



IX. On the method of manufacturing acetat of copper, crystals of venus, or crystallised verdigrise

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principle, or any peculiar and active electricity of the organs. By their assistance you will be enabled to invent new experiments, and to foretell the result of them, as I have several times done, and still do daily. If you, however, abandon these principles, you will find nothing but uncertainty and contradiction, and the whole will be an inexplicable problem.

IX. *On the Method of manufacturing Acetat of Copper, Crystals of Venus, or Crystallised Verdigrise.* By J. A. CHAPTAL.*

CRYSTALS of Venus were for a long time manufactured in Holland, but at present they are manufactured at Montpellier, with a degree of perfection which renders them preferable to those of any other country. The process most generally employed consists in dissolving verdigrise in vinegar, and evaporating the solution to a pellicle to obtain the crystals. The vinegar used is nothing else than four *vinasse* (spoilt wine) distilled. In every manufactory there is therefore an alembic, in which this weak kind of vinegar is continually distilled.

This distilled vinegar is put into a kettle, where it is boiled on the verdigrise. After saturation the solution is left to clarify, and then poured into another kettle of copper, where it is evaporated to a pellicle. Sticks are then immersed into it, and by means of some pack-thread are tied to wooden bars which rest on the edge of the kettle. These sticks are about a foot long, and are split cross-wise nearly two inches at the end, so that they open into four branches, kept at about the distance of an inch from each other by small pegs. The crystals adhere to these sticks, and cover them entirely, forming themselves into groups or clusters, which present on all sides perfect rhombs of a very lively dark blue colour.

* From the *Annales de Chimie*, No. 75.

Each cluster weighs from five to six pounds. These crystals, when broken, exhibit on their fracture a brilliant agreeable green, inclining a little to blue.

Three pounds of moist verdigrise are necessary to make a pound of crystals. The indissolved residuum is rejected as useless. Analysis, however, having proved to me that a great deal of copper in a metallic state, or weakly oxydated, still exists in it, I disposed boards in the form of a stage around the manufactory of C. Durand, and, forming strata of about two inches in thickness with these remains, I soon saw them covered with an efflorescence of verdigrise. I took care to moisten them from time to time with vinegar, to dissolve the verdigrise as soon as a sufficiently strong efflorescence was formed, and they were again disposed in strata to proceed as before, in order that I might derive as much advantage from the residuum as I should find convenient.

There are some manufactories of the crystals of Venus where the verdigrise is prepared by means of vinegar distilled according to the method followed at Grenoble, which is well understood. All the operations tend to the same end, which is the solution of the copper in the acetous acid; and the purity of the materials renders it certain that there will be no residuum or loss. But however simple may be the process for manufacturing crystallised verdigrise, the high price at which it is sold makes it to be much wished that it could be still rendered more so. I made some experiments for that purpose; but at present I shall confine myself to a short view of my results. We must set out from the principle, that the acetous acid does not attack copper in the state of a metal, and that it cannot effect a solution of it but when reduced to an oxyd. The question then will be to discover the means of oxydating it in an economical manner.

1st, I exposed the plates of copper to the gaseous emanations of the oxygenated muriatic acid in large glass receivers, connected together in the manner of adoptors, to which I fitted a retort from which the acid was disengaged.

2^d, I took

2d, I took a large earthen jar of Provence, well glazed, capable of containing two hundred (French) pints of water, buried it one half in a stratum of very warm dung in full decomposition, and having put some manganese in the bottom of it, and adapted to it a straight glass tube which reached from the mouth to the bottom, I filled the jar with plates of copper slightly rolled, in order that they might not touch each other but in some points. I then made to pass into the bottom of the jar, by means of the tube, the necessary quantity of the muriatic acid, and immediately closed the upper aperture with a luted covering. Two days after these plates were entirely crusted over with a greenish oxyd, which detached itself in dust and in scales: I separated of it two pounds ten ounces. This oxyd, less lively than that of the common verdigrise, is soluble in vinegar: and this method may then be employed, with some advantage, to form the acetat of copper; but it cannot supply the place of the acetous verdigrise either in painting or dyeing.

3d, I formed sulphat of copper by pouring, upon plates of copper brought to a red heat in a crucible, about a third in weight of pounded sulphur. This sulphure, exceedingly friable, pulverised and exposed to a pretty violent heat for four or five hours, left a grey powder, easily attacked by the acetous acid. That which I digested at a heat above a gentle temperature, gave, by evaporation, a considerable quantity of very blue and beautiful crystals of acetat of copper, and a stratum of true sulphat of copper of a pale blue and without crystals.

4th, I saturated distilled acetous acid with oxygenated muriatic acid gas. This acid, digested cold on the copper, dissolved it in part; but it formed a beautiful micaceous scaly white, which had no relation with the acetat. Copper exposed to the vapour of this acetous acid, saturated with oxygenated muriatic acid gas, becomes covered with very brilliant small crystals of a bright-blue colour, some of which are transparent and white. These crystals presented long
square

square pyramids, effloresced in the air, and had none of the characters of the acetat of copper.

5th, The acetous acid, distilled several times on the oxyd of manganese, attacks copper and dissolves it, but too weakly and in too small quantity for me to recommend this method.

6th, The acetite of lead poured upon a solution of the sulphat of copper immediately produces a decomposition from which there results sulphat of lead, which precipitates itself in a little time; and acetat of copper, which remains in solution. By decanting the latter, and evaporating it to a pellicle in a copper kettle, you will obtain beautiful crystals of Venus. If you wash well the sulphat of lead, and prepare it to be employed in painting, as white lead, this last process may become very advantageous.

CrySTALLISED verdigrise is in great request for painting and varnishing, to which it supplies lively and durable colours. Chemists obtain from it by distillation that acid, the smell of which is very penetrating, called *radical vinegar* and also *acetic acid*.¹⁹

X. *An Attempt to determine the true Form and necessary Angles of Weather that ought to be given to Vanes of a Vertical Windmill as they recede from the Centre, left undetermined by Mr. Smeaton.* By RICHARD HALL GOWER, in the Sea Service of the Honourable East India Company*.

ON reading Mr. Smeaton's Experiments to discover the proper Construction of Windmill Vanes, read before the Royal Society the 31st of May and the 14th of June 1759, I was sorry to find that millwrights had hitherto been without any fixed principle wherewith to give the vanes of vertical windmills their proper degree of weather.

If it were required to determine by calculation the number

* Communicated by the Author.