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derived from some similar source, acting on substances either themselves organized, or like coal of organic origin.

Durham, May 1838.

VI. *On the Separation of the Oxalic from other Organic Acids.*

By JAMES F. W. JOHNSTON, M.A., F.R.SS., L. & E. F.G.S., Professor of Chemistry and Mineralogy, Durham.*

AT the Liverpool meeting of the British Association in September last, I exhibited and stated the composition of a beautiful salt I had formed some months before, consisting of an atom of nitrate with an atom of oxalate of lead and two atoms of water. In the Number of the Philosophical Magazine for May is given an extract of a paper by M. De-jardin, in which this salt is very correctly described, and certainly without the knowledge of my having previously made it known†. As the study of this interesting compound, however, has suggested an easy method of separating the oxalic from other organic acids, I shall briefly describe the unpublished observations I have made upon it.

I prepare the salt by adding nitric acid in considerable quantity to a weak solution of oxalic acid, or of acetate of lead, and pouring in slowly a solution of subacetate of lead, or of dilute oxalic acid. Shining plates of the compound speedily begin to fall. If the quantity of oxalic acid be minute, or if it be largely diluted, the crystals fall only after some time, and in the form of six-sided tables, of which two of the sides are longer than the others, possessing a silvery whiteness and pearly lustre, and striated longitudinally so as to exhibit the most beautiful prismatic colours when light is reflected from them. I have also obtained it in acicular prisms nearly an inch in length, which according to the measurement of Professor Miller of Cambridge, are oblique rhombic prisms.

Decomposed by sulphuretted hydrogen it gives a colourless solution, which, when evaporated, emits fumes of nitric and yields crystals of oxalic acid.

Heated to 212° this salt does not diminish in weight; at a temperature of about 500° Fahr. it loses 2 atoms (5.425 per cent.) of water, and before it reaches 570° Fahr. it has given off copious red fumes, lost upwards of 19 per cent., and is

* Communicated by the Author.

† I may take this opportunity of mentioning, that under the name of Iodal, M. L'Amy has lately described a compound of which I published an account in the Edinburgh Journal of Science (II. p. 415.) some years ago. It is obtained by the action of nitric acid on iodine in alcohol, and has not yet been analysed.

wholly converted into carbonate of lead. At a higher temperature the carbonic acid is driven off.

Water decomposes it, extracting when boiled over the salt the greater part of the nitrate, and leaving nearly pure oxalate; a small portion of the double salt being dissolved at the same time, which precipitates again on cooling. Thus 24.26 grs. boiled in water left 12.70 grs. of insoluble residue, or 52.35 per cent.; the quantity of oxalate in the salt being only 50.016 per cent. When newly precipitated, or before it has been dried at 212°, it is much more readily decomposed, so that it cannot be washed on the filter even with dilute nitric acid without decomposition.

10.59 grs. heated to nearly 500 Fahr. lost before any trace of red fumes appeared 0.56 = 5.28 per cent. of water. Three successive portions on heating to redness left respectively 67.51, 67.55, and a purer variety 67.28 per cent. of oxide of lead.

These results agree with the formula $\text{P}^{\text{I}}\text{N} + \text{P}^{\text{I}}\text{C} + 2 \text{HO}$.

	Exper.	Calcul.
Or, Oxide of lead	67.28	67.312
Acids	37.54	37.263
Water.....	5.28	5.425
	<hr/> 100.	<hr/> 100.

I met with this salt in the course of an examination of the action of nitric acid on certain organic substances. Thus if oil of turpentine or of lemons, the balsams, the sugars, colophony, elemi, gamboge and other resins, Burgundy pitch, or indigo be boiled in nitric acid, either dilute or concentrated, and to the acid solution, from which the yellow resin formed during the operation has been precipitated by water, subnitrate of lead be added, the new salt falls in great abundance, indicating the production of oxalic acid. Not suspecting the crystals I obtained in this way to be a double salt, I was at much pains in making out their elementary composition by burning with oxide of copper, and I only prepared it directly from a mixture of oxalic and nitric acids after I had completely analysed it. During the action of nitric acid, however, on some, if not upon all the organic substances above mentioned, other acids are formed; and this is more especially known to be the case in regard to indigo. These acids are held in solution along with the oxalic, and continue to be so held after the addition of subacetate of lead to the acid liquid ceases to throw down any more of the double salt. It becomes interesting then to examine how far the whole of the oxalic acid

could be thrown down by this means while the solution still remained acid.

1. If into solutions of acetic, tartaric, citric, carbazotic, indigotic, benzoic, succinic, gallic, meconic, pyromeconic, mucic, or camphoric acids, nitric acid be poured and afterwards subacetate of lead, or if nitric acid be added largely to solutions of acetate or nitrate of lead and solutions of these acids be dropped in, the precipitate at first formed speedily redissolves, and no further precipitate, crystalline or otherwise, appears on standing for any length of time. I have not tried any other organic acids, but the same is probably true of many of them also.

2. But if into a solution thus prepared, and containing already one or more of these acids, a few drops of a solution of oxalic acid be introduced, crystals of the double salt begin to appear.

3. This is beautifully illustrated, and at the same time the conversion of tartaric into oxalic acid, by dissolving the former or the bitartrate of potash in dilute nitric acid; the solution gives no precipitate with subacetate of lead, but boil it a little, and a precipitate in shining crystals appears on adding the salt of lead. This forms a very instructive class experiment. Care must be taken to have the solution sufficiently acid, or more or less of pure oxalate of lead will accompany the double salt.

4. 15.92 grs. of tartaric and 6.08 grs. of oxalic acid with one atom of water ($\bar{\text{C}} + \bar{\text{H}}$) were dissolved in a small quantity of water, and poured into an acid concentrated solution of nitrate of lead in large excess. The double salt collected and dried at 212° Fahr. weighed 45.03 grs., equivalent to 6.14 grs. of ($\bar{\text{C}} + \bar{\text{H}}$). This indicates 0.06 of oxalic acid in excess, an error which can hardly be avoided, from the impossibility of sufficiently washing the precipitate and filter without risking decomposition.

5. But the oxalic acid may also be separated from all these other acids, and estimated with tolerable precision, without the formation of the double salt. Thus 10 grs. of oxalic acid in

crystals ($\bar{\text{C}} + 3 \bar{\text{H}}$), equivalent to 5.73 of anhydrous acid, were mixed with 20 of tartaric acid, 10 of citric, 2 of benzoic, 4 of succinic, and an unmeasured quantity of acetic acid dissolved in two ounces of distilled water, and acid nitrate of lead *added* to the solution. By this method of proceeding a sufficient quantity of nitric acid was present to prevent the tartrate,

benzoate, &c. from falling, but not enough to cause the formation of the double salt. A crystalline precipitate, indeed, fell, but it was only oxalate, with a few flakes of the double salt. After drying at 212 it weighed 23.16 grs. and lost when heated to redness 26.85 per cent. Pure dry oxalate contains 24.68 per cent. of acid; and 23.16 grs. of oxalate are equivalent to 5.71 of anhydrous acid, very nearly the quantity employed. Some time must be allowed for the perfect deposition of the whole of the oxalate or of its double salt.

From these experiments it appears that by simply acidifying strongly with nitric acid, the oxalic may be separated almost completely from solutions containing any of the other organic acids above enumerated, and its quantity determined with considerable accuracy.

The utility of this process in separating the oxalic acid, formed so largely in the preparation of the indigotic and carbazotic acids and other highly oxidized compounds, need not be pointed out, nor the means it affords us of estimating *quantitatively* the nature of the changes produced on organized bodies by the action of oxidizing agents.

Durham, May 29, 1838.

VII. *Of the Reaction of the Essential Oils with Sulphurous Acid, as evolved in union with Æther in the Process of Ætherification, or otherwise. By R. HARE, M.D., Professor of Chemistry in the University of Pennsylvania*.*

HAVING mixed and subjected to distillation two ounces of oil of turpentine, four ounces of alcohol and eight ounces of sulphuric acid, a yellow liquid came over, having all the appearance of that which is obtained in the process for making oil of wine, described in a preceding article. On removing, by means of ammonia, the sulphurous acid existing in the liquid, and driving off the æther by heat, a liquid remained, which differed from oil of turpentine in taste and smell, although a resemblance might still be traced. This liquid was without any sensible action on potassium, which continued bright in it for many weeks. It proved, on examination, to contain a small quantity of sulphuric acid. I ascertained, afterwards, that in order to produce these results, it was sufficient to pour oil of turpentine on the mass which remains after the termination of the ordinary operation for obtaining æther, and apply heat. Subsequently it was observed that when the sulphurous æther was removed by heat

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