

ton, that was nailed on, and there took some pieces from a Delft dish without throwing it down, broke a quart mug, and from a four-ounce phial half full of oil cut off its empty half part without spilling a drop of the oil. The activity of the lightning was with abated violence to all other points of the compass; but not without some considerable degree of force; for it scraped the plaister off the wall in many different and distant places, both in the chamber and kitchen: and to the south-west of the chamber, where was the window, broke many panes of glass, and tore the lead outwardly, without melting it; and broke two panes of the kitchen window, with its lead, situated under the chamber window. Both kitchen and chamber smelt as strong of sulphur some hours after, as if fumigated with brimstone matches.

Sam. Cooper.

VIII. *Experiments concerning the Encaustic Painting of the Ancients. In a Letter to the Right Honourable George Earl of Macclesfield, President of the Royal Society, from Mr. Josiah Colebrooke, F. R. S.*

My Lord,

Read Mar. 1. 1759. **T**HE result of experiments (whatever the success attending them may be), in philosophical or mechanical inquiries, is not below the attention of the Royal Society.

The

The art of painting with burnt wax, (as it is called) hath long been lost to the world; the use of it to painters, in the infancy of the art of painting, was of the utmost consequence, drying oil being unknown, they had nothing to preserve their colours entire from the injury of damps, and the heat of the sun; a varnish of some sort was therefore necessary; but they being unacquainted with distilled spirits, could not, as we now do, dissolve gums to make a transparent coat for their pictures; this invention therefore of burnt wax supplied that defect to them, and with this manner of painting, the chambers and other rooms in their houses were furnished; this Pliny calls *encaustum*, and we encaustick painting.

The following experiments which I have the honour to lay before your Lordship and the Society, were occasioned by the extract of a letter from the Abbé Mazeas, translated by Dr. Parsons, and published in the second part of the 49th volume of the *Philosophical Transactions*, N^o 100, concerning the antient method of painting with burnt wax, revived by Count Caylus.

The Count's method was,

First, To rub the cloth or board designed for the picture simply over with bees-wax.

Secondly, To lay on the colours mixed with common water; but as the colours will not adhere to the wax, the whole picture was first rubbed over with * Spanish chalk, and then the colours are used.

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Thirdly,

* Spanish chalk is called by Dr. Parsons, in a note, Spanish white; this is a better kind of whitening than the common, and was the only

Thirdly, When the picture is dry, it is put near the fire, whereby the wax melts, and absorbs all the colours.

EXPERIMENT I.

A piece of oak board was rubbed over with bees-wax, first against the grain of the wood, and then with the grain, to fill up all the pores that remained after it had been planed, and afterwards was rubbed over with as much dry Spanish white, as could be made to stick on it; this, on being painted (the colours mixed with water only), so clogged the pencil, and mixed so unequally with the ground, that it was impossible to make even an outline, but what was so much thicker in one part than another, that it would not bear so much as the name of painting; neither had it any appearance of a picture: However, to pursue the experiment, this was put at a distance from the fire, on the hearth, and the wax melted by slow degrees; but the Spanish white (tho' laid as smooth as so soft a body would admit, before the colour was laid on) yet on melting the wax into it, was not sufficient to hide the grain of the wood, nor shew the colours by a proper whiteness of the ground, the wax in rubbing on the board, was unavoidably

only white that had the name of Spanish annexed to it, that I could procure, tho' I enquired for it at most if not all the colour shops in town.

My friend Mr. Dacosta shewed me a piece of Spanish chalk in his collection, which seemed more like a *cinolia* (tobacco pipe clay), and was the reason of my using that in one of the experiments.

thicker

thicker in some parts than other, and the Spanish white the same: on this I suspected there must be some mistake in the Spanish white and made the enquiry mentioned in the note * pag. 41.

To obviate the inequality of the ground in the first experiment;

EXPERIMENT II.

A piece of old waincoat (oak board) $\frac{3}{4}$ of an inch thick, which having been part of an old drawer, was not likely to shrink on being brought near the fire; this was smoothed with a fish-skin, made quite warm before the fire, and then with a brush dipped in white wax, melted in an earthen pipkin smeared all over, and applied to the fire again, that the wax might be equally thick on all parts of the board, a ground was laid (on the waxed board) with levigated chalk mixed with gum water (*viz.* Gum Arabick dissolved in water): When it was dry, I painted it with a kind of landskip, and pursuing the method laid down by Count Caylus, brought it gradually to the fire; I fixed the picture on a fire screen which would preserve the heat, and communicate it to the back part of the board, this was placed first at the distance of three feet from the fire, and brought forward by slow degrees till it came within one foot of the fire, which made the wax swell and bloat up the picture; but as the chalk did not absorb the wax, the picture fell from the board and left it quite bare.

EXPERIMENT III.

I mixed three parts white wax, and one part white resin, hoping the tenacity of the resin might preserve the picture. This was laid on a board heated, with a brush, as in the former; and the ground was chalk, prepared as before. This was placed horizontally on an ironing box, charged with an hot heater, shifting it from time to time, that the wax and resin might penetrate the chalk; and hoping from this position, that the ground, bloated by melting the wax, would subside into its proper place: but this, like the other, came from the board, and would not at all adhere.

EXPERIMENT IV.

Prepared chalk four drams, white wax, white resin, of each a dram, burnt alabaster half a dram, were all powdered together and sifted, mixed with spirit of molasses instead of water, and put for a ground on a board smeared with wax and resin, as in *Exp.* 3. This was also placed horizontally on a box-iron, as the former: the picture blistered, and was cracked all over; and tho' removed from the box-iron to an oven moderately heated (in the same horizontal position), it would not subside, nor become smooth. When it was cold, I took an iron spatula made warm, and moved it gently over the surface of the picture, as if I were to spread a plaster. (This thought occurred, from the board being prepared with wax and resin, and the ground having the same materials in its composition, the force of the spatula

spatula might make them unite.) This succeeded so well, as to reduce the surface to a tolerable degree of smoothness: but as the ground was broke off in many places, I repaired it with flake white, mixed up with the yolk of an egg and milk, and repainted it with molasses spirit (instead of water); and then put it into an oven with a moderate degree of heat. In this I found the colours fixed, but darker than when it was first painted; and it would bear being washed with water, not rubbed with a wet cloth.

EXPERIMENT V.

A board (that had been used in a former experiment) was smeared with wax and resin, of each equal parts; was wetted with molasses spirit, to make whitening (or Spanish white) mixed with gum-water adhere. This, when dry, was scraped with a knife, to make it equally thick in all places. It was put into a warm oven, to make the varnish incorporate partly with the whitening before it was painted; and it had only a small degree of heat: water only was used to mix the colours. This was again put into an oven with a greater degree of heat; but it flaked off from the board: whether it might be owing to the board's having had a second coat of varnish (the first having been scraped and melted off), and that the unctuous parts of the wax had so entered its pores, that it would not retain a second varnish, I cannot tell.

EXPERIMENT VI.

Having miscarried in these trials, I took a new board, planed smooth, but not polished, either with
a fish-

a fish-skin or rushes : I warmed it, and smeared it with wax only ; then took *cimolia* (tobacco-pipe clay) divested of its sand, by being dissolved in water and poured off, leaving the coarse heavy parts behind. After this was dried and powdered, I mixed it with a small quantity of the yolk of an egg and cow's milk, and made a ground with this on the waxed board : this I was induced to try, by knowing that the yolk of an egg will dissolve almost all unctuous substances, and make them incorporate with water ; and I apprehended, that a ground, thus prepared, would adhere so much the more firmly to the board than the former had done, as to prevent its flaking off. The milk, I thought, might answer two purposes ; first, uniting the ground with the wax ; and secondly, by answering the end of size, or gum-water, and prevent the colours sinking too deep into the ground, or running one into another. When the ground was near dry, I smoothed it with a pallet-knife, and washed with milk and egg where I had occasion to make it smooth and even : when dry I painted it, mixing the colours with common water ; this, on being placed horizontally in an oven, only warm enough to melt the wax, flaked from the board ; but held so much better together than any of the former, that I pasted part of it on paper.

EXPERIMENT VII.

* Flake white mixed with egg and milk, crumbled all to pieces in the oven, put on the waxed board, as in the last experiment.

The bad success which had attended all the former experiments, led me to consider of what use the wax was in this kind of painting: and it occurred to me, that it was only as a varnish to preserve the colours from fading.

In order to try this,

EXPERIMENT VIII.

I took what the bricklayers call fine stuff, or putty †; to this I added a small quantity of burnt alabaster, to make it dry: this it soon did in the open air; but before I put on any colours, I dried it gently by the fire, lest the colours should run. When it was painted, I warmed it gradually by the fire (to prevent the ground from cracking), till it was very hot. I then took white wax three parts, white resin one part, melted them in an earthen pipkin, and with a brush spread them all over the painted board, and kept it close to the fire in a perpendicular situation, that what wax and resin the plaister would not absorb might drop off. When it was cold, I found the colours were not altered, either from the

* Flake white is the purest sort of white lead.

† Putty is lime slacked, and, while warm, dissolved in water, and strained through a sieve.

heat of the fire, or passing the brush over them. I then rubbed it with a soft linen cloth, and thereby procured a kind of gloss, which I afterwards increased by rubbing it with an hard brush; which was so far from scratching or leaving any marks on the picture, that it became more smooth and polished by it.

After I had made all the foregoing experiments, in conversation with my honoured and learned friend Dr. Kidby, a fellow of this Society, I said I had been trying to find out what the encaustic painting of the ancients was. Upon which, he told me, that there was a passage in Vitruvius *de architectura* relative to that kind of painting; and was so good as to transcribe it for me from the 7th book, chap. 9. *De minii temperatura*. Vitruvius's words are; *At si quis subtilior fuerit, & voluerit expolitionem miniaceam suum colorem retinere, cum paries expolitus & aridus fuerit, tunc ceram punicam liquefactam igni, paulo oleo temperatam, seta inducat, deinde postea carbonibus in ferreo vase compositis, eam ceram apprime cum pariete, calefaciendo sudare cogat, fiatque ut peræquetur, deinde cum candela linteisque puris subigat, uti signa marmorea nuda curantur. Hæc autem xavois græce dicitur. Ita obstans ceræ punicæ lorica non patitur, nec lunæ splendorem, nec solis radios lambendo eripere ex his politionibus colorem.*

Which I thus translate: " But if any one is more
 " wary, and would have the polishing [painting]
 " with vermilion hold its colour, when the wall is
 " painted and dry, let him take Carthaginian [Bar-
 " bary] wax, melted with a little oil, and rub it on
 " the wall with an hair pencil; and afterwards let
 " him

“ him put live coals into an iron vessel (chafing-dish),
 “ and hold it close to the wax, when the wall, by
 “ being heated, begins to sweat; then let it be made
 “ smooth: afterwards let him rub it with a * candle
 “ and † clean linen rags, in the same manner as they
 “ do the naked marble statues. This the Greeks call
 “ *καυσις*. The coat of Carthaginian wax (thus put
 “ on) is so strong, that it neither suffers the moon
 “ by night, nor the sun-beams by day, to destroy
 “ the colour.”

Being satisfied, from this passage in Vitruvius, that the manner of using wax in *Exp.* 8. was right, I was now to find if the wax-varnish, thus burnt into the picture, would bear washing: but here I was a little disappointed; for rubbing one corner with a wet linen cloth, some of the colour came off; but washing with a soft hair pencil dipped in water, and letting it dry without wiping, the colours stood very well.

A board painted, as in *Exp.* 8, was hung in the most smoaky part of a chimney for a day, and ex-

* This account of the method of polishing [painting] walls coloured with vermilion, gave me great satisfaction, as it proved the method I had taken in experiment 8. (which I had tried before I saw or knew of this passage in Vitruvius) was right. The use of the candle, as I apprehend, was to melt the wax on the walls, where by accident the brush had put on too much, or afford wax where the brush had not put on enough, or had left any part bare.

† The rubbing the wall with a linen cloth, while warm, will do very well, where there is only one colour to be preserved; but where there are many, as in a landscape, it will be apt to take off some, or render the colouring rather faint; which I found by wiping the wax off from a painting while it was hot.

posed to the open air in a very foggy night. In the morning the board was seemingly wet through, and the water ran off the picture. This was suffered to dry without wiping; and the picture had not suffered at all from the smoke or the dew, either in the ground or the colours: but when dry, by rubbing it, first with a soft cloth, and afterwards with a brush, it recovered its former gloss.

Suspecting that some tallow might have been mixed with the white wax I had used, which might cause the colours to come off on being rubbed with a wet cloth, I took yellow wax which had been melted from the honeycomb in a private family, and consequently not at all adulterated; to three parts of this I added one part resin, and melted them together.

EXPERIMENT IX.

Spanish white, mixed with fish glew, was put for a ground on a board, and painted with water colours only. The board was made warm; and then the wax and resin were put on with a brush, and kept close to the fire till the picture had imbibed all the varnish, and looked dry. When it was cold, I rubbed it first with a linen cloth, and then polished it with an hard brush.

In these experiments I found great difficulties with regard to colours; many water colours being made from the juices of plants, have some degree of an acid in them; and these, when painted on an alkaline ground, as chalk, whitening, *cimolia*, and plaister, are, totally changed their colours, and from green became

became brown ; which contributed much to make the experiments tedious. I would therefore advise the use of mineral or metallic colours for this sort of painting, as most likely to preserve their colour : for although I neutralized Spanish white, by fermenting it with vinegar, and afterwards washed it very well with water, it did not succeed to my wish.

These experiments, and this passage from Vitruvius, will in some measure explain the obscurity of part of that passage in Pliny which Dr. Parsons, in his learned comment on the encaustic painting with wax, seems to despair of.

Ceris pingere was one species of encaustic painting. *Ἐγκαυστικόν*, *inustum*, may be translated, forced in by the means of fire, burnt in : for whatever is forced in by the help of fire can be rendered into Latin by no other significant word, that I know of, but *inustum*. If this is allowed me, and I think I have the authority of Vitruvius (a writer in the Augustan age) for it, who seems to have wrote from his own knowlege, and not like Pliny, who copied from others much more than he knew himself, the difficulty with regard to this kind of painting is solved, and the encaustic with burnt wax recovered to the public.

What he means by the next kind he mentions, *in ebore cestro id est viriculo*, I will not attempt to explain at present.

The ship painting is more easily accounted for : the practice being, in part, continued to this time ; and is what is corruptly called breaming, for brenning or burning. This is done by reeds set on fire, and held under the side of a ship till it is quite hot ;

then resin, tallow, tar, and brimstone, melted together, and put on with an hair brush while the planks remain hot, make such a kind of paint as Pliny describes; which, he says, *nec sole, nec sale, ventisque corrumpitur*, as they were ignorant of the use of oil painting, they mixed that colour with the wax, &c. which they intended for each particular part of the ship, and put it on in the manner above described.

In the pictures painted for these experiments, and now laid before your Lordship and the Society, I hope neither the design of the landschape, nor the execution of it, will be so much taken into consideration as the varnish (which was the thing wanted in this inquiry): and I think that will evince, that the encaustic painting with burnt wax is fully restored by these experiments; and though not a new invention, yet having been lost for so many ages, and now applied further, and to other purposes than it was by Vitruvius (who confined it to vermilion only), may almost amount to a new discovery, the use of it may be a means of preserving many curious drawings to * posterity: for this kind of painting may be on paper, cloth, or any other substance that will admit a ground to be laid on it. The process is very simple, and is not attended with the disagreeable smell unavoidable in oil painting, nor with some inconveniences inseparable from that art; and as there is no substance we know, more durable than wax, it hath the greatest probability of being lasting.

* A bird painted by Mr. Edwards on paper, and the colours fixed by burned wax, was shewn to the Society, April 5th.

I ask pardon of your Lordship and the Society for taking up so much time as this paper hath required: but if it meets with your Lordship's and the Society's approbation, I may, in some future paper (when the necessary avocations of my profession will allow me leisure), lay before you some experiments, relating to colours which are not likely to change by being painted on any kind of ground.

As your Lordship's recommendation contributed much to make me a member of this learned body, I must beg your patronage of this communication; and am, with the greatest respect,

Your Lordship's and the Society's

Most obedient humble Servant,

Budge-row,
February 27, 1759.

Josiah Colebrooke.

IX. *A Letter concerning the success of the preceding Experiments. In a Letter to the Right Honourable Lord Charles Cavendish, V. P. R. S. from Mr. Josiah Colebrooke, F. R. S.*

My Lord,

Read April 5. 1759. **I**N a paper (I lately had the honour to lay before the Royal Society, on the encaustic painting of the ancients) I mentioned an use which might be made of it to preserve drawings. I have now the pleasure of laying before your Lordship