VI. *On a Substance from the Elm Tree, called Ulmin.* By James Smithson, *Esq. F. R. S.*

Read December 10, 1812.

1. THE substance now denominated Ulmin was first made known by the celebrated Mr. KLAPROTH, to whom nearly every department of chemistry is under numerous and great obligations.*

Ulmin has been ranked by Dr. THOMSON, in his System of Chemistry, as a distinct vegetable principle, on the ground of its possessing qualities totally peculiar and extraordinary. It is said, that though in its original state easily soluble in water and wholly insoluble in alcohol and ether, it changes, when nitric, or oxymuriatic acid is poured into its solution, into a resinous substance no longer soluble in water, but soluble in alcohol, and this singular alteration is attributed to the union to it of a small portion of oxygen which it has acquired from these acids.* Being possessed of some of this substance which had been sent to me some years ago from Palermo, by the same person from whom Mr. KLAPROTH had received it, I became induced, by the foregoing account, to pay attention to it, and have observed facts which appear to warrant a different etiology of its phenomena, and opinion of its nature, from what has been given of them.

The ulmin made use of in the following experiments, had

* Dr. THOMSON's Syst. of Chem. Vol. IV. p. 696. Fourth edition.

been freed from the fragments of bark by solution in water and filtration, and recovered in a dry state by the evaporation of the solution on a water bath.

2. In lumps, ulmin appears black, but in thin pieces it is seen to be transparent, and of a deep red colour.

In a dilute state, solution of ulmin is yellow; in a concentrated one, dark red, and not unlike blood.

When solution of ulmin dries, either spontaneously or by being heated, the ulmin divides into long narrow strips disposed in rays to the centre, which curl up and detach themselves from the vessel, and the fluid part seems to draw together, and becomes remarkably protuberant. Solution of ulmin slowly and feebly restores the colour of turnsol paper reddened by an acid.

3. Dilute nitric acid being poured into a solution of ulmin, a copious precipitate immediately formed. The mixture was thrown on a filter. The matter which has been considered as a resin remained on the paper, and a clear yellow liquor came through. This yellow solution, on evaporation, produced a number of prismatic crystals looking like nitrate of potash. They were tinged yellow by some of the resin. This mixture, heated in a gold dish, deflagrated with violence, and a large quantity of fixed alkali remained.

Dilute muriatic acid caused an exactly similar precipitation in solution of ulmin to nitric acid, and the precipitate was the same resin-like substance. The filtered liquor afforded a quantity of saline matter, which, after being freed by ignition from a portion of dissolved resin, shot into pure white cubes of muriate of potash, as appeared by decomposing them by nitric acid.

Sulphuric, phosphoric, oxalic, tartaric, and citric acids, occasioned a similar precipitation in solution of ulmin.

Distilled vinegar produced no turbidness in it; and the mixture being exhaled to dryness, at a gentle heat, was found to be again wholly soluble in water. But when the mixture was made to boil, some decomposition took place. On adding muriatic acid to a mixture of solution of ulmin and distilled vinegar, a precipitate was produced, as in a mere solution in water.

The nitric and muriatic acids received a small quantity of lime and iron from the ulmin, and I believe also a little magnesia; but these can be considered only as foreign admixtures.

4. To acquire an idea of the quantity of potash in ulmin, 4 grains of ulmin were decomposed by nitric acid. They afforded 2.4 grains of resin-like matter. The nitrate of potash obtained was heated to deflagration, in small quantities at a time, in a platina crucible to free it from resin. The alkali produced was supersaturated with nitric acid, dried, and slightly fused. It then weighed 1.2 grains. If we admit $\frac{1}{2}$ of nitrate of potash to be alkali, this will denote $\frac{15}{100}$ of potash in ulmin.

5 grains of ulmin were decomposed by muriatic acid. The resinous matter weighed 3.3 grains, and the muriate of potash, after being ignited, dissolved away from the charcoal, dried, and again made red hot, weighed 1.4 grains. If we suppose $\frac{2}{3}$ of muriate of potash to be alkali, this will indicate $\frac{19}{100}$ of potash in ulmin.

2 grains of ulmin were made red hot in a gold crucible. It then weighed only 1.05 grain. The form of the flakes was

in no degree altered, but they had acquired the blue and yellow colours of heated steel, of which they had likewise the metallic aspect and lustre, and could difficultly, if at all, have been distinguished by the eye from heated steel-filings, or fragments of slender watch-springs. Water immediately destroyed their metallic appearance.

Muriatic acid, poured on, caused a strong effervescence, and formed muriate of potash, which, freed from all charcoal, and made red hot, weighed 0.6 grain, corresponding to $\frac{20}{100}$ of potash in ulmin.

These experiments assign about $\frac{1}{5}$ for the quantity of potash in ulmin, but as it is impossible to operate, on so small a scale, on such substances without loss, it is probable that it even exceeds this proportion.

5. The substance separated from ulmin by acids has the following qualities:

It is very glossy, and has a resinous appearance.

In lumps it appears black, but in minute fragments it is found to be transparent, and of a garnet-red colour.

It burns with flame, and is reduced to white ashes.

Alcohol dissolves it, but only in very small quantity.

Water likewise dissolves it, but also only in very small quantity. Acids cause a precipitate in this solution, though this resin-like matter appears neither to contain any alkali, nor to retain any of the acid by means of which it was obtained.

Its solution in water seems to redden turnsol paper.

Neither ammonia, nor carbonate of soda, promote its solution in cold water.

On adding a small quantity of potash to water in which it

lies, it dissolves immediately and abundantly. This solution has all the qualities of a solution of ulmin, and, on exhalation, leaves a matter precisely like it, which cracks and separates from the glass, and does not grow moist in the air, &c.

Hence it appears that ulmin is not a simple vegetable principle of anomalous qualities, but a combination with potash of a red, or more properly a high yellow matter, which, if not of a peculiar genus, seems rather more related to the extractives than to the resins.

English Ulmin.

I collected, from an elm tree in Kensington gardens, a small quantity of a black shining substance which looked like ulmin.

It was readily soluble in water, and the solution was in colour and appearance exactly similar to a solution of ulmin.

This solution, exhaled to a dry state on a water-bath, left a matter exactly like ulmin, and which cracked and divided as ulmin does, when dried in the same manner. It did not, however, rise up from the watch-glass in long strips, like the Sicilian kind, but this may have been owing partly to its small quantity, which occasioned it to be spread very thin on the watch-glass, and partly to its containing a considerable excess of alkali, for it differed also from the Palermo ulmin by becoming soft in the air, and its solution strongly restored the blue colour of reddened turnsol paper.

Nitric acid, added to a filtered solution of this ulmin, immediately caused a precipitate in it, and the filtered solution, on evaporation, afforded numerous crystals of nitrate of potash.

This English ulmin made a considerable effervescence with acetous acid, which the Palermo ulmin had not been observed to do. This acetous solution, in which the acid was in excess, was exhaled dry, and repeatedly washed with spirit of wine. No part of the brown matter dissolved. Water dissolved this brown residuum readily and entirely. This solution did not sensibly restore the blue colour of reddened turnsol paper. Exhaled to a dry state, the matter left did not separate from the watch-glass quite as freely as Palermo ulmin, which had been treated with acetous acid; but it seemed no longer to grow moist in the air. Redissolved in water, and nitric acid added, the mixture became thick from a copious precipitate.

The spirit of wine contained a quantity of acetate of potash.

The excess of alkali, in this English ulmin, may be owing to the tree from which it was collected having been affected with the disease, which produces the alkaline ulcer to which the elm is subject.

Sap of the Elm Tree.

Thinking that the production of ulmin by the plant might not be the consequence of disease, and that it might exist in the healthy sap, a bit of elm twig, gathered in the beginning of last July, was cut into thin slices and boiled in water. It afforded a brown solution, like a solution of ulmin. Exhaled to dryness, this solution left a dark brown substance, in appearance similar to ulmin, but on adding water to this dry mass, a large quantity of brown glutinous matter remained insoluble. The mixture being thrown on a filter, a clear yellow liquor passed, which may have contained ulmin, but the quantity was too small to admit of satisfactory conclusions.

Perhaps older wood, the juice of which was more perfected, would afford other results, since ulmin appears to be the product of old trees; but the inquiry, being merely collateral to the object I had originally in view, was not persevered in.