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☞ With this, the regular Number for July 1864, is published, and should be delivered to Subscribers, the Supplement (No. 185) to Vol. XXVII., containing papers by Prof. Studer, Mr. A. Cayley, Dr. Atkinson, M. E. Jochmann, Mr. C. Tomlinson, Mr. W. Gibbs, together with *Proceedings of the Royal Society, Geological Society, Intelligence and Miscellaneous Articles,* and the *Title-page, Table of Contents,* and *Index* to Vol. XXVII.

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upon the face of his pile, it required all Melloni's acuteness to *nurse* the calorific action up to a measurable quantity. Such experiments, however, demonstrate, not that the two agents are dissimilar, but that the sense of vision can be excited by an amount of force almost infinitely small.

46. Here also we are able to offer a remark as to the applicability of radiant heat to fog-signalling. The proposition, in the abstract, is a philosophical one; for were our fogs of a physical character similar to that of the iodine held in solution by the bisulphide of carbon, or to that of iodine or bromine vapour, it would be possible to transmit through them powerful fluxes of radiant heat, even after the entire stoppage of the light from our signal lamps. But our fogs are not of this character. They are unfortunately so constituted as to act very destructively upon the purely calorific rays; and this fact, taken in conjunction with the marvellous sensitiveness of the eye, leads to the conclusion that long before the *light* of our signals ceases to be visible, their radiant heat has lost the power of affecting, in any sensible degree, the most delicate thermoscopic apparatus that we could apply to their detection.

Royal Institution, October 1864.

XL. *On Evansite, a new Mineral Species.*

By DAVID FORBES, *F.R.S., &c.*[*]

THIS mineral was brought from Hungary in the year 1855 by the late Mr. Brooke Evans of Birmingham[†], and was then reported to be found in some abundance as an incrustation in drusic cavities which occurred in the brown iron ores. It was regarded as pertaining to the mineral species allophane[‡], with which it agrees in many of its physical properties, as hardness, colour, specific gravity, &c., as well as in the percentage of loss sustained upon heating the mineral to redness.

The specimen I received from Mr. Evans was labelled Allophane from Zsetcznik, Gomar Comitat, and was very beautiful in appearance, consisting of an agglomeration of small stalactites with reniform and globular excrescences on brown hæmatite, many of these excrescences much resembling artificial or natural pearls, having both the figure and characteristic pearly lustre of such.

I doubted the identity of the mineral with allophane; and a

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[*] Communicated by the Author.

[†] After whom the species is now named.

[‡] A considerable number of specimens had been given by Mr. Evans to private collections in England all labelled "allophane," and I understand that many more had likewise been distributed in Germany under the same name.

preliminary blowpipe examination immediately confirmed this opinion by proving the absence of silica in any quantity, and indicating the presence of phosphoric acid; and consequently I was more disposed to regard it as hydrargyllite or Gibbsite. I commenced, however, a systematic examination of the mineral, but my sudden departure and prolonged absence in South America has prevented my having had an opportunity of making the results public until my recent return.

The physical characters of Evansite are as follows:—Amorphous and without trace of crystallization; reniform or botryoidal; colourless or milk-white, and sometimes faintly tinged with yellow or blue, and occasionally presenting iridescent hues; streak white; translucent to semi-opake. Lustre, vitreous or resinous; splendid and waxy internally; very brittle. Fracture semiconchoidal and shining.

Hardness 3·5 to 4, scratching calc-spar with facility but not fluor-spar; one fragment, however, was found to leave a faint mark on fluor-spar.

Specific gravity. Several determinations were carefully made, and precautions were taken to expel all air from between the laminæ of the mineral by using boiling distilled water and allowing it to cool down to the temperature of 60° Fahr.; the results were as follows:—

1. Using 28·51 grains of the translucent colourless mineral in small fragments, the loss in water was found to be 15·59 grains, and the consequent specific gravity 1·822.

2. With 13·686 grains similar to last, the loss in water was 7·31 grains, and the calculated specific gravity consequently 1·872.

3. With 12·87 grains of faint-yellow-coloured mineral in fragments, the loss obtained was 6·13 grs., and the consequent specific gravity would be 2·099.

4. When 18·793 grains of semiopake mineral in one piece was immersed under water, it lost 9·55 grains, and consequently had a specific gravity of 1·965.

The mean of these four determinations will give 1·939 as the specific gravity of Evansite.

The behaviour of this mineral before the blowpipe was found to be as follows:—

In a closed tube it immediately evolved water, decrepitated, and, on continued application of heat, gave off more water and remained behind in the form of a milk-white powder. On testing, the water evolved did not show any reaction with Brazil wood, red or blue litmus, or turmeric test papers.

In an open tube the same reactions were observed. Heated between platinum points it very slightly swelled out, became of a milk-white colour, and presented, when viewed through the glass, an innumerable series of minute cracks; did not fuse in the strongest heat; appeared to colour the outer flame bluish green, but so feebly as to be all but indistinct. On moistening the mineral with sulphuric acid, this reaction was rendered rather more apparent. On charcoal it proved infusible and unaltered, in both oxidizing and deoxidizing flames; but when heated, after moistening it with a solution of nitrate of cobalt, an intense blue colour was communicated to the assay. It dissolved readily both in borax-glass and phosphate of soda* in the oxidating flame, forming colourless glasses, which remain colourless on cooling: some of the faint-yellow-coloured specimens give a very light-coloured yellow glass when hot, but, on cooling, become colourless, a reaction due to the presence of iron. In the reducing-flame both these fluxes give the same reactions. In a few cases the glass formed by phosphate of soda shows a trace apparently of silica floating in the clear glass bead.

A qualitative chemical examination showed the mineral to be completely soluble in sulphuric, nitric, and hydrochloric acids. The solution, when treated by a stream of sulphuretted hydrogen gas passing through it, gave no precipitate whatever. The acid solution gave a yellow precipitate, indicative of phosphoric acid, when treated with molybdate of ammonia; and further, alumina and a trace of oxide of iron were found, but no lime, glucina or zirconia, which were specially tested for.

Fluorine was examined for by treating 12·10 grains in a platinum crucible with sulphuric acid at a gentle heat, the crucible being at the same time covered with a glass plate waxed on the under side and kept cold on the upper side; some characters were traced through the wax with a fine point; no visible etching was remarked after the operation.

The mineral, therefore, consisted only of water, alumina, and phosphoric acid with an accidental trace of oxide of iron and silica. Its quantitative analysis was conducted as follows:—

Determination of the Water.

22·22 grs. of the transparent colourless mineral left, after heating to redness, 13·49 grs. residue; also evolved 8·73 grs. grs. water, equivalent to 39·285 per cent. water in the mineral.

15·38 grs., same quality, left under same treatment 8·93 residue; also 6·45 grs. water, equivalent to 41·18 per cent.

13·365 grs., translucent but of a faint yellow colour, left 8·105 grs. residue; also 5·26 grs. water, which would make 39·37 per cent.

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* Instead of, as commonly, using microcosmic salt (phosphate of soda and ammonia), I prefer employing the dried phosphate of soda prepared by heating strongly the above until all ammonia is driven off. It will be found much more convenient in practice, as it melts gently, and does not froth and spit as the microcosmic salt does.

24·877 grs., translucent and colourless, heated in a water-bath at 212° Fahr. for twenty hours, left 20·25 grs. residue, being 4·627 grs. water, or equal to 18·69 per cent. water given off at 212° Fahr.; on further heating to redness left 14·94 grs. residue, thus giving a total of 5·31 grs. water, or equivalent to 39·91 per cent.

The average of these four experiments affords 39·945 per cent. water.

Determination of the Insoluble Matter (Silica).

18·07 grs. of the mineral were dissolved in hydrochloric acid with addition of a little nitric acid; some flakes remained persistently insoluble, and were collected on a filter, washed, dried and incinerated, and weighed 0·250 gr., or equal to 1·39 per cent.

13·365 grs. of the translucent but yellow-coloured mineral, after having been previously ignited to determine the amount of water present, were now dissolved in nitrohydrochloric acid; the insoluble residue collected on a filter, washed, and determined after incineration, weighed 0·46 gr., or equivalent to 3·44 per cent. I satisfied myself, however, that this result is quite erroneous and much too high, owing to a part of the phosphate of alumina in the mineral becoming itself insoluble, through the previous heating it had been submitted to in determining the percentage of water in it.

Determination of the Phosphoric Acid.

22·22 grs. of the white translucent mineral were dissolved in nitrohydrochloric acid, and to the solution an excess of a solution of molybdate of ammonia, previously rendered strongly acid by addition of nitric acid in large excess, was added until all phosphoric acid present was precipitated in the form of the yellow phosphomolybdate of ammonia. After filtration this precipitate was dissolved in ammonia, and the solution then precipitated by adding a mixed solution of sulphate of magnesia, chloride of ammonium, and caustic ammonia. The precipitate of phosphate of ammonia and magnesia was allowed to stand for twelve hours, then filtered off, washed with ammonia-water, and determined on ignition, affording 6·40 grs. pyrophosphate of magnesia, equivalent to 4·09 grs. phosphoric acid, or 18·42 per cent. phosphoric acid in the mineral.

Another estimation of the phosphoric acid in the mineral was made by Girard's modification of Reynoso's process, as follows:—

15·38 grs. were dissolved in nitric acid, and 22 grs. of metallic tin then added to the solution and boiled until entirely oxidized; the solution was then filtered off, and the insoluble oxide and phosphate of tin dissolved in excess of sulphide of ammonium by digestion; the solution was filtered from some little insoluble residue, and then precipitated by the addition of a previously mixed solution of sulphate of magnesia, chloride of ammonium, and ammonia in excess, allowed to stand twelve hours, and the precipitated phosphate of ammonia and magnesia then filtered off and determined as in the last case; the pyrophosphate of magnesia amounted to 4·605 grs., equivalent to 2·944 grs. phosphoric acid, or 19·01 per cent.

A third determination of the phosphoric acid was now made upon 13·365 grs. dissolved in hydrochloric acid, some 50 grs. crystallized tartaric acid added, and then ammonia in excess; the solution remained clear, and was then precipitated by a mixed solution of sulphate of magnesia, chloride of ammonium, and liquid ammonia, and allowed to stand twelve hours. The supernatant solution was now carefully decanted, and the precipitate redissolved in hydrochloric acid, a little tartaric acid added, and then ammonia in excess: after standing twelve hours the precipitated phosphate of ammonia and magnesia was collected and determined as usual; the pyrophosphate of magnesia weighed 4·14 grs., equivalent to 2·63 grs. phosphoric acid, or 19·73 per cent. in the mineral. The mean of these three determinations of phosphoric acid will consequently amount to 19·05 per cent.

Determination of the Alumina.

22·22 grs. (the same as employed as before mentioned in determining the phosphoric acid by the molybdate-of-ammonia method) were here made use of, and the solution, after separating the precipitate of phosphomolybdate of ammonia, was now subjected to the action of a stream of sulphuretted hydrogen gas until no more precipitate of sulphide of molybdenum fell; it was then filtered from this precipitate, and the solution, after boiling to remove any excess of the gas, precipitated by ammonia, by which the alumina present was thrown down, which, being washed, dried, and incinerated, weighed 8·90 grains, or consequently 40·05 per cent. in the mineral.

Another determination of the alumina was made on the quantity of mineral (15·38 grs.) used in determining the phosphoric acid according to the tin method. The matter insoluble in sulphide of ammonium was, as far as possible, dissolved in nitrohydrochloric acid, this solution was added to the nitric-acid solution obtained in the first instance after filtering off the oxide and phosphate of tin, and the whole then precipitated by ammonia and the alumina collected. From its appearance, however, it was suspected that it might contain tin; it was redissolved in sulphuric acid and a stream of sulphuretted hydrogen passed through the solution, when a considerable precipitate of the sulphides of lead and tin* fell, which was filtered off, and the alumina determined as usual by precipitation by ammonia. After ignition it weighed 5·90 grs., or equivalent to 38·36 per cent. in the mineral.

The average of these two determinations of alumina will be 39·20 per cent.

From the results of the above determinations the analyses will now stand as follows:—

	a.	*b.*	*c.*
Water	8·73	6·45	5·260
Phosphoric acid .	4·09	2·94	2·630
Alumina . . .	8·90	5·90	5·290†
Insoluble (silica) .	0·31	0·09†	0·185
Loss in analysis .	0·19	......	......
	22·22	15·38	13·365

And calculating the percentages derived from these results,—

	a.	*b.*	*c.*	Mean.
Water	39·29	41·18	39·37	39·95
Phosphoric acid .	18·42	19·01	19·73	19·05
Alumina . . .	40·05	38·36	41·51†	39·31
Insoluble (silica) .	1·39	1·45†	1·39	1·41
Loss	0·85	......	......	0·28
	100·00	100·00	100·00	100·00

From the above analysis the formula $3Al^2O^3, PO^5 + 18HO$ may, I think, be safely deduced. This formula will, on calculation, represent the following percentage composition:—

$3Al^2O^3 = 153·78 = 39·75$ Alumina.
$6PO^5 = 71·00 = 18·36$ Phosphoric acid.
$18HO = 162·00 = 41·89$ Water.
$386·78 \quad 100·00$

For comparison I annex a Table showing the chemical composition of all the hydrated phosphates hitherto announced as having been found in the mineral kingdom.

	$2Al^2O^3, 2PO^5 + 12HO.$		$2Al^2O^3, PO^5 + 5HO.$	$2Al^2O^3, PO^5 + 6HO.$	$2Al^2O^3, PO^5 + 8HO.$	$Al^2O^3, PO^5, + 8HO.$
	Wavellite.	Kapricite.	Kalaite.	Peganite.	Fischerite.	Gibbsite.
	Barnstaple.	Hungary.	Silesia.	Striegis.	Nischna Tugal.	Mass. U.S.
Phosphoric acid.	34·98	35·49	30·90	30·49	29·03	37·62
Alumina . . .	37·18	39·59	44·50	44·49	38·47	26·66
Oxide of iron .	....	....	1·80	2·20	1·20	....
Oxide of copper.	....	....	3·70	....	0·80	....
Gangue . . .	....	....	....	....	3·00	....
Water . . .	28·00	24·92	19·00	22·82	27·50	35·72
	100·16	100·00	99·90	100·00	100·00	100·00
	Fuchs.	Städeler.	Zellner.	Hermann.	Hermann.	Hermann.

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* Doubtless the lead had been in the tin as an impurity.

† Determined as loss.