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4. Having found these transitions, or any others, in some mountains, if they are not then found in other mountains, you must examine whether their absence does not arise from their having been destroyed; vestiges of them are to be sought for; and if it appears that they never existed, you must endeavour to discover, in the nature and position of the mountains, what may have been the cause of their absence*.

[To be continued.]

XI. *Observations on the Manufacture of the Acetite of Copper or Verdigrise, Verdet, &c.* By J. A. CHAPTAL.†

THE acetite of copper is one of the preparations of that metal most frequently used in the arts. It is not only one of the principal resources of painting, but upon many occasions is employed with great advantage in dyeing. Almost all the oxydes of copper obtained by the action of saline substances have a blue colour, more or less inclining to green, and almost all the neutral salts corrode the metal, and produce that oxyde which is called verdigrise. It is sufficient to bring them into contact with the copper, or to immerse the metallic plates in a saline solution, and afterwards to expose them to the air to dry.

Those acids which oxydate the copper by their decomposition, produce an effect like that of neutral salts. The oxyde is of a soft blueish-green colour; their action is so speedy, that if the copper be exposed to the vapour of them for some minutes its surface will be immediately oxydated. The oxygenated muriatic acid produces that effect as well as the vapour of the nitric acid, and even those of the sulphuric acid. A phenomenon which cannot escape the eye of an

* The best method of observing mountains, in order to acquire a thorough knowledge of them, is, not to confine oneself merely to follow the valleys, but to intersect also, as much as possible, the principal chains and the branches detached from them in the direction of their breadth. C.

† From *Annales de Chimie*, No. LXXV.

observer, is, that the oxydes of copper obtained by fire are very different from those produced by the decomposition of acids on that metal. The colour of them is grey, instead of being green; and when the calcination is continued a long time at a violent heat, they may be concentrated to a red oxyde of a blood colour. This phenomenon was observed by Kunckel in his chemical laboratory.

Saline substances are not the only ones capable of oxydating copper green. All oils and fat matters produce the same effect. Even water, when left for a considerable time in copper vessels, causes an oxydation. But what will appear very extraordinary is, that the greater part of these substances have no sensible effect upon copper, except when cold. Those salts even which corrode that metal when left at rest in vessels, do not attack it in so sensible a manner when in a state of ebullition.

Of all the preparations of copper by oxydation, there is none more valuable than that made by vinegar. All the verdigrise used in commerce is prepared by that acid, and it is at Montpellier in particular and in the neighbourhood, that the manufactories of it are established. In the Memoirs of the Academy of Paris for 1750 and 1753, may be seen a very exact description of the process then followed at Montpellier for making verdigrise; but as that process has been much improved, and as at present the husks of grapes are employed instead of the stalks, a method far more economical, since wine is no longer used, the following account of the manner of manufacturing verdigrise, as now practised, may be of utility to the public.

The first materials used for this purpose are copper and the husks or skins of grapes left after the last pressing. The copper employed was formerly all imported from Sweden; but at present it is brought from different foundries established at Saint Bel, Lyons, Avignon, Bedarieux, Montpellier, &c. It is in round plates half a line in thickness, and from twenty to twenty-five inches in diameter. Each plate at
Montpellier

Montpellier is divided into twenty-five laminæ, forming almost all oblong squares of from four to six inches in length, three in breadth, and weighing about four ounces. They are beat separately with the hammer on an anvil to smooth their surfaces, and to give the copper the necessary confidence. Without this precaution it would exfoliate, and it would be more difficult to scrape the surface in order to detach the oxydated crust. Besides this, scales of pure metal would be taken off, which would hasten the consumption of the copper.

The husks of grapes, known at Montpellier under the name of *racque*, were formerly thrown on the dung-hill after the poultry had picked out the small stones contained in them. At present they are preserved for making verdigrise, and sold at the rate of from fifteen to twenty livres per *muid*. The preparation of them is as follows: After the vintage is finished, the husks are subjected to the press, in order to extract all the wine with which they may be impregnated, and they are then put into vats, where they are pressed down with the feet to fill up all the vacuities and render the mass as compact as possible. The coverings of these vats are carefully fastened down, and they are preserved for use in a dry cool place.

These husks are not always of the same quality: when the grapes contain little of the saccharine matter, when the season has been rainy, the fermentation incomplete, or when the wine is not generous, the husks are attended with several faults. 1. They are difficult to be preserved, and there is great danger of their soon being spoilt. 2. They produce very little effect, cannot be easily heated, send forth very little of the acetous odour, and make the plates of copper sweat without shewing efflorescence on their surface. Independently of the nature of the grapes and the state of the wine, the quality of the husks varies also according as they have been expressed with more or less care. Husks which have not been much pressed, produce a far greater effect than those which have been dried. To explain their different effects,

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it will be sufficient to observe that their action is proportioned to the quantity of wine they retain, as it is that liquor alone which can pass to the state of vinegar. When the husks therefore are destined for a verdigrise manufactory, care must be taken to express them only weakly, in order to preserve more of their acidifiable principle.

When a sufficient quantity of copper and of husks has been provided, nothing remains but to proceed to the operations, which are generally performed in cellars. They may be performed also on a ground floor if it be somewhat damp, if the temperature be subject to little variation, and if there be not too much light. The first operation is to make the husks ferment, which is called *avina*. For that purpose one of the vats is opened, and the husks are put into two others of equal size, taking care to expose them as little as possible to the air, and not to compress them. One vat full of husks ought to fill two, and to occupy a double space after this operation. In some manufactories the husks contained in a vat are distributed into twenty or twenty-five earthen vessels or jars called *oules*, and which are generally sixteen inches in height, fourteen in diameter at the belly, and about twelve at the mouth. When the husks have been put into these vessels, they are covered by putting the lid merely on the opening without pressing it down. The covers are of straw, and made for that purpose. In this state the husks soon heat; and this change may be known by thrusting the hand into them, and by the sour smell which they begin to exhale. The fermentation first takes place at the bottom of the vessel, and gradually ascending extends itself to the whole mass. It proceeds to 30 or 35 degrees of Reaumur.

At the end of three or four days the heat decreases, and at length ceases entirely; and as the manufacturers apprehend the loss of a portion of the vinegar by the natural effect of a heat too much prolonged, they take care after three days fermentation to remove the husks from the fermenting vessels, in order that they may sooner cool. Those who employ vats
remove

remove them into jars, and those who use jars put them into others. Besides the loss of the acetous spirit, too great heat inclines the mass at the bottom of the vessel to become mouldy; which renders it unfit for making verdigrise. Some manufacturers, to increase the effect of the husks, form them into heaps, which they besprinkle with generous wine before they bring them to ferment.

The fermentation does not always take place at the same time, nor with the same energy. Sometimes it commences in twenty-four hours, and sometimes it has not begun at the end of three weeks. The heat sometimes will rise to such a height that the hand cannot be kept in the mass, and that the acetous odour is so strong that one can hardly approach the vessels; while at others the heat is hardly sensible, and soon vanishes. There are even instances of the husks becoming putrid and mouldy without turning acid. The fermentation is assisted and promoted by raising the heat of the place by means of chafing-dishes, by covering the vessels with cloths, by shutting the doors, and by airing the mass with more care. The differences in the fermentation depend,

1. On the temperature of the air: in summer the fermentation is speedier.
2. On the nature of the husks: those which arise from very saccharine grapes heat more easily.
3. On the volume of the mass: a larger mass ferments sooner, and with more strength, than a small one.
4. On the contact of the air: the best aired husks ferment best.

At the same time that the husks are made to ferment, a preliminary preparation called *desafouga* is given to the plates of copper which are used for the first time. This operation is not employed for those which have been already used, and consists in dissolving verdigrise in water in an earthen vessel, and rubbing over each plate with a piece of coarse linen dipped in this solution. The plates are then immediately placed close to each other, and left in that manner to dry. Sometimes the plates are only laid on the
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top of the fermented husks, or placed under those which have been already used for causing the copper to oxydate. It has been observed, that when the operation called *desafouga* has not been employed, the plates grow black at the first operation, instead of becoming green.

When the plates are thus prepared, and the husks have been brought to ferment, the workmen try whether the latter are proper for the process, by placing under them a plate of copper, and leaving it buried there for twenty-four hours. If the plate of copper, after this period, is found covered with a smooth green crust, in such a manner that none of the metal appears, they are then thought fit for being disposed in layers with the copper. On the other hand, if drops of water are observed on the surface of the plates, the plates are said to *sweat*, and it is concluded that the heat of the husks has not sufficiently subsided. They consequently defer making another trial till the next day. When they are assured that the husks are in a proper state, they form them into layers in the following manner :

The plates are all put into a box, which, instead of having a bottom, is divided in the middle by a wooden grate. The plates disposed on this grate are so strongly heated by a chafing-dish placed under them, that the woman employed in this labour is sometimes obliged to take them up with a cloth, in order that she may not burn her hands. As soon as they have acquired that heat, they are put into the jars in layers with the husks. Each jar is then closed with a covering of straw, and left to oxydate. This period is called *coûta*, to hatch. Thirty or forty pounds of copper, more or less according to the thickness of the plates, are put into each jar. At the end of ten, twelve, fifteen, or twenty days, the jar is opened ; and if the husks are white, it is time to take out the plates. The crystals are then seen detached, and of a silky appearance on their surface. The husks are thrown back, and the plates are put in what is called *relai*. For that purpose

pose they are immediately deposited in a corner of the cellar on sticks ranged on the floor. They are placed in an upright position, one leaning against the other; and at the end of two or three days they are moistened, by taking them up in handfulls and immersing them in water in earthen pans. They are deposited quite wet in their former position, and left there for seven or eight days; after which they are once or twice immersed again. This immersion and drying are renewed six or eight times, every seven or eight days. As the plates formerly were put into wine, these immersions were called *one wine, two wines, three wines*, according to the number of times. By this process the plates swell up, the green is nourished, and a coat of verdigrise is formed on all their surfaces, which may be easily detached by scraping them with a knife.

Each jar furnishes five or six pounds of verdigrise at each operation. It is then called fresh verdigrise, moist verdigrise, &c. This verdigrise is sold in that state by the manufacturers to people who dry it for foreign exportation. In this first state it is only a paste, which is carefully pounded in large wooden troughs, and then put into bags of white leather, a foot in height and ten inches in diameter. These bags are exposed to the air or the sun, and are left in that state till the verdigrise has acquired the proper degree of dryness. By this operation it decreases about fifty per cent., more or less according to its primitive state. It is said to stand proof by the knife, when the point of that instrument pushed against a cake of verdigrise through the skin cannot penetrate it.

The plates of copper which have been already used are again employed for the same operation, till they are almost completely consumed. Instead of heating them artificially, as above mentioned, they are sometimes exposed only to the sun. The same plates will serve sometimes for ten years, but they are often worn out in two or three. This, however,
depends

depends on the quality of the copper. That which is extremely smooth, well beat, and very compact, is always most esteemed.

Formerly moist verdigrise could not be sold till its quality had been previously ascertained; and for that purpose it was carried to a public warehouse, where it was sold after that point had been determined.

By comparing this process with that described by Montet, it will be found that the changes introduced are much in favour of the new. Formerly the workmen took the stalks of the grapes dried in the sun, and began by immersing them for eight days in *vinasse* (the residuum of the distillation of wine for making brandy). They then suffered the moisture to drain off through a basket, after which they put about four pounds into a jar, and poured over them three or four pints of wine. The stalks were made to imbibe a large portion of the wine, by stirring them strongly with the hand; the jar was then covered, and the stalks were suffered to ferment. The fermentation commenced sooner or later, according to the nature of the wine and the temperature of the air. But after it had once begun, the wine became turbid, and exhaled a strong odour of vinegar. At length the heat decreased, and the stalks were then taken out and the wine was drawn off. When the stalks were a little drained, they were disposed in layers with the plates of copper, and the operation was continued in the same manner as with the husks. When the plates were taken from the jars to be put in *relai*, instead of immersing them in pure water, as is done at present, they were moistened three or four times with four wine, which was called giving them three or four wines.

It may be easily seen that there is a great saving in the process followed at present, since the manufacturers no longer use wine, which enhanced the price of the verdigrise. Some have condemned, in the new process, the practice of using the copper too soon; but this objection fell to the ground,
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when it was observed that the verdigrise obtained was in proportion to the copper corroded; and what proves that this method is more advantageous, is, that all the manufacturers have abandoned the old method and adopted the new*.

XII. *On the Method of preparing Tallow Candles with Wooden Wicks. By Professor MEDICUS of Heidelberg†.*

“FOR several years past tallow candles with wooden wicks have been prepared, in large quantities, by the candle-makers at Munich, and much used in that neighbourhood. I have burnt them during the whole winter, and never wish to use any other kind, as they are attended with several advantages which common tallow candles do not possess. They afford about the same quantity of light as a wax candle; burn also with great steadiness and uniformity, and never crackle or run. The candle-makers here keep the method of preparing these candles as secret as they can; but I shall communicate to the public what I have been able to learn respecting the process.

“The only difference between these candles and the common tallow candles is, that the ground work of the wick consists of a very thin slip of wood, bound round to a considerable thickness with very fine unspun cotton; but in such a manner that the size of the wick does not much exceed that of the wick of a common candle. The cotton is wound round the wick by the hand; but in general it is done by means of a reel, which I have not yet been able to see. The thin slips of wood are furnished to the candle-makers by the country people, and, if we may judge from

* There are no large manufactories of verdigrise at Montpellier; but each family makes a certain quantity, and the operations are in general performed by women.

† From Riems *Neue Sammlung Oekonomischer Schriften*, part xii.