

LXIII. *On the Dimorphism of the Chromate of Lead.* By JAMES F. W. JOHNSTON, A.M., F.R.SS. L. & E., F.G.S., Professor of Chemistry, University of Durham.*

BESIDES those substances which, like the biniodide of mercury and the carbonates of lime and of lead, are known to be dimorphous as *individuals*, there are other bodies, simple and compound, known to be dimorphous as *groups*, though the individual members of these groups have not yet been observed to assume more than one form. The analogous compounds of the tungstic, molybdic, and chromic acids, present groups of this kind. The tungstate and molybdate of lead and the tungstate of lime occur in square prisms, while the chromate of lead has hitherto been observed only in oblique rhombic prisms; the general formula for all of them being $R\ddot{R}$.

In my report on the present state of our knowledge in regard to dimorphous bodies presented to the last meeting of the British Association, and which will appear in the ensuing volume of their Transactions, I had already attributed this difference of form exhibited by the several members of the above, and many other analogous groups, to the existence of a true dimorphism; and while I considered that such groups, being chemically analogous, might also be considered as crystallographically dimorphous or heteromorphous, I expressed my conviction that further observation would prove the several members of these groups to be also heteromorphous, each individual assuming the forms already observed in any of the others. I am now enabled to confirm these views by a very interesting example.

On a late visit to the cabinet of my friend Mr. Brooke, whose skill as a crystallographer is so highly and so deservedly estimated, he showed me a small specimen of what he called *molybdate of lead* (crystallographically so) *with the colour of the chromate*. Of this specimen he has since kindly favoured me with a few minute fragments, in all not exceeding the fifth of a grain, but sufficient to enable me to determine that the beautiful red crystals were not molybdate having the colour of chromate of lead, but *chromate in the form of the molybdate*. Fused with borax the mineral gave in both flames a beautiful green bead; with microcosmic salt a bead which at a high temperature was nearly colourless, as it cooled became reddish brown, and when solid was of a beautiful green. A larger addition of the mineral rendered the glass opaque, but did not blacken it. It dissolved without residue in nitric and

* Communicated by the Author.

muriatic acids, giving with the latter a greenish solution, and on evaporation chloride of lead mixed with a green substance (chloride of chromium?).

From these characters there can be no doubt that the substance is chromate of lead.

The specimens on which these minute red crystals occur is from the Bannat. None of the crystals appear to exceed the sixteenth of an inch in length, and they rest on a thin yellow coating which resembles molybdate of lead. Besides the small specimens he possesses Mr. Brooke informs me he has never seen but one other. He has measured two of the crystals, and satisfied himself that in form they are identical with the molybdate.

We are justified therefore in including the chromate of lead among known dimorphous bodies, and in more confidently anticipating that the analogous tungstates and molybdates will prove so also. A strict examination of the specimens already existing in cabinets may be expected to fill up several of the gaps. In the following table:

| | Oblique Rh. Prism. | Square Prism. |
|---------------------|--------------------|-------------------------|
| Chromate of lead. | Common form. | Rarer form from Bannat. |
| Tungstate of lead. | unknown. | Common form. |
| Tungstate of lime. | do. | do. |
| *Molybdate of lead. | do. | do. |

There is another member of this group, the tungstate of iron and manganese (wolfram) which, though represented by the formula $\text{Fe } \ddot{\text{T}}\text{u} + \text{Mn } \ddot{\text{T}}\text{u}$, in which the bases are isomorphous, yet crystallizes in a form different from either of those above mentioned. The two oblique rhombic prisms have

in wolfram $\text{M}, \text{M} = 101^\circ 5'$ $\text{P}, \text{M} = 110^\circ 50'$
 in chromate of lead $= 93^\circ 30'$ $= 99^\circ 10'$

We have here therefore a third form in which the members of this group may possibly crystallize. As wolfram however is a double salt, it is equally possible that this third form may result from the union of the other two. A square prism of tungstate of iron, with a less oblique prism of tungstate of manganese, may be capable of producing the more oblique prism of wolfram, or the union of the two salts in some other way may produce the third form, without rendering it absolutely necessary at present to have recourse to a trimorphism. In a former paper on the dimorphism of baryto-calcite†, I

* I need not draw attention to the link which this new fact affords for connecting the molybdic with the sulphuric and other analogous acids.

† Lond. and Edin. Phil. Mag., vol. vi. p. 1.

suggested a similar solution for a difficulty of a similar but less striking character. At the same time it should be observed that there is nothing in the idea itself of a body assuming three or more incompatible forms which should induce us to reject it. It is the absence of *direct* proof of the fact which alone makes it prudent, in the present state of our knowledge, to endeavour to explain away appearances such as that presented by the group we are considering.

We should however expect to find wolfram in the two other forms, even if its own special form do not belong to the group of simple tungstates, chromates, and molybdates. It has indeed been met with frequently both at Huel Maudlin in Cornwall, and Schönfeld in Saxony, in square prisms, or octohedrons; but these have generally been considered pseudomorphous,—as mere casts of former crystals of tungstate of lime. I have not seen any of these crystals, and cannot therefore judge of the evidence on which this opinion rests; but as there appears no reason why wolfram should not in favourable circumstances assume the form of the square prism, it is not unworthy the attention of mineralogists to examine how far these supposed pseudomorphous crystals are really and *always* so.

Durham, March 1838.

Note.—Since the above paper was written I have seen some of the octohedrons of wolfram from Huel Maudlin, and externally many of them are perfect; internally, however, they are often more or less hollow, exhibit no cleavage, but a structure radiating from the surface inwards, while the interior of the hollows is often studded with minute brilliant terminal facets. These characters appear to justify the conclusion that they are pseudomorphous. Their interior cavity would seem to imply that they are also epigene, and that, as in the case of some of the Chessy malachites, the change has commenced on the exterior of the original crystal.

LXIV. *On the Composition of certain Mineral Substances of Organic Origin.* By JAMES F. W. JOHNSTON, A.M., F.R.SS. Lond. and Ed., F.G.S., Professor of Chemistry and Mineralogy, Durham.*

III. *Ozocerite from Urpeth Colliery, near Newcastle-upon-Tyne.*

THE attention of chemists and mineralogists has for several years past been drawn to a species of fossil wax found in

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