XLII. On a new kind of painting with the serum or watery part of the blood

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To cite this article: F. Carbonel M.D. (1803) XLII. On a new kind of painting with the serum or watery part of the blood , Philosophical Magazine Series 1, 15:59, 240-245, DOI: [10.1080/14786440308676264](https://doi.org/10.1080/14786440308676264)

To link to this article: <http://dx.doi.org/10.1080/14786440308676264>

Published online: 18 May 2009.

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as low as possible, both on account of their utility in our manufactories, and of the necessity of maintaining a competition with the English coals.

The carriage by the caufeways from Charleroi and Mons to Bruffels adds greatly to the price of these coals. A canal has been projected for uniting the Sambre towards Thuin with the small river of Senne; which would convey the coals of the mines in the neighbourhood of Charleroi to Bruffels, and would thus form a communication with the Scheldt and Batavia, so as to prevent the necessity of land carriage.

This canal, valuable in this point of view, would be of utility also to the export trade of these countries in regard to the glass and nails sent to Holland and to our own ports, and which are thence conveyed to the Indies.

It would be of utility also to government for transporting the timber of the Forest of Souane, through which it would pass.

To point out these improvements will, no doubt, be sufficient to induce government to pay serious attention to them; but until new means of circulation be provided, it is of importance that the existing roads should be properly repaired.

I shall terminate this article by observing, that it is the interest of France to facilitate its commercial intercourse with Holland, and particularly that which relates to the importation of our coals into that country: consequently, instead of laying a duty on their exportation to the amount, as is said, of 20 per cent., this branch of commerce ought to be entirely free. It would be good policy also to encourage by bounties the exportation of the coals of this department, especially when destined for French ports in parts of our territory which cannot receive this fuel from the mines of the interior, and which if not supplied by our mines would procure them from foreign countries.

[To be continued.]

*XLII. On a new Kind of Painting with the Serum or watery Part of the Blood. By F. CARBONEL, M.D. of Barcelona.**

THE advantages and utility of painting have at all times excited the emulation of professors and of artists. The progress of this art, which imitates nature, has fortunately corresponded to their wishes; but its advancement would cer-

* From the *Journal de Physique*, Ventose, an. 11.

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tainly have been more rapid if artists had been sooner made acquainted with the new chemistry. This assertion is proved by the present discovery.

The necessity of painting surfaces of different kinds, their various situations, and the complex circumstances which attend the application of colours, have given rise to the different kinds of painting which are known; such as painting in fresco, painting in size, oil-painting, painting with milk, painting on porcelain, painting with wax, painting on glass, &c.

The journey of the king of Spain to Barcelona, and the preparation of the edifices destined for the use of their majesties, afforded me an opportunity of solving a new problem in regard to this art. It was necessary to discover some kind of painting of the common colour of stone which might be able to resist rain, which should be unalterable in the sun, easy to be applied on wood, and which should dry soon and exhale no bad odour; in a word, a painting equally durable with that in size, and which should have the property of being able to withstand the inclemency of the weather. The solubility of gelatin in water, the bad smell of oil, the weak adhesion of milk of lime to wood, and its ready alteration by heat, made me sensible that it would be impossible to have recourse to any of the known vehicles for securing the colouring matters. After some examination I found that albumen* was the only substance which could answer the required conditions, on account of its insolubility in water, and the consistence it acquires by combining with calcareous earths. This substance, prepared by the vital power in the animal organs, is found almost pure in the white of an egg or albumen, and is found in combination in different animal substances. But the great viscosity of the white of an egg, the clots which are formed by its combination with lime, and particularly its dearth, made me give up all idea of employing it for painting a whole edifice.

I then conceived that the serum of blood, the principal part of which consists of albumen, would be attended with all the advantages of white of egg for the proposed end, without having any of its inconveniences. Chémical analysis of animal substances, indeed, shows that the serum of blood, commonly called the water of the blood, or, improperly, the lymph of the blood, is a kind of animal mucilage composed of albuminous or gelatinous substances in different propor-

* This painting was much wanted for the bridge which joins the *bour de la Douane* to the palace of the captain-general, as no other kind could be employed for fear of injuring the queen's health.

tions, dissolved in an indeterminate quantity of water, constantly united to pure soda, which reduces the albuminous substance to an almost saponaceous state. There is found also in the serum phosphate of soda, of lime, and of ammonia. But these saline substances are not essential to this combination, since they not only may vary in their proportions, but be wanting either in whole or in part; and even unite in the serum to other salts, such as the muriate of potash, the phosphate of magnesia, &c., without the albuminous, alkaline, or gelatinous substance of the serum being changed, or exhibiting different characteristic properties.

This doctrine, received by all the celebrated modern chemists, induced me to think that the albuminous substance of serum, modified by its combination with gelatin and soda, ought to form with calcareous earth a composition which would retain no more of that viscosity and tenacity assumed by the mixture of the white of an egg and lime, than what might be necessary for answering the proposed end.

These reasons, and the low price of this liquid in large cities, soon induced me to try the effects of the serum of blood with pulverized quicklime; and I found, with much satisfaction, that my first trials corresponded in every respect to the hopes I had conceived.

Practice and Application of the new Kind of Painting.

The preparation of this new kind of paint is easy, and requires very little time. Nothing is necessary but to pulverize the lime, and to dilute it in the serum of blood until it forms a liquid of sufficient thickness for painting; which is then to be applied in the usual manner. The colour which this composition acquires is whitish, and more or less shining, according to the purity of the serum and the whiteness of the lime. This earth may be employed either in the state of quick or caustic lime reduced to powder, or well flaked with a small quantity of water to lessen the adhesion of its integrant parts. It must then be reduced to a fine powder, and be sifted through a close sieve. If kept for some days, it is necessary to preserve it in a close tub or earthen vessel, to prevent its combination with the carbonic acid and water of the atmosphere. The serum is separated from the curdled blood by decantation: but care must be taken to shake the matter as little as possible, and to suffer it each time to remain at rest.

In this composition two things only are to be observed: the first is, that serum being a fluid highly susceptible of corruption, it must be employed the same day it is separated; or

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at furthest the day following, provided it be kept in a cool place sheltered from the contact of the air, especially during the summer, when it alters much more easily.

In case of doubt, inspection of the fluid alone may serve to determine its quality; for the signs of its fermentation are very evident. This observation is applicable also to the colouring liquor, but in a less degree. It follows from this circumstance, that the vessels which have been used for containing, preparing, or applying paint made with serum ought to be washed every day. The second precaution to be taken is, that as the re-action of the serum and lime increases in the course of time, as well as the density of the mixture, in order that it may be preserved in the necessary state of fluidity, or to diminish or increase it according to the nature of the substances to be painted and the number of strata to be applied, another vessel filled with serum must be provided, to give to the colouring liquor the necessary fluidity. It thence follows that the mixture must be prepared as it is used.

Having assured myself of the successful and constant effects of this kind of painting, I tried to mix it with different colouring substances, to render the application of the invention more general.

The well known re-action of animal substances and of lime on the metallic oxides, and particularly on those in which oxygen is united to the metal with little force, made me suspect an alteration of some colours when mixed with this liquid; an alteration naturally produced by the separation of a part of the oxygen from the metallic oxides. On the other hand, the analogy which coloured chalks have with calcareous earth induced me to believe that their combination would be attended with the happiest result. The oxides of lead, copper, and arsenic, indeed, undergo a singular alteration in their respective colours, when they are united with serum and calcareous earth: but this is not the case with cobalt green; which on that account appears to me to be very proper for being used as a colouring matter in this new kind of painting. Those earths, however, called red, green, black, or yellow, which are of an argillo-calcareous nature, when mixed with these substances, may furnish different agreeable colours of a durability equal to the blueish colour produced merely by the mixture of lime and of serum.

I have however remarked, that the durability of this painting is considerably altered when there is mixed with it a very large quantity of colouring earth, such as the black earth used for painting an iron colour, or the representation of white marble with black spots. To remedy this inconvenience, no-

thing will be necessary but to mix a little white of an egg with the serum before it is united with the lime or the black earth. I must here add, that wood painted in this manner may be polished, and made to acquire a certain degree of lustre. In this case I have observed that fresh spermaceti may be substituted with advantage for the tallow or oil in which the rags employed for rubbing wood before it is polished are commonly dipped. This kind of paint may be applied also with the same success to earthen ware, lead, iron, cut stone, &c.

The circumstances which induced me to employ this new kind of painting, obliged me to make an extensive use of it, without allowing me time to carry my operations any further. More than 300 arrobes* of serum were consumed in the course of a few days. In this manner we were able to paint not only the passage and bridge of the king's palace, but also the windows and doors of the same edifice, those of the magnificent building of the Exchange, the *Place de Taureau*, and many private houses. The happy effects it produced, when exposed to the eyes of the public, are a sufficient proof that practice here perfectly corresponds with theory.

It is hardly necessary to observe, that the surfaces to be painted must be smooth; that the wood must be covered with a stratum of plaster; and that this painting must not be applied over painting with oil or with turpentine, because the heat would make it crack.

I propose to continue the small number of trials I have already made, to render the use of my discovery more general. The following is the result of those which I have hitherto been able to attempt.

In consequence of the viscosity, adhesion, and speedy defecation of this composition, it may be employed in the same manner as bitumen, to cement with great solidity broken articles of every kind. In this case it opposes a strong resistance to the action of fire, water, many of the gases, and to vapour.

As serum contains a large quantity of albuminous matter, having myself separated from it nearly half its weight, it may be employed with advantage for clarifying sugar, wine, and other substances, in a more æconomical manner than by the white of an egg.

This new composition may be employed also for covering the surface of damp walls intended to be painted in oil colours; taking care, however, to cover it with a coating of

* An arrobe weighs 25 or 26 pounds.

plaster

plaster and glue, to prevent its re-action on the colouring parts of the painting.

The hardness of this substance, and its susceptibility of receiving a polish, induce me to believe that it might be employed on stucco, and for imitating it on walls and ceilings.

It may be used also for uniting water-conduits, and for cementing stones of all dimensions, and especially those which are put into wood caissons for building under water.

It appears from different works, that the ancients had conceived the idea of employing blood in the composition of their cements and mortar; but the use of it in painting was before unknown. Besides, there was too great a distance between this use of blood and that of serum freed from the fibrous part and the colouring matter, to admit of any doubt that the principle of my discovery is entirely my own.

It follows from what has been here said, that this new kind of painting may be added to those already known, and that it may be called painting *in serum*; that it is as easily applied as prepared; that the elements of it are common, and of little value; and that it unites in it all the advantages of painting in oil and in distemper, without having any of their inconveniences.

XLIII. *On the Kind of Air-Furnaces employed in Iron Foundries for casting large Pieces of Ordnance, Shafts for Mills, Cylinders, and other heavy Articles.* By Mr. DAVID MUSHET, of the Calder Iron Works*.

THE furnaces about to be described are employed for melting pig-iron with the flame of pit-coal. Furnaces of this kind are constructed of various sizes according to circumstances. The small sizes will run down from seven to ten hundred weight, and are used in small foundries for what the trade call *jobbing*.

Fig. 1. (Plate IV.) a ground plan of two large air-furnaces, and chimney for melting pig- or cast-iron with the flame of pit-coal.

The letters ABCD point out the exterior dimensions of the stalk or chimney, which is first erected, leaving two openings or arches into which the fore-part of the furnaces are afterwards built. The breadth of the chimney at the particular place which the plan exhibits is 16 feet from A to B, and from A to D or from B to C 6 feet 6 inches. The plan is drawn at that elevation where the flame enters the chimney

* Communicated by the Author.