſalt.

EXPERIMENT II.

This ſpar, in its crude ſtate, effervesces ſtrongly with oil of vitriol diluted with water. Three drams of the ſpar treated in this manner, and afterwards deprived by calcination of its exceſs of acid, and then of its ſaline part by diſtilled

diſtilled water, left a ſelenite, which when dried weighed ʒ ij. and gr. xx. This proportion is greater than in the former experiment, which I attribute to the acid of vitriol having been diluted with water, and its combining on that account in a greater quantity with the calcareous earth of the ſpar. The ſaline part by evaporation and cryſtallization produced ʒij. and gr. xxviii. of ſalt, compoſed of ſmall long cryſtals, like Epſom ſalts; it taſte was bitter and ſtyptic.

This ſpar, in its natural ſtate, effervesces ſtrongly with rectified acid of ſalt, produces heat, and totally diſſolves in it; the ſolution is of a fine yellow colour.

Rectified acid of nitre diſſolves alſo this ſpar with effervesence and heat; but the ſolution is colourleſs.

I judged from the foregoing experiments that this ſpar was compoſed of calcareous earth, ſome iron, and a portion of ſome other earth, which, with acid of vitriol, forms a ſoluble ſalt.

EXPERIMENT III.

In order to determine the quantity of calcareous earth this ſpar contained, I diſſolved three drams of it in rectified acid of ſalt, and by the addition of a ſufficient quantity of a ſolution of tartar of vitriol in water, I obtained a ſelenite,

a ſelenite, which, when waſhed and dried with a ſtrong heat, weighed ʒ iij. and gr. xxxvi.

Three drams of dried whiting, diſſolved in the ſame acid, and treated in the like manner, afforded ʒ iv. and gr. xviii. of ſelenite. The whiting was all diſſolved, except three grains. The calcareous earth contained in the ſpar muſt, by its formation into ſelenite, be increaſed in weight in the ſame proportion as the whiting; and hence it is evident, that three drams of this ſpar contains ʒ j ff. and gr. xix, of calcareous earth. The remaining part muſt be the earth above-mentioned, with ſome iron.

EXPERIMENT IV.

In order to judge of the quantity of iron that this ſpar contained (not having any more of it left) I took the ſalt of the firſt experiment, and diſſolved it with water, to which I added ſome acid of ſalt. I then precipitated the iron in form of Pruſſian blue with the common alkaline *lixivium* uſed for that purpoſe, and thereby obtained ſixteen grains of a fine deep-coloured blue. Acid of ſalt was added in the uſual manner, to heighten the colour, by which means nothing but iron was precipitated.

Two drams of common green copperas, treated in the ſame manner, produced ʒ j. leſs than two grains of the

ſame ſort of blue, though not ſo good. Hence we may conclude, that the ſalt of the firſt experiment, which was produced by three drams of ſpar with acid of vitriol, contained thirteen grains of vitriol of iron.

Pruſſian blue, made without help of allum, contains nearly half its weight of iron. Hence, from the foregoing experiments, three drams of this ſpar contain gr. viii. of iron, ʒj. and gr. xlix. of calcareous earth, and ʒj. gr. iij. of the earth of *ſal catharticus amarus*, or perhaps ſome other earth, which forms, with acid of vitriol, a ſoluble ſalt.

The ſpathoſe iron ore being frequently found cryſtallized like the foregoing new ſpar, and having alſo a gloſs on it, I was willing to try whether it had any affinity with it; but by the following experiments it appears to be of a different nature, not containing any calcareous earth.

The ſpathoſe iron ore diſſolves almoſt totally in acid of ſalt, and the ſolution is of a deep yellow colour. A ſolution of tartar of vitriol in water added to it cauſes no precipitation; and hence it is evident, that it contains no calcareous earth. Acid of vitriol treated with the ſpathoſe iron diſſolves the whole of it, excepting a few dregs; another proof of its containing no calcareous earth. The acid of nitre diſſolves alſo this ſpar, and the ſolution is colourleſs.