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*XXVII. *Experiments and Obſervations upon a blue Subſtance, found in a Peat-moſs in* Scotland: *By* Sylveſter Douglas, *Eſquire.*

Read February 13, 1766.

THE blue coloured ſubſtance, which is the ſubject of the following obſervations, and which is now before you, was accidentally dug up in the ſummer 1759, in order to mix with ſome other materials for the purpoſe of manure, to be laid on ſome ground, at preſent in my poſſeſſion, in the north of Scotland, about twelve miles from Aberdeen.

I have not met with a deſcription of this ſubſtance in any naturaliſt. Kentman indeed in a few lines mentions a blue earth, which he calls *cæruleum Patavinum*, which agrees with the ſubſtance I am about to deſcribe, in one remarkable circumſtance; that it is at firſt of a white colour, and becomes blue only in conſequence of being expoſed to the air. Mr. Da Coſta's *ochra friabilis cærulea* †, would alſo have been found probably to correſpond with it, if a more particular account could have been given of the circumſtances in which it was found, and its appearance before the air had acted upon it. Mr. Cronſtedt, in

* This paper, having being miſlaid, could not be printed in the Volume of the Philoſophical Tranſactions for 1766.

† Nat. Hiſt. of Foſſ. p. 103.

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his late Syſtem of mineralogy, mentions a blue ſubſtance, which ſeems to be of the ſame kind, and which, I think, he ſays, is found ſomewhere in Pruſſia. His account of it is very ſhort; and I am not very certain with regard to it, as I have not the book by me.

The place, where it is dug up, is of a marſhy nature, in the corner of an exhauſted peat-moſs. Immediately under the ſward lies a *ſtratum*, about a foot deep, of common peat; next to that is the ſubſtance itſelf, with irregular *ſtriæ* of a peaty matter all through it, to the depth of near another foot; and below this, I think, there is clay. While it is thus wet, and ſhut out from the air, it is of a white colour, and ſeemingly of a fatty conſiſtence, not unlike lime that has been prepared for cement. All the water in the neighbourhood of the place is in ſome meaſure impregnated with iron. When this ſubſtance is expoſed to the air, it gradually as it dries aſſumes the blue colour; the peaty matter intermixed with it continuing of the ſame appearance as before. The whole mixed maſs is of a very friable texture, eaſily crumbling betwixt the fingers; and the blue part, gently rubbed between them, feels like a fine impalpable powder. It has hardly any ſenſible taſte; what it has, approaches a little to that of ſulphur: the ſmell, when it is firſt taken up, is ſenſibly ſulphureous, and if a piece of paper, with part of it adhering to it, be kindled, it ſhews a flame ſimilar to burning ſulphur.

The only means of ſeparating it from the black matter is by elutriation. When water is poured on it, and they are ſhaken together, and then left at reſt for ſome time, the black part ſubſides to the bottom,

and the blue can be poured off ſtill diffuſed in the water, from which however it ſoon ſeparates, and falls to the bottom. It is not poſſible entirely to free the blue from the peaty matter, for, after above twenty different additions of water, there were ſtill ſtreaks of black interſperſed through it, when it was allowed to ſubſide; neither have I ever been able to ſeparate all the blue from any of the black part.

When a little water is added to a quantity of it, it acquires ſome degree of tenacity, and when a ſmall portion of water is allowed to ſtand on its ſurface for a day or two, the water becomes of a yellowiſh colour.

Theſe are the chief circumſtances relating to its natural hiſtory, and the obvious properties it diſcovers without the aſſiſtance of chemical operations. The following are the experiments I have made upon it, with a view to diſcover its nature more particularly.

In order to find whether there was any part of it ſoluble in water, I paſſed a large quantity of water, which I had uſed in ſeparating the black from it, through a filter, and then ſet it to evaporate in B M; but there was nothing left in the veſſel after the evaporation, except ſome earth, which the water had probably contained in itſelf.

To a quantity of the blue powder, I added the common vitriolic acid of the ſhops; a degree of efferveſcence enſued, and a conſiderable froth remained for ſome time on the ſurface; the whole was changed into a dark brown colour, and, when filtrated, the ſolution was a tranſparent brown liquor. A conſiderable ſediment remained behind on the filter; but I am inclined to think, that this conſiſted chiefly of the peaty

peaty matter, which had not been entirely ſeparated; for when the experiment was repeated ſeveral times with different parcels of the blue, it appeared more or leſs ſoluble according as the black had been more or leſs perfectly ſeparated; and when I added the vitriolic acid to a quantity of the black, though it turned it all of a brown colour, it only ſeemed to diſſolve a quantity equal to the portion of blue, which ſtill adhered to it.

The nitrous acid, added to the blue powder, produced pretty much the ſame effects, only the filtrated ſolution was of a much lighter brown.

The fixed vegetable alkali diſſolved alſo a conſiderable part of it; but whether the whole or not, I cannot ſay. The ſolution was an opaque brown liquor, which did not become tranſparent after being twice filtrated, though it depoſited no ſediment upon ſtanding ſeveral days.

I added a ſmall quantity of volatile alkali to it, which ſeemed to diſſolve part of it, and turned the reſt obſcurely green.

To the ſolution in vitriolic acid, I joined ſome fixed vegetable alkali: an efferveſcence aroſe, and a light curd of a colour between green and blue was thrown to the top, which ſoon ſubſided, and became white.

A ſimilar præcipitate was obtained from the nitrous acid, only it was not at firſt thrown up to the ſurface in the ſame manner as the foregoing.

From the ſolution in fixed vegetable alkali, a reddiſh brown præcipitate was obtained, by the addition of vitriolic acid. Equal quantities of the blue powder and of black flux were mixed together, and being

put into a crucible, were kept in a ſtrong degree of heat for ſeveral hours: on being removed, and taken out of the crucible, the whole was found concreted into a ſpungy maſs, the bottom of which was cruſted over with ſomething that had a kind of metallic appearance. This maſs was powdered, and the lighter parts waſhed off; after which, a magnet was applied to what remained, and it attracted many of its particles ſtrongly, without being brought in contact with them.

Part of the white præcipitate from vitriolic acid was mixed with a little fixed alkali, and being laid on a piece of charcoal, the flame of a candle was directed to it by means of a blow-pipe. It was thus kept in a red heat for about an hour, and on being removed, the magnet was applied to it, but none of the powder was attracted by it. The quantity that can be examined in this way does not exceed a few grains.

To a ſmall quantity of the white præcipitate, I added an infuſion of tea; which turned it blue, approaching to the original colour, but not ſo deep.

To another parcel of the ſame, I added ſome infuſion of galls, and ſhook them together. The liquor became of a dark blue colour, and what part of the powder remained at the bottom of the glaſs was of the ſame colour. This was not ſo bright as that of the original powder diffuſed in water, but entirely ſuch as might be expected from the diffuſion of it in a brown liquor like infuſion of galls; and, to ſhew this, I poured ſome of the infuſion of that aſtringent on the blue ſubſtance itſelf, and on ſhaking them together, they produced a colour almoſt entirely the ſame.

A quantity of the brown ſolution in vitriolic acid was diluted with water till it became very pale. I then poured to it ſome infuſion of galls, which turned it immediately black.

A parcel of the blue ſubſtance, being placed at the diſtance of a foot from the fire, was changed to a greeniſh colour.

Theſe experiments, compared with its natural hiſtory, ſeem to throw ſome light on the nature and compoſition of this curious production. It is the known property of all vegetable aſtringents, to affect the colour of iron, either when it is combined with vitriolic acid, in the form of green vitriol, or by itſelf; and I believe they have no ſuch effect on any other metal. The colour they produce with it is various, inclining indeed to black, but almoſt of every different ſhade between black and blue; and it ſeems to me, that they occaſion a more pure black with vitriol, and a purple blue with iron itſelf, as is ſeen for inſtance on dropping a little infuſion of tea on a knife.

Now we find, that when a vegetable aſtringent is added to a ſolution of this ſubſtance in vitriolic acid, it ſtrikes a black colour with it, and reſtores the original blue to the white præcipitate from that acid. We alſo find, that there actually is iron contained in it; becauſe, when fluxed with the black flux, its particles are attracted by the loadſtone; and we can draw no argument, from our not having diſcovered iron in the experiment with the blow-pipe, againſt the preſence of that metal, as ſo little can be examined in that way. I therefore think it probable, that the principal ingredients of it, and thoſe on which its colour

colour depends, are iron and ſome vegetable aſtringent. The ſituation in which it is found favours this conjecture very ſtrongly; for, in the firſt place, the water in the neighbourhood of it is all impregnated with iron; and ſecondly, in almoſt every peat-moſs, there are the remains of oak trees, ſtill freſh diſperſed through them; and both their wood and bark are of a ſtrong aſtringent nature.

I do not pretend to ſay, that theſe are its only ingredients. I think we may conclude, from the lightneſs of the ſubſtance, that iron does not form a very great part of it; and the ſmell, and the particular flame it exhibits in burning, would ſeem to ſhew the preſence of ſulphur in it. This, however, can be only in a very ſmall proportion, ſince ſo much of it is ſoluble in acids, which do not at all affect ſulphur. I ſuppoſe the præcipitate from acids conſiſts chiefly of iron and earth.

I have made ſome trials on the blue powder after it was partly well freed from the black matter, in order to ſee how far it might be uſeful as a paint: a quantity of it was rubbed in a glaſs mortar with oil of walnuts; but, after being thoroughly mixed with the oil, its colour was changed to black. It is probable, therefore, that little can be expected from it as an oil colour; but it retains its natural brightneſs when mixed with gum-water; and, as it is naturally in a very fine powder, it is diffuſed intimately through it without any difficulty, ſo that, if it could be got in ſufficient quantity, it would be a cheap and uſefull water-colour. I think there is reaſon to believe, that it might be found in moſt peat-moſſes, as what ſeem to be the materials of which it is compoſed are pre-

ſent almoſt in all of them. Two or three years ago a gentleman ſent me a parcel of it, which he found in a moſs on his eſtate, five or ſix miles diſtant from the place where I firſt obſerved it. I am informed, that Mr. Da Coſta has had ſpecimens of a blue earth ſent him from different parts of England: what Sir Hans Sloane gave him from Ireland ſeems alſo to have been the ſame, and, from what I have quoted from Kentman and Cronſtedt, it would appear, that it is obtained on ſeveral parts of the continent. From all this, I think we may conclude, that it might be procured in ſufficient quantity to be a cheap paint; particularly as it is in a manner levigated and prepared by nature.

It is to be lamented, that its colour is ſo eaſily affected by alkalies, eſpecially the volatile alkali, which abounds ſo much in the atmoſphere in towns, and by any conſiderable degree of heat. I have, never however, found any change produced on it from being expoſed for a conſiderable time to the air, or to the heat of a room where a fire was kept conſtantly burning.