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BY WILLIAM NICHOLSON.

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metal for oxigen". Supposing the composition of the water in the first instance to take place according to Mr. Davy's views, then, in the second, the oximuriatic acid is attracted from the tin by the ammonia, at the same time it attracts, in its turn, the hidrogen of the water; and as by the attraction of the ammonia the affinity between the oximuriatic acid and tin is weakened, the tin by this being enabled to attract the oxigen of the water, and the oximuriatic acid attracting the hidrogen, the water is decomposed, and the oxide of tin and muriate of ammonia are formed.

I am, Sir,

Your humble servant,

Edinburgh, April the 9th, 1811. W. CRANE.

VIII.

Experiments on Allanite, a new Mineral from Greenland, by THOMAS THOMSON, ***M. D. F. R. S. E. Fellow of the Imperial Chirurgo-Medical Academy of Petersburgh.****

ABOUT three years ago, a Danish vessel† was brought into Leith as a prize. Among other articles, she contained a small collection of minerals, which were purchased by Thomas Allan, Esq., and Colonel Imrie, both members of this society. The country from which these minerals had been brought was not known for certain; but as the collection abounded in cryolite, it was conjectured, with very considerable probability, that they had been collected in Greenland. Collection of minerals in a Danish prize.

Among the remarkable minerals in this collection there was one, which, from its correspondence with gadolinite, as described in the different mineralogical works, particularly attracted the attention of Mr. Allan. Confirmed in the idea of its being a variety of that mineral by the opinion of One of these supposed to be gadolinite.

* From the Transactions of the Royal Society of Edinburgh.

† Der Fruhling, Captain Jacob Ketelsen, captured on her passage from Iceland to Copenhagen.

Count

Count Bournon, added to some experiments made by Dr. Wollaston, he was induced to give the description, which has since been published in a preceding part of the present volume.

About a year ago, Mr. Allan, who has greatly distinguished himself by his ardent zeal for the progress of mineralogy in all its branches, favoured me with some specimens of this curious mineral, and requested me to examine its composition; a request which I agreed to with pleasure, because I expected to obtain from it a quantity of *yttria*, an earth which I had been long anxious to examine, but had not been able to procure a sufficient quantity of the Swedish gadolinite for my purpose. The object of this paper is to communicate the result of my experiments to the Royal Society; experiments which cannot appear with such propriety any where as in their transactions, as they already contain a paper by Mr. Allan on the mineral in question.

Description of it.

Sect. 1. I am fortunately enabled to give a fuller and more accurate description of this mineral than that which formerly appeared, Mr. Allan having since that time discovered an additional quantity of it, among which he not only found fresher and better characterised fragments, but also some entire crystals. In its composition it approaches most nearly to cerite; but it differs from it so much in its external characters, that it must be considered as a distinct species. I have therefore taken the liberty to give it the name of Allanite, in honour of Mr. Allan, to whom we are in reality indebted for the discovery of its peculiar nature.

Allanite occurs massive and disseminated, in irregular masses, mixed with black mica and felspar; also crystallised; the varieties observed are,

1. A four-sided oblique prism, measuring 117° and 63°.

2. A six-sided prism, acuminated with pyramids of four sides, set on the two adjoining opposite planes. These last are so minute as to be incapable of measurement. But, as nearly as the eye can determine, the form resembles fig. 1, Pl. II; the prism of which has two right angles, and four measuring 135°.

3. A flat prism, with the acute angle of 63° replaced by one plane, and terminated by an acumination, having three principal

principal facettes set on the larger lateral planes, with which the centre one measures 125° and 55°. Of this specimen an engraving is given in the annexed plate, fig. 2.

Specific gravity, according to my experiments, 3·533. The specimen appears to be nearly, though not absolutely, pure. This substance, however, is so very much mixed with mica, that no reliance can be placed on any of the trials which have been made. Count Bournon, surprised at the low specific gravity noted by Mr. Allan, which was 3·480, broke down one of the specimens which had been sent him, in order to procure the substance in the purest state possible, and the result of four experiments was as follows.

4·001
3·797
3·654
3·119

In a subsequent experiment of Mr. Allan's, he found it 3·665. From these it appears, that the substance is not in a pure state. Its colour is so entirely the same with the mica, with which it is accompanied, that it is only by mechanical attrition that they can be separated.

Colour, brownish-black.

External lustre, dull; internal, shining and resinous, slightly inclining to metallic.

Fracture, small conchoidal.

Fragments, indeterminate, sharp-edged.

Opake.

Semihard in a high degree. Does not scratch quartz or felspar, but scratches hornblende and crown glass.

Brittle.

Easily frangible.

Powder, dark greenish-gray.

Before the blowpipe it froths, and melts imperfectly into a brown scoria.

Gelatinises in nitric acid. In a strong red heat it loses 3·98 *per cent* of its weight.

Sect. 2. My first experiments were made on the supposition, that the mineral was a variety of gadolinite, and were pretty much in the style of those previously made on that substance by Ekeberg, Klaproth, and Vauquelin. Experiments to ascertain its composition.

1. 100 grains of the mineral, previously reduced to a fine Silex.

powder in an agate mortar, were digested repeatedly on a sand bath in muriatic acid, till the liquid ceased to have any action on it. The undissolved residue was silica, mixed with some fragments of mica. When heated to redness, it weighed 33·4 grains.

Alumina.

2. The muriatic acid solution was evaporated almost to dryness, to get rid of the excess of acid, dissolved in a large quantity of water, mixed with a considerable excess of carbonate of ammonia, and boiled for a few minutes. By this treatment, the whole contents of the mineral were precipitated in the state of a yellowish powder, which was separated by the filter, and boiled, while still moist, in potash lie. A small portion of it only was dissolved. The potash lie was separated from the undissolved portion by the filtre, and mixed with a solution of sal ammoniac, by means of which a white powder precipitated from it. This white matter, being heated to redness, weighed 7·9 grains. It was digested in sulphuric acid, but 3·76 grains refused to dissolve. This portion possessed the properties of silica. The dissolved portion, being mixed with a few drops of sulphate of potash, shot into crystals of alum. It was therefore alumina, and amounted to 4·14 grains.

Metallic oxide.

3. The yellow matter, which refused to dissolve in the potash lie, was mixed with nitric acid. An effervescence took place, but the liquid remained muddy, till it was exposed to heat, when a clear reddish-brown solution was effected. This solution was evaporated to dryness, and kept for a few minutes in the temperature of about 400°, to peroxidize the iron, and render it insoluble. A sufficient quantity of water was then poured on it, and digested on it for half an hour, on the sand bath. The whole was then thrown upon a filter. The dark red matter, which remained on the filter, was drenched in oil, and heated to redness, in a covered crucible. It was then black, and attracted by the magnet; but had not exactly the appearance of oxide of iron. It weighed 42·4 grains.

Lime.

4. The liquid, which passed through the filter, had not the sweet taste which I expected, but a slightly bitter one, similar to a weak solution of nitrate of lime. Hence it was clear, that no yttria was present, as there ought to have been,

been, had the mineral contained that earth. This liquid being mixed with carbonate of ammonia, a white powder precipitated, which, after being dried in a red heat, weighed 17 grains. It dissolved in acids with effervescence; the solution was precipitated white by oxalate of ammonia, but not by pure ammonia. When dissolved in sulphuric acid, and evaporated to dryness, a light matter remained, tasteless, and hardly soluble in water. These properties indicate carbonate of lime. Now, 17 grains of carbonate of lime are equivalent to about 9·23 grains of lime.

5. From the preceding analysis, supposing it accurate, it followed, that the mineral was composed of Deductions.

Silica,	37·16
Lime,	9·23
Alumina,	4·14
Oxide of iron,	42·40
Volatile matter,	3·98
	96·91
Loss,	3·09
	100·00

But the appearance of the supposed oxide of iron induced me to suspect, that it did not consist wholly of that metal. I thought it even conceivable, that the yttria, which the mineral contained, might have been rendered insoluble by the application of too much heat, and might have been concealed by the iron, with which it was mixed. A number of experiments, which it is needless to specify, soon convinced me, that, beside iron, there was likewise another substance present, which possessed properties different from any that I had been in the habit of examining. It possessed one property at least in common with yttria; its solution in acids had a sweet taste; but few of its other properties had any resemblance to those which the chemists, to whom we are indebted for our knowledge of yttria, have particularised. But as I had never myself made any experiments on yttria, I was rather at a loss what conclusion to draw. From this uncertainty I was relieved by Mr. Allan, who had the goodness to give me a small fragment of The oxide examined.

gadolinite, which had been received directly from Mr Ekeberg. From this I extracted about 10 grains of yttria; and upon comparing its properties with those of the substance in question, I found them quite different. Convinced by these experiments, that the mineral contained no yttria, but that one of its constituents was a substance with which I was still unacquainted, I had recourse to the following mode of analysis, in order to obtain this substance in a pure state.

Analysis. Sect. III. 1. 100 grains of the mineral, previously reduced to a fine powder, were digested in hot nitric acid, till nothing more could be dissolved. The undissolved residue, which

Silex. was silica, mixed with some scales of mica, weighed, after being heated to redness, 35·4 grains.

Oxide of iron. 2. The nitric acid solution was transparent, and of a light brown colour. When strongly concentrated by evaporation, to get rid of the excess of acid, and set aside in an open capsule, it concreted into a whitish solid matter, consisting chiefly of soft crystals, nearly colourless, having only a slight tinge of yellow. These crystals, being left exposed to the air, became gradually moist, but did not speedily deliquesce. The whole was therefore dissolved in water, and the excess of acid, which was still present, carefully neutralised with ammonia. By this treatment the solution acquired a much deeper brown colour; but it still continued transparent. Succinate of ammonia was then dropped in with caution. A copious reddish-brown precipitate fell, which being washed, dried, and heated to redness in a covered crucible, weighed 25·4 grains. It possessed all the characters of black oxide of iron. For it was attracted by the magnet, completely soluble in muriatic acid, and the solution was not precipitated by oxalate of ammonia.

Another precipitate thrown down. 3. The liquid being still of a brown colour, I conceived it not to be completely free from iron. On this account, an additional quantity of succinate of ammonia was added. A new precipitate fell; but instead of the dark reddish-brown colour, which characterises succinate of iron, it had a beautiful flesh-red colour, which it retained after being dried in the open air. When heated to redness in a covered crucible,

crucible, it became black, and had some resemblance to gunpowder. It weighed 7·2 grains.

4. This substance attracted my peculiar attention, in consequence of its appearance. I found it to possess the following characters: This examined.

a. It was tasteless, and not in the least attracted by the magnet, except a few atoms, which were easily separated from the rest. Its characters.

b. It was insoluble in water, and not sensibly acted on when boiled in sulphuric, nitric, muriatic, or nitro-muriatic acid.

c. Before the blowpipe it melted with borax and microcosmic salt, and formed with both a colourless bead. With carbonate of soda it formed a dark-red opake bead.

d. When heated to redness with potash, and digested in water, snuff-coloured flocks remained undissolved, which gradually subsided to the bottom. The liquid being separated, and examined, was found to contain nothing but potash. When muriatic acid was poured upon the snuff-coloured flocks, a slight effervescence took place, and when heat was applied, the whole dissolved. The solution was transparent, and of a yellow colour, with a slight tint of green. When evaporated to dryness, to get rid of the excess of acid, a beautiful yellow matter gradually separated. Water boiled upon this matter dissolved the whole. The taste of the solution was astringent, with a slight metallic flavour, by no means unpleasant, and no sweetness was perceptible.

e. A portion of the black powder being exposed to a red heat for an hour, in an open crucible, became reddish-brown, and lost somewhat of its weight. In this altered state, it was soluble by means of heat, though with difficulty, both in nitric and sulphuric acids. The solutions had a reddish-brown colour, a slight metallic astringent taste, but no sweetness.

f. The solution of this matter in nitric and muriatic acid, when examined by reagents, exhibited the following phenomena: Action of reagents on its solution.

(1.) With prussiate of potash, it threw down a white precipitate in flocks. It soon subsided; readily dissolved in nitric acid; the solution was green.

(2.)

(2.) Prussiate of mercury. A light yellow precipitate, soluble in nitric acid.

(3.) Infusion of nut galls. No change.

(4.) Gallic acid. No change.

(5.) Oxalate of ammonia. No change.

(6.) Tartrate of potash. No change.

(7.) Phosphate of soda. No change.

(8.) Hydrosulphuret of ammonia. Copious black flocks. Liquor remains transparent.

(9.) Arseniate of potash. A white precipitate.

(10.) Potash. ..... } Copious yellow-coloured
(11.) Carbonate of soda. } flocks; readily dissolved in
(12.) Carbonate of ammonia. } nitric acid.

(13.) Succinate of ammonia. A white precipitate.

(14.) Benzoate of potash. A white precipitate.

(15.) A plate of zinc, being put into the solution in muriatic acid, became black, and threw down a black powder, which was insoluble in sulphuric, nitric, muriatic, nitro-muriatic, acetic, and phosphoric acids, in every temperature, whether these acids were concentrated or diluted.

(16.) A plate of tin, put into the nitric solution, occasioned no change.

(17.) A portion being enclosed in a charcoal crucible, and exposed for an hour to the heat of a forge, was not reduced to a metallic button, nor could any trace of it be detected when the crucible was examined.

These properties were all that the small quantity of the matter in my possession enabled me to ascertain. They unequivocally point out a metallic oxide. Upon comparing them with the properties of all the metallic oxides known, none will be found with which this matter exactly agrees. Cerium is the metal, the oxides of which approach the nearest. The colour is nearly the same, and both are precipitated white by prussiate of potash, succinate of ammonia, and benzoate of potash. But, in other respects, the two substances differ entirely. Oxide of cerium is precipitated white by oxalate of ammonia and tartrate of potash; our oxide is not precipitated at all: Oxide of cerium is precipitated white by hydrosulphuret of ammonia; while our oxide is precipitated black: Oxide of cerium is not precipitated

These properties approach those of cerium,

but with some difference.

fated by zinc, while our oxide is thrown down black. There are other differences between the two, but those which I have just mentioned are the most striking.

These properties induced me to consider the substance which I had obtained from the Greenland mineral as the oxide of a metal hitherto unknown; and I proposed to distinguish it by the name of *junonium*. Supposed a new metal.

In the experiments above detailed, I had expended almost all the oxide of *junonium* which I had in my possession, taking it for granted, that I could easily procure more of it from the Greenland mineral. But, soon after, I was informed by Mr. Wollaston, to whom I had sent a specimen of the mineral, that he had not been able to obtain any of my supposed junonium in his trials. This induced me to repeat the analysis no less than three times, and in neither case was I able to procure any more of the substance, which I described above. Thus, it has been out of my power, to verify the preceding details, and to put the existence of a new metal in the mineral beyond doubt. At the same time I may be allowed to say, that the above experiments were made with every possible attention on my part, and most of them were repeated, at least a dozen times. I have no doubt myself of their accuracy; but think that the existence of a new metal can hardly be admitted, without stronger proofs than the solitary analysis which I have performed. Junonium.

5. The liquid, thus freed from iron and junonium, was supersaturated with pure ammonia. A grayish white gelatinous matter precipitated. It was separated by the filter, and became gradually darker coloured when drying. This matter, after being exposed to a red heat, weighed about 38 grains. When boiled in potash lie, 4·1 grains were dissolved, of a substance which, separated in the usual way, exhibited the properties of alumina. Alumine.

6. The remaining 33·9 grains were again dissolved in muriatic acid, and precipitated by pure ammonia. The precipitate was separated by the filter, and allowed to dry spontaneously in the open air. It assumed an appearance very much resembling gum arabic, being semitransparent, and of a brown colour. When dried upon the sand-bath, it became very dark brown, broke with a vitreous fracture, and still retained a small degree of transparency. It was tasteless, An oxide,

tasteless, felt gritty between the teeth, and was easily reduced to powder. It effervesced in sulphuric, nitric, muriatic, and acetic acids, and a solution of it was effected in each by means of heat, though not without considerable difficulty. The solutions had an austere, and slightly sweetish taste. When examined by reagents, they exhibited the following properties:

examined by reagents,

(1.) Prussiate of potash. A white precipitate.
(2.) Oxalate of ammonia. A white precipitate.
(3.) Tartrate of potash. A white precipitate.
(4.) Hydrosulphuret of potash. A white precipitate.
(5.) Phosphate of soda. A white precipitate.
(6.) Arseniate of potash. A white precipitate.
(7.) Potash and its carbonate. A white precipitate.
(8.) Carbonate of ammonia. A white precipitate.
(9.) Ammonia. A white gelatinous precipitate.
(10.) A plate of zinc. No change.

appeared to differ in some respects from that of cerium;

These properties indicated oxide of cerium. I was therefore disposed to consider the substance which I had obtained as oxide of cerium. But on perusing the accounts of that substance, given by the celebrated chemists to whose labours we are indebted for our knowledge of it, there were several circumstances of ambiguity which occurred. My powder was dissolved in acids with much greater difficulty than appeared to be the case with oxide of cerium. The colour of my oxide, when obtained from oxalate, by exposing it to a red heat, was much lighter, and more inclined to yellow, than the oxide of cerium.

In this uncertainty, Dr. Wollaston, to whom I communicated my difficulties, offered to send me down a specimen of the mineral called *cerite*, that I might extract from it real oxide of cerium, and compare my oxide with it. This offer I thankfully accepted*; and upon comparing the properties of my oxide with those of oxide of cerium, extracted from *cerite*, I was fully satisfied that they were identical. The

but this owing to the method in which it was procured.

more

* The specimen of cerite, which I analysed, was so much mixed with actinolite, that the statement of the results which I obtained cannot be

more difficult solubility of mine was owing to the method I had employed to procure it, and to the strong heat to which I had subjected it; whereas the oxide of cerium from cerite had been examined in the state of carbonate.

7. In the many experiments made upon this powder, and upon oxide of cerium from cerite, I repeated every thing that had been established by Berzelius and Hisinger, Klaproth and Vauquelin, and had an opportunity of observing many particulars, which they have not noticed. It may be worth while, therefore, without repeating the details of these chemists, to mention a few circumstances, which will be found useful in examining this hitherto scarce oxide. Some particulars respecting it not before noticed.

a. The precipitate occasioned by the oxalate of ammonia is at first in white flocks, not unlike that of muriate of silver, but it soon assumes a pulverulent form. It dissolves readily in nitric acid, without the assistance of heat. The same remark applies to the precipitate thrown down by the tartrate of potash. But tartrate of cerium is much more soluble in acids than the oxalate.

b. The solution of cerium in acetic acid is precipitated gray by infusion of nut-galls. Cerium is precipitated likewise by the same reagent from other acids, provided the solution contains no excess of acid. This fact was first observed by Dr. Wollaston, who communicated it to me last summer. I immediately repeated his experiments with success.

c. Cerium is not precipitated from its solutions in acids by a plate of zinc. In some cases, indeed, I have obtained a yellowish-red powder, which was thrown down very slowly. But it proved, on examination, to consist almost entirely of red oxide of iron, and of course only appeared when the solution of cerium was contaminated with iron.

be of much importance. The specific gravity of the specimen was 4·149, I found it composed as follows:

A white powder, left by muriatic acid, and presumed to be silica,	47·3
Red oxide of cerium	44·
Iron	4·
Volatile matter	3·
Loss	1·7
	100·0

2. The

d. The solutions of cerium in acids have an astringent taste, with a perceptible sweetness, which, however, is different from the sweetness, which some of the solutions of iron in acids possess.

e. The muriate and sulphate of cerium readily crystallise; but I could not succeed in obtaining crystals of nitrate of cerium.

Best method of obtaining the oxide.

f. The best way of obtaining pure oxide of cerium is, to precipitate the solution by oxalate of ammonia, wash the precipitate well, and expose it to a red heat. The powder obtained by this process is always red: but it varies very much in its shade, and in its beauty, according to circumstances. This powder always contains carbonic acid.

Essential characters of cerium.

g. I consider the following as the essential characters of cerium. The solution has a sweet astringent taste. It is precipitated white by prussiate of potash, oxalate of ammonia, tartrate of potash, carbonate of potash, carbonate of ammonia, succinate of ammonia, benzoate of potash, and hydrosulphuret of ammonia. The precipitates are redissolved by nitric or muriatic acids. Ammonia throws it down in gelatinous flocks. Zinc does not precipitate it at all.

4. The white oxide of cerium, mentioned by Hisinger and Berzelius, and described by Vauquelin, did not present itself to me in any of my experiments: unless the white flocks precipitated by ammonia from the original solution be considered as white oxide. They became brown on drying, and, when heated to redness, were certainly converted into red oxide.

As cerium, as well as iron, is precipitated by succinate of ammonia, the preceding method of separating the two from each other was not unexceptionable. Accordingly, in some subsequent analyses, I separated the cerium by means of oxalate of ammonia, before I precipitated the iron. I found, that the proportions obtained by the analysis above described were so near accuracy, that no material alteration is necessary.

Lime.

5. The liquid, thus freed from iron, alumina, and cerium, was mixed with carbonate of soda. It precipitated a quantity of carbonate of lime, which amounted, as before, to about

ust 17 grains, indicating 9·2 grains of lime.

From the preceding analysis, which was repeated no less than three times, a different method being employed in each, the constituents of allanite are as follows:

Silica	35·4
Lime	9·2
Alumina	4·1
Oxide of iron	25·4
Oxide of cerium	33·9
Volatile matter	4·
	112·0

Component parts of allanite.

omit the 7 grains of junonium, because I only detected it one specimen of allanite. The excess of weight in the preding numbers is to be ascribed chiefly to the carbonic id combined with the oxide of cerium, from which it was completely freed by a red heat. I have reason to believe, too, that the proportion of iron is not quite so much as 25 grains. For, in another analysis, I obtained only 18 grains, and in a third 20 grains. Some of the cerium was perhaps precipitated along with it in the preceding analysis, and thus its weight was apparently increased.

The iron probably overrated.

IX.

Observations on Three Papers of Mr. Davy. By Messrs. Gay-Lussac and Thenard*.

In the Annales de Chimie for September last are translations of three papers by Mr. Davy, sent to France by that gentleman, and entitled, 1, Observations on the Researches of Messrs. Gay-Lussac and Thenard relative to the Amalgam furnished by ammonia. 2. Examination of some observations of Messrs. Gay-Lussac and Thenard on the facts respecting the Metals of the Alkalis. 3. Reply to

Mr. Davy's observations on the researches of Gay-Lussac and Thenard

* Abridged from the Annal. de Chim. vol. LXXV, p. 290.

Messrs.