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NATURAL HISTORY,

AGRICULTURE, AND THE ARTS.

BY THOMAS THOMSON, M.D. F.R.S. L. & E. F.L.S. &c.

MEMBER OF THE GEOLOGICAL SOCIETY, OF THE WERNERIAN SOCIETY, AND OF THE
IMPERIAL MEDICO-CHIRURGICAL ACADEMY OF PETERSBURG.

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method is found to afford a better preparation than was formerly obtained from twice the quantity of cinchona.

The stratum of bark should be of such a thickness that the water may neither pass through too slowly nor too rapidly. I have found a strainer of two inches, three inches, or four inches diameter, most suitable for $\frac{1}{4}$ oz., 1 oz., or 2 oz. of cinchona.

I remain, Sir, your obedient servant,

Lancaster, April 15, 1817.

C. JOHNSON.

ARTICLE VII.

*Abstract of a Memoir entitled Examination of some Minerals found in the Neighbourhood of Fahlun, and of their Situation. By J. G. Gahn, J. Berzelius, C. Wallman, and H. P. Eggertz. Inserted in the fifth Volume of the Afhandlingar i Fysik, Kemi och Mineralogi.**

THE neighbourhood of Fahlun being remarkable for the great variety of uncommon minerals which have been found in it, Messrs. Gahn, Berzelius, Wallman, and Eggertz, undertook to examine them, both in a mineralogical and geognostic point of view; and in the excursions which they made last summer for that purpose their attention was fixed chiefly on the excavations at Finbo.

While analyzing the deuto-fluate of cerium, and the double fluate of cerium and yttria, Berzelius found in them a new earth, which he had extracted the preceding year from the gadolinite of Korarvet, but in too small quantity to be able at that time to determine its properties with the requisite precision. I shall extract from the memoir in question every thing that concerns the new earth.

Minerals in which the new Earth is found.

The neutral *deuto-fluate of cerium* of Finbo is of a deeper red than that of Broddbo. It is sometimes found crystallized in six-sided prisms, the length of which exceeds the breadth, sometimes in plates more or less thin, and sometimes in irregular amorphous masses. It is imbedded in a rock composed of albite, quartz, and mica, and is accompanied by emeralds and ytthro-tantalite; but it occurs so sparingly that all the specimens which we found were hardly sufficient for a single analysis. I satisfied myself, therefore, with ascertaining by small experiments that it is a neutral fluate of cerium; and by means of the blow-pipe I have satisfied myself that

* This volume has not yet been published. For the present abstract I am indebted to the Chevalier d'Ohsson, who kindly translated it from the Swedish original, of which he was possessed of a copy.—T.

its deeper colour is owing to the presence of a greater proportion of manganese.

The rarest variety is that which is amorphous, and presents no marks of crystallization. Some of the experiments made upon it deserve to be stated here, though they cannot be considered as exhibiting an exact analysis.

A. Forty-eight parts of it being reduced to an impalpable powder, and calcined in a red heat, were submitted to the action of concentrated sulphuric acid, which occasioned the separation of the fluoric acid gas, and converted the mass into a semiliquid substance of a fine deep brown colour. After two hours' digestion it was brought in contact with a little water, which occasioned a slight muddiness. The yellow liquid was decanted off, and mixed with hot water, which occasioned still greater opacity. The precipitate, being collected on the same filter as the undissolved portion, and being washed and heated to redness, weighed 9.6 parts.

B. The liquid was mixed with sulphate of potash till the whole of the cerium separated. When properly washed and dried, the oxide of cerium obtained weighed 26.3 parts.

C. The solution was then treated with ammonia. The resulting precipitate weighed, after calcination, 1.525 parts; and I found by an examination which I conceive it to be unnecessary to state separately, a mixture of yttria, alumina, oxide of manganese, and silica.

D. The 9.6 parts that had not been dissolved by sulphuric acid were digested at the temperature of boiling water in muriatic acid, which dissolved them with the exception of 2.5 parts, which were silica mixed with a trace of proto-fluate of cerium.

E. The muriatic solution was mixed with caustic ammonia. The precipitate, being thrown upon a filter, was well washed, and dissolved while still moist in nitric acid; and this solution was left to evaporate spontaneously in a warm place. It produced a gummy mass, deliquescing in the air, which, being dissolved in a greater quantity of water, and boiled, let fall a white gelatinous precipitate, which was collected on the filter. It weighed three parts. Caustic ammonia, being mixed with the remaining solution, precipitated oxide of cerium, which still contained a portion of the earth precipitated by boiling. I shall describe below the experiments made on this earth.

The analysis, then, had assigned oxide of cerium as the principal substance, and had given the total quantity of 37.4 of solid matter. The loss, amounting to 10.6, greatly exceeds the quantity of fluoric acid which was requisite to saturate the different bases. This excess of loss is no doubt owing to the fluoric acid having carried off with it a portion of silica, which in all probability was only mechanically mixed, as it is in the minerals which I shall mention immediately.

Double Fluuate of Cerium and Yttria.—There is an earthy mineral found at Finbo which is much more common than the neutral fluates and subfluates of cerium; but its size seldom exceeds that of

a pea. Its most usual colour is pale red, similar to that of a mixture of carmine and white lead; but it is sometimes white, or deep red, or nearly yellow. It is so soft that it may be easily scratched by the nail, and it may be easily detached from its matrix by the fingers. It then leaves a rough irregular cavity.

This mineral occurs likewise in irregular amorphous masses of a reddish-brown colour, sometimes separate, sometimes surrounding gadolinite, or mixed with it so as to appear a part of it. It never shows any tendency to assume a regular figure, or a crystalline texture.

I have made several analyses of this mineral, which have all given different results; which shows that the relative quantities of its constituent parts are very variable.

While analyzing a specimen of this mineral, which did not differ in its external appearance from other specimens, I found a new quantity of the same earth which had been extracted from the amorphous neutral deuto-fluate of cerium. I shall state briefly this experiment.

Twenty-two parts of the pulverized mineral were treated with sulphuric acid, which decomposed it, with the exception of 3.5 parts. The solution was mixed with sulphate of potash, to separate the oxide of cerium. It weighed two parts. I then added caustic ammonia. The precipitate which fell, being heated to redness, weighed 15.5 parts. I poured muriatic acid on it, which readily dissolved a portion of it. The residue was only dissolved by means of a long digestion. The liquid was evaporated to dryness by means of a gentle heat, in order to drive off the excess of acid. I then poured water over it, which dissolved the muriate of yttria. The residue was dissolved in muriatic acid, and the liquid was saturated by caustic ammonia as accurately as possible. I then added water, and caused it to boil. A white gelatinous precipitate fell, which was collected on the filter. The liquor that passed through the filter was again saturated by caustic ammonia, and heated to ebullition, which occasioned the precipitation of a new portion of the same earth. When washed and slightly dried, it weighed seven parts. In the 3.5 parts of yttria separated from the 15.5 parts I found, by means of caustic potash, a small quantity of alumina; the weight of which, however, I did not exactly determine.

Particular Examination of the new Earth.

While I was examining the composition of gadolinite during the summer of 1815, I obtained in one of my analyses a peculiar substance, amounting to 30 per cent. of the weight of the mineral, and which possessed properties different from the other earths. It was absolutely similar to the substance just found at Finbo. It was separated from gadolinite in the following manner:—The mineral having been dissolved in nitro-muriatic acid, the filtered solution was saturated by caustic ammonia, and precipitated by succinate of ammonia, having a slight excess of acid. The liquor being filtered,

I mixed it with sulphate of potash, which occasioned a precipitate. Before separating the yttria, I wished to prevent the oxide of manganese from being deposited along with it. For this purpose I filtered into the liquid a boiling solution of muriate of ammonia, in order to form a double salt composed of muriate of ammonia and proto-muriate of manganese, which would prevent this last oxide from being precipitated by the ammonia. The consequence was a bulky white deposit. I continued to pour in the salt till all precipitation was at an end. The precipitate was thrown upon a filter, washed, and dried. Perceiving that it was a substance different from any which I expected to find in gadolinite, I wished to prepare a greater quantity of it. But though I endeavoured with the greatest care to ascertain all the external differences which the specimens of gadolinite from Korarvet exhibited, and examined each of them separately, I could not obtain the smallest trace of the substance, though I had fallen upon pretty correct methods of separating it from yttria and oxide of cerium, even when it existed only in small proportions. I therefore deferred to a future opportunity further researches on this substance, without even mentioning it in the analysis of that variety of gadolinite, because I still considered its existence as problematic. Having found it again at Finbo, I endeavoured to determine its properties more exactly; but as it happens here also that the same mineral does not always contain it, or that minerals which contain it are absolutely similar to those which do not contain it, I could not be sure at present of obtaining a new portion of it, without destroying a great part of the specimens of a mineral which is very rare. I have thought it right, therefore, in the present uncertainty, to describe it such as I have found it, that if it be discovered hereafter in greater abundance, as it is probable it will, my statements may facilitate the means of separating and examining it. I may state here, by way of apology for the imperfection of this notice, that I have not had altogether half a gramme of this earth to make my experiments with.

To obtain it from those minerals that contain protoxide of cerium and yttria, we must first separate the oxide of iron by succinate of ammonia. The new earth, indeed, may, when alone, be precipitated by the succinates; but in the analytical experiments in which I have obtained it, it precipitated in so small a quantity along with iron, that I could not separate it from that oxide. The deutoxide of cerium is then precipitated by the sulphate of potash; after which the yttria and the new earth are precipitated together by caustic ammonia. Dissolve them in muriatic acid. Evaporate the solution to dryness, and pour boiling water on the residue, which will dissolve the greatest part of the yttria; but the undissolved residue still contains a portion of it. Dissolve it in muriatic or nitric acid, and evaporate it till it becomes as exactly neutral as possible. Then pour water upon it, and boil it for an instant. The new earth is precipitated, and the liquid contains disengaged acid. By satu-

rating this liquid, and boiling it a second time, we obtain a new precipitate of the new earth.

This earth, when separated by the filter, has the appearance of a gelatinous, semitransparent mass. When washed and dried, it becomes white, absorbs carbonic acid, and dissolves with effervescence in acids. Though calcined, it retains its white colour; and when the heat to which it has been exposed was only moderate, it dissolves readily in muriatic acid; but if the heat has been violent, it will not dissolve till it be digested in strong muriatic acid. This solution has a yellowish colour; but it becomes colourless when diluted with water, as is the case with glucina, yttria, and alumina. If it be mixed with yttria, it dissolves more readily after having been exposed to heat. The neutral solutions of this earth have a purely astringent taste, which is neither sweet, nor saline, nor bitter, nor metallic. In this property it differs from all other species of earths except zirconia.

When dissolved in *sulphuric acid* with a slight excess of acid, and subjected to evaporation, it yields transparent crystals, which are not altered by exposure to the air, and which have a strong styptic taste.

The mother water remaining after the formation of these crystals retains but very little of the earth. When the crystals are exposed to the action of water, they are entirely decomposed. The solution becomes muddy, a subsulphate precipitates, and a supersulphate remains in solution. When this solution is boiled, it lets fall no precipitate. If the crystals of the sulphate of the new earth are exposed to the action of water in a state of rest, the subsulphate which remains undissolved retains the form of the crystals; but upon the least movement they fall to powder. The acid solution, when mixed with sulphate of potash till saturation, does not let fall any precipitate; neither does any precipitate appear when sulphate of potash is dropped into the muriate of this earth. If the liquid be raised to the boiling temperature, a portion of the earth precipitates in the state of subsulphate, and a portion remains in the liquid, which may be precipitated by means of caustic ammonia.

This earth dissolves very easily in nitric acid; but, after being heated to redness, it does not dissolve in it except by long boiling. The solution does not crystallize, but forms a mucilaginous mass, which becomes more liquid by exposure to the air, and which, when evaporated by a moderate heat, leaves a white, opaque mass, similar to enamel, in a great measure insoluble in water. When the neutral solution of this nitrate in water is boiled, a great portion of the earth is precipitated. If the solution contain an excess of acid, it allows a portion of the earth to precipitate when it is diluted with water and boiled. A slight calcination of the nitrate leaves the earth with its white colour, so that we discover no evidence of a higher degree of oxidizement.

It dissolves in muriatic acid, in the same manner as in nitric acid.

The solution does not crystallize. When evaporated by a moderate heat, it is converted into a syrupy mass, which does not deliquesce in the air, but dries, becomes white like enamel, and afterwards dissolves only in very small quantity in water, leaving a subsalt undissolved; so that by spontaneous evaporation it lets the portion of muriatic acid escape to which it owed its solubility. A solution of this muriate, not too acid, and diluted with water, when raised to the boiling temperature, lets fall the greatest portion of the earth in the form of a gelatinous mass, light, and semitransparent. A solution of this earth in muriatic or nitric acid, when evaporated by a strong heat, leaves on the edges of the vessel a white, opaque film, having the appearance of enamel. It appears very distinctly when the liquid is made to pass over the inside of the glass. This is a very characteristic mark of this earth; and I am not aware that it belongs to any other substance, except to the solution of phosphate of iron in nitric acid, which however does not present the phenomenon in so eminent a degree. I have been able from this layer of enamel to determine very well beforehand whether the mineral which I was analyzing contained this earth or not. This mark, however, is less evident when the earth is mixed with a considerable quantity of yttria and protoxide of cerium.

This earth combines with avidity with carbonic acid. The precipitates produced by caustic ammonia, or by boiling the neutral solutions of the earth in acids, absorb carbonic acid from the air in drying. The alkaline carbonates precipitate the earth combined with the whole of their carbonic acid.

The *oxalate of ammonia* throws down a white, voluminous precipitate, insoluble in water as well as in caustic alkalies.

The *tartrate of ammonia* produces a white precipitate, which redissolves at first, and does not become permanent till a sufficient quantity of the salt has been added. This precipitate is redissolved by caustic ammonia. Boiling drives off the ammonia; but the earth is not deposited till the liquid has been concentrated to a certain degree by evaporation. It then precipitates under the form of a gelatinous mass, almost transparent.

The *citrate of ammonia* does not occasion any precipitate, not even when caustic ammonia is added to it; but if the liquid be boiled, the earth precipitates in proportion as the ammonia evaporates. This precipitate is analogous to those that are produced by boiling in the other neutral solutions of this earth.

The *benzoate of ammonia* produces a white, bulky precipitate.

The *succinate of ammonia* occasions a precipitate, which is immediately redissolved. If a sufficient quantity be added to prevent the precipitate from redissolving, and if we attempt to redissolve it by pouring in water, it is decomposed, and remains in a great measure undissolved, under the form of a salt with excess of base, while the liquid contains the greatest part of the acid united to a small portion of the earth.

The *ferruginous prussiate of potash* poured into a solution of this

earth, throws down a white precipitate, which is completely re-dissolved by muriatic acid.

Caustic potash and ammonia have no action on this earth newly precipitated, not even at a boiling temperature.

The solution of carbonate of potash or carbonate of ammonia dissolves a small quantity of it, which precipitates again when the liquid is supersaturated with an acid, and then neutralized by caustic ammonia; but this earth is much less soluble in the alkaline carbonates than any of the earths formerly known that dissolve in them.

A portion of this earth weighing 12 parts was exposed in a charcoal crucible to the heat employed to reduce tantalum, and the fire was kept up for an hour. When withdrawn, it did not appear to have undergone any other alteration than to have contracted in its dimensions, and to have acquired a slight transparency, having probably been near the fusing point. It exhibited no appearance of reduction, and was dissolved by boiling in muriatic acid. As it is at present generally known that the salifiable bases are metallic oxides, it may appear indifferent whether we say *earth* or *metallic oxide*. But these substances being divided into alkalis, earths, and metallic oxides, the proper method seems to be to attach every new link of the chain of oxides to those with which it has the greatest analogy. And since the earths are distinguished chiefly by being colourless, and by being irreducible when heated with charcoal without the assistance of a foreign metal, I consider the substance which has been just described as belonging particularly to the class of earths.

Although the experiments of which I have just given an account cannot certainly be considered as more than preparatory to a more complete examination of this earth, when a greater quantity of it is found, I have thought that it would be convenient to give it a name, that it might be pointed out more easily. A part of these experiments having been made in the laboratory of Mr. Gahn, at Fahlun, we were accustomed to speak of it to each other under the appellation *thorina*, from *Thor*, an ancient Scandinavian deity. It may, therefore, not be unsuitable to distinguish it provisionally by this denomination.

Thorina does not fuse before the blow-pipe. With borax it melts into a transparent glass, which, when exposed to the exterior flame, becomes opaque and milky. With phosphate of soda it fuses into a transparent pearl. It is infusible with soda. When soaked with a solution of cobalt, it becomes greyish-brown.

Thorina differs from the other earths by the following properties :

From *alumina*, by its insolubility in hydrate of potash; from *glucina*, by the same property; from *yttria*, by its purely astringent taste without any sweetness, and by the property which its solutions possess of being precipitated by boiling when they do not contain too great an excess of acid. It differs from zirconia by the following properties: 1. After being heated to redness, it is still capable of

being dissolved in acids. 2. Sulphate of potash does not precipitate it from its solutions, while it precipitates zirconia from solutions containing even a considerable excess of acid. 3. It is precipitated by oxalate of ammonia, which is not the case with zirconia. 4. Sulphate of thorina crystallizes readily, while sulphate of zirconia, supposing it free from alkali, forms, when dried, a gelatinous, transparent mass, without any trace of crystallization.

As thorina has a greater analogy with zirconia than with any other body, and as the two earths occur together at Finbo, it may be useful perhaps to exhibit here a parallel between their properties:—

Thorina.

Taste of the neutral solutions purely astringent.

Crystallizes easily with sulphuric acid. The crystals are decomposed by water.

The muriatic solution gives a precipitate when boiled. This precipitate is bulky, semitransparent, and gelatinous. Muriate of thorina does not crystallize.

The nitric solution, when boiled, lets fall a gelatinous earth.

Alkaline *succinates*, *benzoates*, and *tartrates*, occasion a precipitate in the solution of thorina. The precipitate by an alkaline tartrate is dissolved by hydrate of potash.

The *citrates* occasion no precipitate; but a precipitate appears when the liquid is boiled.

Oxalate of ammonia precipitates thorina from its solution in sulphuric acid.

Sulphate or muriate of thorina dissolved in water, and mixed to saturation with sul-

Zirconia.

The same.

Does not crystallize, but becomes mucilaginous; and when long exposed to a moderate heat becomes white, opaque, saline. Deliquesces in the air; but becomes muddy when water is poured into it, unless the solution be very acid. The dried salt can bear a moderate heat, without being more than partially decomposed.

The muriatic solution is precipitated by boiling. The precipitate is a heavy, white, opaque powder. Muriate of zirconia crystallizes by evaporation.

The same.

The same.

The *citrates* occasion no precipitate, nor does one appear when the liquid is boiled.

Oxalate of ammonia throws down no precipitate from sulphate of zirconia.

A salt of zirconia dissolved in water, and mixed to saturation with sulphate of potash, is en-

Thorina.

phate of potash, lets fall no precipitate.

Insoluble in hydrate of potash.
Soluble in alkaline carbonates.

Becomes by calcination difficult of solution.

Zirconia.

tirely precipitated. If this is done in the cold, the precipitate is entirely soluble in water.

The same.
The same, but in much greater quantity.

When heated to redness, becomes insoluble.

These two earths exhibit the same properties before the blow-pipe.*

I have reason to presume that the thorina found in the mineral from Korarvet, which I analyzed, was in the state of a *silicate*, similar to gadolinite; but that the portion found at Finbo was in a state of combination with fluoric acid.

ARTICLE VIII.

Magnetical and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude $51^{\circ} 37' 42''$ North. Longitude west in time $1^{\circ} 20' 7''$.

Magnetical Observations, 1817. — Variation West.

Month.	Morning Observ.		Noon Observ.		Evening Observ.	
	Hour.	Variation.	Hour.	Variation.	Hour.	Variation.
April 18	8h 45'	24° 30' 51''	1h 45'	24° 44' 38''	6h 45'	24° 35' 23''
19	8 45.	24 30 33	1 45	24 44 54	6 45	24 35 47
20	8 45	24 31 05	1 55	24 42 00	6 45	24 35 13'
21	8 45	24 30 08	1 45	24 44 58	6 45	24 35 36
22	8 45	24 33 53	1 45	24 42 16	6 40	24 36 18
23	8 40	24 32 32	1 45	24 43 48	6 45	24 35 50
24	8 45	24 33 21	1 45	24 46 58	6 45	24 37 06
25	8 40	24 32 57	1 45	24 45 31	6 45	24 35 37
26	8 45	24 32 46	1 45	24 43 06	6 45	24 33 26
27	8 45	24 34 14	1 45	24 45 40	6 45	24 35 33
28	8 45	24 29 27	1 45	24 40 08	6 45	24 35 37
29	8 35	24 30 39	1 55	24 40 37	6 45	24 34 01
30	8 45	24 30 21	1 55	24 42 00	— —	— — —
Mean for Month.	8 44	24 31 52	1 46	24 44 43	6 40	24 35 58

* I have read somewhere that zirconia gives a blue colour with cobalt, and hoped that this would furnish a ready method of distinguishing the two earths; but the blue colour does not appear except when the zirconia contains an alkali. When pure zirconia is obtained by expelling the acid from sulphate of zirconia by heat, it does not enter into fusion nor become blue with cobalt, but greyish-brown.