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The use of tempera by painters and restorers in Italy and Latin Europe, c. 1800–1870

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INTRODUCTION

This contribution discusses the written sources on tempera painting published in Italy and the Romance countries from 1800 to 1870, a period during which, as seen in these texts, 'tempera' paints were understood to be based on water-soluble binding media, whose use was particularly suited to mural painting, scenography and (ephemeral) decorative painting. This article also presents the results of binding media analyses on tempera paintings by two landscape painters from the northeast of Italy, Ippolito Caffi (1809–1866) and Giuseppe Bernardino Bison (1762–1844), who made substantial use of tempera.

TREATISES ON PAINTING TECHNIQUE

In the 19th century, the main texts that discuss the use of temperas are treatises on painting technique and restoration, and a few historio-critical writings. In the treatises on painting technique, the historical development of temperas is investigated and attention is paid to technical characteristics with a view to replacing oil (which had been observed to darken quickly) as a binding medium, not only for use by artists' applications, but also in restoration. Clearly these two areas were interrelated, which may be seen in many texts: a number of the treatises on painting technique dedicate several pages to restoration (De Burtin 1808, pp. 382–445; Bouvier 1832, pp. 619–652; Merimée 1830, pp. 252–268; Paillot de Montabert 1829, vol. 9, pp. 692–720), while some of the treatises on restoration – such as that by Ulisse Forni (Forni 1866/edn 2004) – also discuss painting techniques.

In addition to these sources, we have also studied *Saggio analitico critico sopra i colori minerali [...]* (*Critical Analytical Essay on the Colours and Minerals [...]*) by Lorenzo Marcucci (1816), first printed in 1813, and *Traité complet de la peinture* (*Complete Treatise of Painting*), published in ten volumes in 1829 by Jean-Nicolas Paillot de Montabert, which is discussed in more detail below. Jean-François Merimée's book, *De la peinture à l'huile* (*On Oil Painting*) from 1830, is also of interest, although less so – its author is predominantly concerned with oil painting, but he recounts the use of tempera by some Venetian artists (such as Titian and Paolo Veronese) for underpainting.[1] De Burtin's treatise, which was very well known in the period, says nothing about the use of tempera and is not therefore discussed. The treatise *Sul modo di dorare, verniciare stuccare e dipingere* (*On the Manner of Gilding, Varnishing, Stuccoing and Painting*) by Bonaiuto Del Vecchio of 1842, is almost entirely unknown outside Venice where it was published, but it is of considerable interest in this context because both Ippolito Caffi[2] and Giuseppe Bernardino Bison,[3] the authors of the tempera works we have analysed, trained at the art academy in Venice. Del Vecchio, like Marcucci (1816, pp. 187–192), Forni (1866/edn 2004, pp. 125–132) and other Italian treatise writers, covers glue-based paints as a separate category distinct from 'temperas' (Del Vecchio 1842, p. 117). In contrast, Paillot de Montabert (1829, vol. 9, pp. 437–452) considers both milk- and egg-based binding media and glues to be temperas. Both the Italian and the French treatise writers consider gum-based paints as a distinct subset, which indicates that for them, water solubility was not seen as the primary 'tempera' defining characteristic.

Although it belongs to the Anglo-Saxon artistic tradition, Charles L. Eastlake's treatise, *Materials for a History of Oil Painting*, published in London in 1847, was also examined because it was translated into Italian by Giovanni Bezzi in 1849 and was used by many Italian scholars of painting technique including, for example, Pietro Selvatico and Giovanni Secco Suardo. Although the treatise is devoted to oil painting, Eastlake also discusses tempera made from glue diluted with honey, which he (rightly) considers typical for canvas painting in the Northern European countries in the 15th and 16th centuries, while he maintains that egg tempera, in his opinion 'the true tempera of the Italians', is not suited to the humidity of the northern climate.[4]

TREATISES ON RESTORATION

Among the texts dealing with restoration, this study includes the article by Antonio Guattani, 'Carlo

Fig. 1 Ippolito Caffi, *View of Piazza della Signoria* in Florence, 1863, tempera on canvas, 320 × 180 cm, Villa Giacomelli, Pradamano (UD). The uneven, stained appearance, especially of the sky area, is due to the current poor condition of the work.

Giuseppe Gerli restauratore a tempera de'quadri' ('Carlo Giuseppe Gerli, restorer of paintings with tempera [paints]'), published in 1808, in which the author praises the stability of the tempera retouching carried out by the restorer. Guattani is not aware of (or does not reveal) the composition of this tempera. However, we know that Gerli managed to formulate such an intense, bright paint that it did not even need varnish, so it is very likely that the tempera in question was based on egg and glue.[5]

The short essay on the restoration of paintings that Christian Friedrich Prange added to his translation of Pierre-Louis Bouvier's treatise in 1828 was originally written in German. As of the second edition of the treatise, this essay, in French translation, became an integral part of Bouvier's text (Bouvier 1832, pp. 619–652); in this manner, it was in effect incorporated into the technical literature of the Romance countries. Prange's discussion suggests that he was only vaguely familiar with egg tempera,[6] which was not very well known in Germany until Jakob Schlesinger appended his essay 'Ueber Tempera-Bilder und deren Restauration' ('On tempera paintings and their restoration') to the treatise by the painter and restorer Christian Koester (Schlesinger 1828).

It is well known that the first actual treatise on restoration in the Romance countries was published in Paris in 1837 by Giovanni Bedotti, an Italian from the Piedmont region. Bedotti believed that retouching should only be carried out in oil and makes no mention of tempera. The treatise published in Paris in 1851 by the French restorer and art dealer Simon Horsin-Déon, *De la conservation et de la restauration des tableaux* (*On the Preservation and on the Restoration of Paintings*), is of considerably more interest to us, as it discusses the tempera painting of the 'Primitives' – although in less detail than Paillot de Montabert – and advises that the retouching of these paintings should be carried out using a binding medium based on honey and gum.[7] The Spanish writer Vincente Polerò y Toledo, who published a treatise entitled *Arte de la restauraciò* (*The Art of Restoration*) in 1853, again does not discuss tempera, either as a painting technique or as a binding medium for retouching (Polerò y Toledo 1853/edn 2010), but it is mentioned in the *Manuale del pittore restauratore* (*Manual of the Painting Restorer*) by Forni, published in 1866. In fact, as might be expected of a Tuscan artist trained in the purist tradition[8] of the time and active as a restorer of paintings at the Uffizi, Forni devotes a large part of his text both to the painting techniques of the early Italians and to the methods for restoring these paintings. In the second half of the manual, in which he describes the materials for painting and restoration, Forni lists the various aqueous binding media, dividing them into gums,[9] glues[10] and 'true' temperas, among which he counts only casein tempera and egg tempera.[11] Turning next to restoration,

Fig. 2 Ippolito Caffi, *View of the Gulf of Naples*, 1863, tempera on canvas, 320 × 180 cm, Villa Giacomelli, Pradamano (UD).

he recommends manufactured 'watercolours' imported from England (based on glue and gum arabic) or France (based on gum arabic and honey) for the retouching of tempera paintings.[12] For retouching other kinds of painting, he advises using a binding medium based on casein[13] or a tempera made from egg yolk and gum arabic.[14] Giovanni Secco Suardo includes some brief reviews of recipes for tempera painting in his manual *Il restauratore dei dipinti* (*The Restoration of Paintings*) (Secco Suardo 1894/edn 1993). However, in contrast to Forni, he considers the characteristics of aqueous media chiefly in relation to restoration.[15] He discusses the problems posed by tempera paintings relating to cleaning and varnishing[16] and the use of temperas for retouching oil paintings.[17]

Fig. 3 Detail of Fig. 2, bottom right.

From a review of the above-mentioned sources, it can be seen that the Italian and French treatises correspond closely. This is clearly illustrated by the fact that Merimée acknowledges his debt to Marcucci,[18] as well as Forni's and Secco Suardo's constant reference to the treatise by Horsin-Déon (Forni 1866/edn 2004; Secco Suardo 1894/edn 1993).[19] A certain amount of lexical confusion emerges from the study of these treatises. Sometimes the word 'tempera' is used to mean all water-soluble binding media, at other times 'glue' and 'gum' painting is distinguished from 'tempera' painting which, for the Italian treatise writers under discussion, is confined to that based on egg yolk or casein. These temperas seem to correspond to those that Giovanni Secco Suardo calls the 'hard' temperas or the ones that in his opinion are not altered by varnishing. It should be made clear, however, that Secco Suardo's 'hard' temperas do not seem to correspond to those that some years later Giorgio de Chirico called '*tempere grasse*' (fatty temperas); these were, for the most part, egg temperas to which various fatty materials had been added (de Chirico 1928, pp. 30–45).

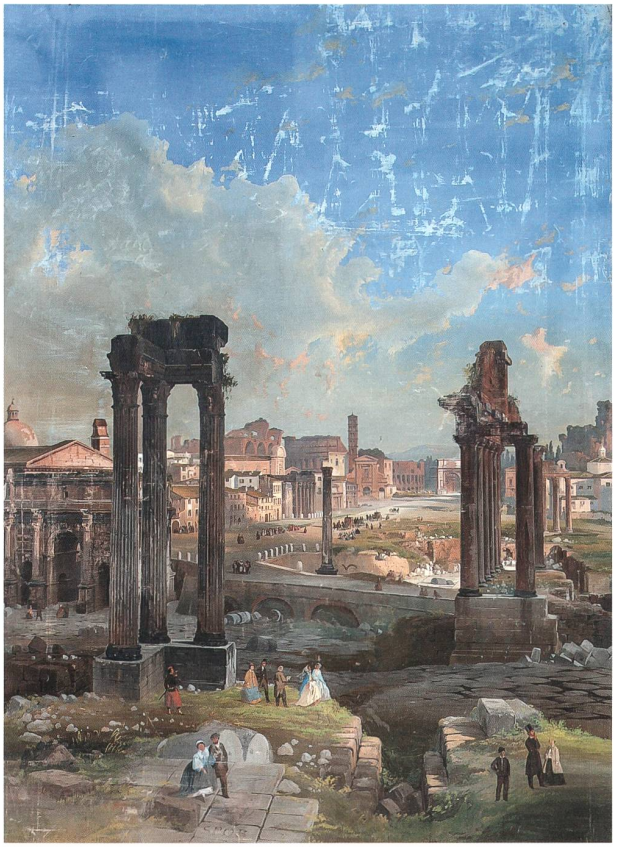

Fig. 4 Ippolito Caffi, *View of the Forum in Rome*, 1863, tempera on canvas, 320 x 180 cm, Villa Giacomelli, Pradamano (UD).

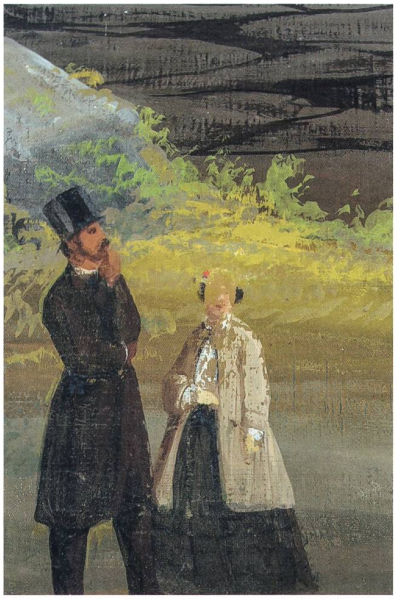

Fig. 5 Detail of Fig. 4, bottom right. The uppermost paint layer has flaked off in some areas.

GLUE TEMPERA FOR DECORATIVE PAINTING

Another aspect that emerges clearly from the analysis of these treatises is the broad diffusion of glue tempera for decorative painting, landscape painting and scenography. These types of painting, already very widespread in the 18th century,[20] were practised extensively in the 19th century; however, they are largely ignored by contemporary critics and treatise writers who, due to the hierarchical ordering of the 'genres', which was still prevalent in the academies, were interested primarily in history painting and portraiture.

If it is true that the interest in tempera for 'fine art painting' during the 19th century was connected to the rediscovery of the Primitives and to the search for a binding medium to replace oil (whose rapid discoloration had now become evident), we must not forget that in the same period, it was still very widely used for decorative painting, landscapes and scenography. Glue tempera was the most commonly employed in this context, and it is not by chance that this is the binding medium found in analyses of the landscapes by Caffi (Figs 1–7) and Bison (Figs 8–10). It is also significant that the analytical results (Casellato *et al.* 2013) correspond with the nature of the recipes in the treatises discussed here. In addition, the large number of recipes to be found in the texts indirectly confirms the importance that glue painting retained throughout the 19th century. This is also verified by Marcucci, who writes: 'egg tempera is best for small format paintings because, if it is used for large formats, and particularly for backdrops, they can easily become blotchy; for these, therefore, it is better to use glue made from parchment clippings' (Marcucci 1816, pp. 192–193).

Marcucci, Paillot de Montabert (1829, vol. 9, p. 448), and Forni (1866/edn 2004, p. 130) recommended so-called *colla*

a bocca ('mouth glue'), made by adding sugar to slow down drying and to increase the elasticity of the glue coating,[21] thereby rendering it more suitable for painting very large surfaces.[22] This is precisely the method that was used by Caffi when he painted the eight large canvases (approx. 300 × 200 cm) for the ballroom of Villa Giacomelli in Pradamano, near Udine (Figs 1–7). Organic analyses carried out on micro samples of the paint film indicate that Caffi's binding medium was a proteinaceous tempera.[23] More specifically, gas chromatography-mass spectrometry (GC-MS) demonstrated the presence of animal glue with the addition of sugar.[24] It is therefore a *colla a bocca* with egg yolk added, perhaps to increase the saturation of certain pigments.[25] GC-MS analysis carried out on the landscape by Bernardino Bison (Udine, private collection, c. 60 × 40 cm, 1820/1825) (Figs 9–11) also confirms the use of a binding medium consisting of a mixture of animal glue and sugar.

There is an interesting technical description of glue painting in the treatise by Paillot de Montabert. He notes that:

> [...] this type of painting [in glue tempera] is the oldest of all; however, it is not the easiest [to employ], because the paint dries very quickly, and the painter has very little time to establish and smoothly blend his tones. This kind of painting can only be carried out by very able hands and by artists who know what they are doing [...] As for large format paintings, this is precisely the method that these sort of paintings demand [...] One very important observation is that the tones should always be kept extremely bright and very lively, since they lose at least half their brightness as they dry [...] A beautiful tempera painting needs to be executed in a single act [...] in this respect, tempera painting is more difficult than oil painting (Paillot de Montabert 1829, vol. 9, pp. 438–443).[26]

The importance of *colla a bocca* is confirmed by the detailed accounts given by Del Vecchio[27] and Forni, who describes its preparation as follows: 'Soak clear *colla forte* (strong glue) or good quality Flemish glue[28] in a small amount of water. Then add white sugar to a tenth of its

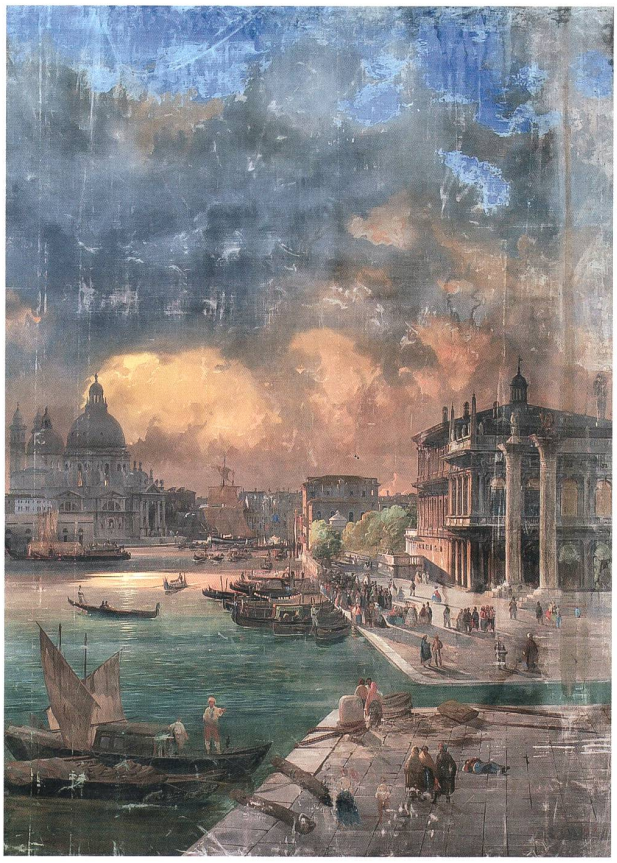

Fig. 6 Ippolito Caffi, *View of Chiesa della Salute in Venice*, 1863, tempera on canvas, 320 x 180 cm, Villa Giacomelli, Pradamano (UD).

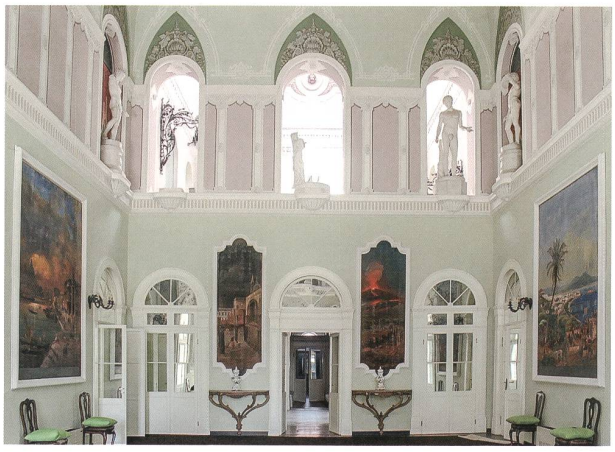

Fig. 7 Ballroom of Villa Giacomelli, Pradamano (UD), with paintings by Ippolito Caffi.

Fig. 8 Giuseppe Bernardino Bison, *Riverscape*, c. 1820, tempera on paper, 40 x 60 cm, private collection, Udine.

Fig. 9 Detail of Fig. 8.

Fig. 10 Detail of Fig. 8.

weight and continue to heat it until the whole thing is transparent and homogeneous. Then take it off the heat and, when it is about to thicken, perfume it with volatile cedarwood oil.'[29]

SOURCES ON THE DARKENING OF OIL

As noted above, the interest in tempera painting in this period was also fuelled by a growing awareness of the changes to which both oil paintings and retouchings executed in oil were subject. This, combined with the discovery of the good state of conservation of medieval paintings, led many 19th-century restorers, authors of treatises and art scholars to promote the use of tempera. One of the first to draw attention to the darkening of oil was Marcucci. He had already suggested in 1813 that artists could avoid this drawback by adopting an oleoresinous medium, which he claimed was used by the Flemish and Venetian artists and by Florentine artists of the 15th and early 16th century, since he believed that this was the reason why their paintings had lasted so much better (Marcucci 1816, pp. 199–240). In his opinion:

> [...] the blackening of oil paintings has three causes. The first is a preparation layer that is bad in two respects: it is made from materials that are too absorbent, and it has a dark colour; the second is the misuse of the heat-bodied oil that they mixed with the pigments; and the third is their use of certain blacks, which expand enormously in a short space of time [...] but the root and only cause is the misuse of oil, since it is this which influences the whole thing, and areas where a larger quantity is absorbed are more subject to blackening (Marcucci 1816, p. 201).[30]

However, Marcucci also notes that the alteration of oil can be limited by the use of certain materials and particular techniques of execution (such as white preparation layers or its application as glazing). In his view, these characteristics are found especially in the paintings of Veronese, who 'used to work his paintings up in tempera and glue and then used to fix them with a coat of good glue, before passing a coat of mastic varnish over the top and finishing in oil' (Marcucci 1816, p. 232, note 1). Preoccupations of this kind were repeated by Merimée in 1830 (pp. 15–19), confirming what has already been said about the familiarity with the Italian texts in France (and vice versa). In contrast, the publications on painting technique by contemporary German scholars seem to have been unknown to Italian authors, with the exception of Pietro Selvatico (1870), who cites texts by Jacob Roux (1771–1830), Philipp Lorenz Geiger (1785–1836) and Karl Ludwig Reimann (1804–1872) (Geiger and Roux 1826; Geiger and Reimann 1827; Roux 1828). However, the linguistic barrier that impeded the reception of German publications in Italy did not block the movement of information in the opposite direction, since many German scholars had a good grasp of Italian. This is demonstrated, for example, by the immediate notice of the publication of Cennini's treatise given by Carl Friedrich von Rumohr in *Kunstblatt* in 1821.

As mentioned above, the problem of oils darkening was also an issue for restorers, but there is a notable discrepancy of opinion on this point. While almost all of the Italian restorers (except for Bedotti) used pigments bound in varnish or tempera media for their retouchings, the French treatise writers – apart from Paillot de Montabert (1829, vol. 9, pp. 437–457) – continued to recommend linseed oil. Forni severely criticised Horsin-Déon for this in the *Manuale del pittore restauratore* of 1866.[31] As already mentioned, for retouching he recommends using paints based on glue and gum,[32] or pigments in tempera made from egg and glue.[33]

Secco Suardo also draws attention to the darkening of oil[34] and suggests retouching in varnish or, on the largest losses, in tempera for the underlayers, with glazes in varnish as finishing layers, in order to avoid this problem. He concludes: 'The system of retouching in tempera or gum (always with reference to paintings in oil or hard tempera) should be considered subsidiary to that in varnish but, since oil should never be used under any circumstances, those things to which varnish does not lend itself very well can be done in tempera.'[35]

PIETRO SELVATICO AND TEMPERA

As previously mentioned, two techno-historical essays by Pietro Selvatico, a scholar and art critic, who was professor of aesthetics and president of the art academy of Venice from 1850 to 1859, were included in the texts on painting technique and restoration analysed. The first, entitled *Storia estetico-critica delle arti del disegno* (*Aesthetic-Critical History of the Arts of Drawing*), was published in Venice in the 1850s (Selvatico 1852–1856); the second, 'La pittura ad olio e a tempera presso gli antichi e i moderni' ('Painting in oil and in tempera in antiquity and in modern times'), was published in 1870 in the journal *Nuova Antologia* (Selvatico 1870).

As noted, Selvatico was one of the few Italians who were familiar with the German literature, but he was a scholar and an art critic by profession, so his approach to the technical sources on painting was different to that of the contemporary artists, restorers and scientists due to his relative lack of technical knowledge. He compensated for this, however, by his greater familiarity with early and contemporary treatises. He rightly distinguished between the tempera on panel carried out in egg yolk and fig latex, typical of the Italians, and that of the Northern European artists, who employed glue and honey as described in the Strasbourg Manuscript, which he knew from Eastlake's transcription.[36] He noted that many well-preserved Venetian and Flemish paintings had underlayers in tempera that had been finished with oleoresinous glazes, a method of execution that in his opinion was responsible for the brightness and chromatic stability of these paintings.[37]

The most interesting aspect of Selvatico's writing, however, is his attempt (in which he was only partly successful) to convince contemporary artists to adopt this technique (tempera + oleoresinous finishing glazes). He could not understand why Italian artists of his time did not recognise the evident superiority of tempera over oil, and he remarked that 'experiments with a variety of binding media have been carried out in Germany, England and Belgium, although with greater emphasis on the varnishes

Fig. 11 Augusto Caratti, *Portrait of the Collector Nicola Bottacin*, 1876, oil on canvas, possibly painted with a first layer in tempera, 77 × 60.5 cm, Museo Bottacin, Padua.

for glazing than on the tempera underlayers'.[38] Selvatico, in contrast, drew attention to these tempera underlayers, highlighting the fact that the best binding medium was not egg, which made the flesh tones too yellow, but casein tempera dissolved in ammonia, like that used by the landscape painter Carlo Markò (1822–1891).[39] He went on to list six contemporary artists who, following his advice, had decided to adopt what he believed to be the painting technique of Veronese (tempera + oleoresin), thereby attaining 'not only something very close to the brilliant transparency of the pictures painted by the greatest Venetians of the sixteenth century, but also the ability to reproduce certain pearl colours in their flesh tones that no one, up until now, could come close to' (Selvatico 1870, p. 512).

One of the artists listed by Selvatico was Augusto Caratti (1828–1900), a native of Padua, who painted, among other things, the portrait of Nicola Bottacin (1805–1876), held in the eponymous museum in that city (Fig. 11). Given that the colours of this painting still appear exceptionally bright and luminous after such a long time (particularly in comparison to so many other 19th-century paintings), we may lament that this method never became more widely disseminated.

CONCLUSION

The main texts on the use of temperas published in Italy, France and Spain in the 19th century are treatises on painting technique and restoration, and historio-critical writings, all of which recommend tempera for its superior durability compared to oil paints that had been observed to darken in the course of time. Based on these sources and on our recent paint analyses of works by Caffi and Bison we may also conclude that in Latin Europe the employment of tempera, which had fallen out of use from some genres of painting (and had to be 'rediscovered' in the 19th century), enjoyed uninterrupted popularity in others, such as decorative painting, landscape painting and scenography, where it was employed on a variety of supports such as plaster, wood, canvas, parchment and paper.

1 Merimée writes, 'Both Titian and Paolo Veronese underpainted [their pictures] substantially, and very often they painted on canvases prepared with size. They then underpainted in water-soluble paints. This procedure is very expedient, and that which was the transition from painting in tempera to painting in oil, is described by Leonardo da Vinci. I have seen many paintings executed in this manner, which is typical of the period when artists began to abandon tempera' ('*Ainsi que le Titien, Paul Véronèse ébauchait dans la pâte et très souvent il peignit sur des toiles imprimées en détrempe. Il ébauchait alors avec des couleurs à l'eau. Ce procédé très expéditif, et qui dut être le passage de la détrempe à la peinture à l'huile, est décrit par Leonardo da Vinci. J'ai vu plusieurs tableaux exécutées de cette manière, les quels appartiennent évidemment à l'époque où l'on commençait à abandonner la détrempe*') (Merimée 1830, p. 18).

2 Ippolito Caffi (1809–1866), born in Belluno, first trained with the painter Pietro Paoletti in Padua, then (between 1827 and 1830) at the art academy of Venice, where he specialised in landscape painting. Between 1832 and 1848 he was based in Rome, from where he undertook extended journeys to Venice and other Italian cities and, in 1843/1844, to the Orient. From 1848, he was ostracised in Venice for political reasons. Between 1849 and 1855 he travelled in Europe (Switzerland, London and Paris). He died in 1866 in the sea battle of Lissa (Pittaluga, M., *ad vocem*, in *Dizionario biografico degli italiani* 16, Rome: Treccani 1973).

3 Giuseppe Bernardino Bison (1761–1844) was born in Palmanova (Friuli), but soon moved to Venice. Between 1779 and 1789 he trained at the art academy in Venice, specialising in landscape painting and scenography. At the academy he met the architect Antonio Selva with whom he collaborated for many years in numerous locations in the Veneto, creating landscape paintings and scenographies, often in tempera, as well as decorative paintings in gardens, churches and palazzi. Between 1807 and 1830, Bison also worked in Trieste, Gorizia and Zara (which were under Habsburg rule at the time) and in 1831 moved to Milan, where he died in 1844 (Bassi, E., *ad vocem*, in *Dizionario biografico degli italiani* 10, Rome: Treccani, 1968).

4 Eastlake writes, 'the term represents a glutinous, as distinguished from an unctuous or oily, medium; and thus comprehends egg, size and gums; or, in a more general expression, binding substances originally soluble in water. Lastly, in its most restricted and proper acceptation, it means a vehicle in which yolk of egg is a chief ingredient: the varieties being, yolk of egg mixed in equal quantities with the colour; yolk and white of egg beaten together, and diluted with the milky juice expressed from the shoots of the fig-tree; and the yolk alone so diluted. These last-named vehicles were the most commonly used by the painters of the South of Europe, before the invention and improvement of oil painting. They are described by the chief Italian writers on art, and by those who have followed them' (Eastlake 1847, p. 101).

5 According to Guattani, 'after a certain amount of practical experimentation, [Gerli] succeeded in his aim, by finding a way to restore pictures using tempera paints [...] without mixing any varnish into the paint, but just applying an overall coat of it over the picture once the restoration was finished. Restorers know [...] that you can never match the hue and saturation of oil paints with pure tempera paints, unless varnish is applied on top.' Gerli's discovery, however, 'made the restored sections so similar to the original painting that even the most prying and practised eye cannot discern the slightest restoration' ('*dopo vari pratici tentativi riuscì nel suo intento col aver trovata la maniera di poter ristaurare i quadri con i colori a tempera [...] senza mischiare la vernice nei colori ma solo di questa darne una mano generale sopra il quadro allorché sia terminato il ristauro. I restauratori sanno [...] che con i colori semplicemente a tempera non si arriva mai al valore e succosità dei colori ad olio, abbenchè sopra vi sia dia la vernice.' Il ritrovato del Gerli invece 'rendeva così uguali le parti ristaurate all'originario dipinto, che anche l'occhio più investigatore, ed esercitato non vi può in alcun modo riconoscere il minimo restauro*') (Guattani 1808).

6 Prange writes, 'One does well to apply all retouching on a white preparation with water-soluble colours (with gouache, in tempera), or in oil paints diluted with turpentine, to lay in the local colour very light. When this is dry, they are painted over with thick oil paints in the same manner as the original is painted, and when this underpainting is dry, [it is] modified by applying the glazing colours and brought into balance with the original colours' ('*Man thut wohl, alle Retuschen auf einem weißen Grund mit Wasserfarben (à gouache, en détrempe) oder mit Ölfarbe, die mit Terpentinöl verdünnt ist, die eigentliche Lokalfarbe ganz hell aufzutragen. Nach dem trocknen werden sie mit pastoser Ölfarbe ebenso wie das Original gemahlt, und nachdem diese Untermahlung trocken geworden, vermittelst der Lasurfarbe modifiziert und mit den alten Originalfarben ins Gleichgewicht gebracht*'). Prange also specifies that '[This term] usually is understood to be a type of water-soluble painting, and designates as binding medium the egg yolk or the egg white beaten together with fig milk. Only the early paintings which have come down to us, allow us to suspect the use of a different medium, and specifically the use of essential oils or wax dissolved in turpentine' ('*Man versteht darunter gewöhnlich blos eine Art von Wasser-Mahlerei, und nennt als Bindungsmittel das Eigelb oder das Eiweiß mit Feigenmilch zusammengeschlagen. Allein die alten Gemälde, die auf uns gekommen sind, lassen ein ganz anderes Bindungsmittel vermuthen, und zwar mehr den Gebrauch wesentlicher Öhle oder des Wachses in Terpentinöl aufgelöst*') (Prange 1828, pp. 491–493).

7 Horsin-Déon confines himself to noting that, '[Italian] paintings, from Cimabue to Perugino, were painted using three different procedures: they are executed either in tempera, or in egg white, or in oil [...] We must say that a large portion of these pictures were painted in tempera, it

is therefore necessary to employ for their repair, a procedure analogous to that which served for their execution. In this case one will repair by means of colours prepared with honey or with gum. One applies the local colour as accurately as possible, because the water-soluble paints do not have the disadvantage of alteration as do those prepared with oil. [...] one varnishes the painting lightly and on this varnish, one harmonises and simulates the grime found in the preserved areas on all of the retouchings, by means of glazes made with pigments ground in oil' ('*depuis Cimabue jusqu'au Perugin, leurs tableaux sont peints par trois procédés diffèrents; ils sont exécutés soit à la détrempe, soit à blanc d'œuf, soit à l'huile. [...] Nous venons de dire qu'une grande partie de ces tableaux étaient peints à la détrempe, il est donc nécessaire d'employer pour la réparation de ceux-ci un procédé analogue à celui qui servit à leur exécution. Dans ce cas on les réparera au moyen de couleurs préparées au miel ou à la gomme. On posera le ton local aussi juste que possible, car les peintures à l'eau n'ont point l'inconvénient de repousser comme celle préparées à l'huile. [...] on vernira le tableau légèrement, et sur ce vernis, au moyen de glacis faits avec des couleurs à l'huile, on harmonisera en simulant sur tous les retouches, des crasses à l'imitation des parties conservées*') (Horsin-Déon 1851, pp. 145–146; on Horsin-Déon, see Perusini 2013, p. 258).

8 For Forni's training, see Thau 2008.

9 Forni refers to the native gum harvested from fruit trees (pear, plum, cherry, peach, apricot), gum arabic and gum tragacanth (which he calls *gomma diagrante*!) and concludes, 'in tempera or water-colour painting, gum is used in place of glue because it does not degenerate, it does not gel and it is less prone to insect attack' ('*nella pittura a tempera o all'acquerello, la gomma si adopera in luogo della colla, perché non si corrompe, né si rappiglia in gelatina, ed è meno offesa dagli insetti*') (Forni 1866/edn 2004, pp. 125–126).

10 The glues to which Forni refers are: *colla forte* ('strong glue') (to which he advises adding vinegar, alcohol and a little hydrochloric acid to prevent it from going mouldy and to keep it liquid, even when cold), glue made from parchment clippings, parchment glue, Flemish glue (more or less the same as parchment, or gilders' glue), fish glue, cheese and lime glue, *fiaschetta con calce* ('"little flask" and lime glue'), Chinese glue (made from ox blood and lime), *colla a bocca* ('mouth glue') (made from strong glue and sugar, mentioned below), and flour paste (Forni 1866/edn 2004, pp. 124–130).

11 In chapter XVII, *On temperas*, Forni lists: milk tempera (made from 1 kg skimmed milk + 226 g quicklime), casein tempera (made from casein + ammonia) and egg tempera, invented by the Sienese Giovanni Rocchi and made from egg yolk + thick gum arabic. These two materials are mixed together thoroughly and dried in the sun; they are then ground and reduced to powder before being mixed with the pigments for grinding (Forni 1866/edn 2004, pp. 131–132).

12 Forni does not mention any specific manufacturer but he must have been very familiar with the technical characteristics of these paints, which he certainly used himself. In the chapter cited, for example, he writes that paintings can be retouched with 'paints based on gum or honey; we import this kind from England or from France. You can make either kind yourself if you have the right presses for compacting them solidly. The English cakes are tempered with a mixture of one part very clear Flemish glue to seven parts gum arabic, both dissolved by boiling in an equal weight of distilled water. The French ones, nominally based on honey, are tempered with a solution of two parts white honey or rock candy to two parts gum arabic, dissolved by boiling in four parts distilled water, to which is added two parts glycerine; the mixture is filtered through paper or cotton wool' ('*si può ritoccare un dipinto con i colori a gomma o a miele, i quali ci vengono così preparati dall'Inghilterra o dalla Francia. Gli uni o gli altri si possono preparare da per sé quando si abbiano le opportune stampe per comprimerli solidamente. I panetti inglesi sono condizionati con una tempera composta di una parte di colla di Fiandra chiarissima e sette di gomma arabica, ambedue sciolte a bollore in egual peso d'acqua distillata. I francesi detti a miele sono temprati con una soluzione composta di due parti di miele bianco, o zucchero candito e due di gomma arabica sciogliendole a bollore in quattro parti di acqua distillata, indi unitovi due parti di glicerina, e filtrata la composizione per carta o bambagia*'. These retouchings were fixed at the end with a matt varnish made from 28 g spike oil + 6 g copaiba balsam or from 28 g [...] oil + 4 g fir resin [Venice turpentine] (Forni 1866/edn 2004, pp. 74–75).

13 'Take some congealed milk and squeeze it through a sieve or a piece of canvas to extract all the curds. When it has been squeezed out like this and dried it is crumbly, like the centre of a loaf of bread. This material, consisting of caseum, does not dissolve in water unless ammonia is added; this transforms the material into a very thick paste, which can be thinned to the desired consistency by the addition of more or less water. This material dries readily and, once dry, cannot be re-dissolved. If the retouchings are still rather matt, try to adjust them by adding some varnish made with a tempera of egg white or of one part bleached ox gall to ¼ cherry gum' ('*Si prende del latte già coagulato e di preme in uno staccio o in una tela per estrarne tutto il siero. Così spremuto e rasciugato si sbriciola come la midolla del pane. Questa materia composta di caseum non si scioglie nell'acqua se non vi si aggiunge dell'ammoniaca la quale trasforma la materia in una crema viscosissima che si può allungare a piacere con più o meno acqua. Questa materia secca sollecitamente ed una volta seccata non si discioglie più. Se i ritocchi rimanessero alquanto opachi allora cercherete di ragguagliarli, dando loro della vernice a tempera fatta di albumina o di una parte di fiele di bue decolorato e di ¼ di gomma di ciliegio*'). Forni adds that 'Prof. Carlo Markò, the Hungarian artist (also cited by Selvatico), often used to work up his landscapes in this tempera before finishing them in oil' (Forni 1866/edn 2004, p. 132).

14 This binding medium was invented 'by the Sienese, Mr. Giovanni Rocchi, an excellent imitator of the tempera paintings of F. Giovanni Angelico'. His procedure was as follows: 'crack some eggs and choose the least red yolks, making sure that they are properly separated from the whites; then beat them with some gum arabic dissolved in water but with the same saturation as the bulk of the egg [...] next, pour fine layers of the mixture into porcelain dishes and cover them with sheets of crystal to protect them from dust. Then dry it through in the sun, scrape it off carefully and collect it in a crystal jar, closed with a cork. This tempera can be kept for several months and, when you need to use it, just has to be softened with water and then mixed with the pigments for grinding' ('*Questo legante è stato ritrovato dal sig. Giovanni Rocchi senese, valentissimo imitatore delle tempere di F. Giovanni Angelico', che procedeva nel modo seguente 'rompe delle uova e prende di preferenza i tuorli meno rossi e ben separati dalle loro chiare; quindi li sbatte con quantità di gomma arabica già sciolta coll'acqua, ma satura quanto il corpo stesso dell'uovo [...] versa poi la composizione in strati sottili in piatti di porcellana e li copre con dei cristalli per preservarli dalla polvere. Fa poi seccare tutto al sole e finemente lo raschia e raccoglie in un vaso di cristallo, chiuso con suvero. Questa tempera si conserva per dei mesi, e dovendola adoperare, basta intenerirla con dell'acqua, innanzi di mescolarla coi colori da macinare*') (Forni 1866/edn 2004, pp. 75–76 and 132).

15 As mentioned above, the first edition of Giovanni Secco Suardo's treatise appeared in 1866. Here, however, we refer to the second edition, published posthumously in 1894 (he died in 1873), since the author only covered the restoration of supports in the first edition.

16 Secco Suardo noted that the early treatise writers (from Theophilus onwards) had never distinguished between hard and soft temperas. He therefore concluded that, 'this distinction did not exist and, instead of identifying two different kinds of tempera, miniatures (that is to say, those paintings whose binding medium consists solely or at least principally of gum) should be separated from temperas' ('*tale diversità non esiste punto e invece che dividere in due le tempere è necessario separare da esse le miniature vale a dire quei dipinti che hanno per solo o almeno per principale legante una gomma*'). As far as varnish was concerned, he ended by noting that, 'all paintings with animal or vegetable glue, and particularly those with fig latex, take varnish very well, especially if it is oil-based. Thanks to the varnish their colours take on a wonderful vitality. In contrast, however, the colours of paints bound with gum alter [...] Among the oldest and most widely used temperas were egg yolk and the one based on glue made by boiling parchment clippings. Pliny himself mentions them. In the north of Europe hide shavings were boiled together with ground antlers, and honey was added to the resulting glue. This custom also seems to have been adopted by some Italian artists [...] with the aim of slowing down the drying of the paint somewhat, in order to give time to blend and grade the colours; however, the southern Europeans added fig latex to the egg, the use of which is cited by Pliny. Although egg was more commonly used on this side of the Alps, it was not unknown to those beyond them' ('*tutti i dipinti con colla animale o vegetale, e soprattutto col lattificio del fico, sopportano benissimo la vernice soprattutto se essa è oleosa ed acquistano mercé sua una straordinaria vivacità di colori, mentre all'opposto quelli legati con la gomma si alterano [...] Fra le tempere le più antiche e generalmente usate erano il tuorlo d'uovo e quella a colla che si ottiene facendo bollire i ritagli di pergamena. Plinio stesso ne parla. I popoli nordici facevano cuocere insieme i ritagli di pelle anche dei corni di cervo pesti ed alla colla che risultava aggiungevano il miele, usanza che pare sia stata adottata anche da alcuni pittori italiani [...] allo scopo di ritardare di alquanto l'asciugamento dei colori, onde avere il tempo di fondere e sfumare le tinte, ed i meridionali invece aggiungeva all'uovo il lattificio del fico, uso del pari citato da Plinio. L'uovo abbenchè più generalmente usato di qua delle alpi, non era sconosciuto nemmeno ai popoli transalpini*') (Secco Suardo 1894/edn 1993, pp. 456–457).

17 Temperas can be used in this context to lay in a base coat (a single, uniform colour), which is then worked up to completion using pigments bound in varnish. However, they can also be used for glazing as long as they are still varnished at the end, so that the paint does not stay matt. According to Secco Suardo, there are six kinds of tempera: 'I) parchment and honey tempera; II) parchment and milk; III) whole egg and milk; IV) whole egg and fig latex; V) whole egg, milk and sweet white wine; VI) egg yolk' (Secco Suardo 1894/edn 1993, pp. 521–530).

18 Merimée repeats Marcucci's theory (Merimée 1830, pp. 13–16) that Flemish artists of the 15th century and some Venetian artists (Titian and Paolo Veronese) used to carry out their underpaintings in tempera, and that this is why their paintings have been spared, to an extent, the darkening typical of oil paintings (Merimée 1830, pp. XIII–XVI).

19 Secco Suardo constantly cites Horsin-Déon's treatise in his manual, and Ulisse Forni copied whole passages from the French treatise without citing the source. In fact, the Tuscan declared himself pushed to write his manual partly in response to the slander of the French, and Horsin-Déon in particular, who accused the Italians of leaving their artworks to degrade without taking any remedial action (Perusini 2013, pp. 21–23).

20 There were both technical and economic reasons for the diffusion of glue painting, since it dried much more quickly and was less expensive than oil painting.

21 The properties of sugar (or of honey) for such purposes had been known for a long time; they are even mentioned in the recipes for glue painting reported in the Strasbourg Manuscript (Secco Suardo 1894/edn 1993, pp. 456–457).

22 Marcucci describes the process as follows, '*On colla a bocca* ('mouth glue'). This is made using equal amounts of *colla forte* ('strong glue') and Flemish glue

dissolved in water; and ground sugar is added to half the weight of the glue, mixing in by stirring; and when it has been reduced to a consistency which allows gelling, it is taken off the heat and poured onto a marble slab greased with a few drops of oil; and it is left to dry in whatever format you want' ('*Della colla a bocca. La medesima si fa impiegando tanto la colla forte che quella di Fiandra disciogliendola con dell'acqua, e vi si unisce la metà del suo peso di zucchero macinato, s'incorpora maneggiandola e quando si è ridotta a consistenza da potersi gelare si leva dal fuoco e si e si versa su un marmo unto con poche gocce di olio e si fa seccare facendogli prendere quella forma che uno desidera*') (Marcucci 1816, p. 189).

23 Micro Fourier transform infrared (FTIR) analysis carried out by Dr Monica Favaro, at CNR-IENI in Padua, produced absorption bands typical of proteinaceous materials.

24 GC-MS analysis carried out by Henk van Keulen, of the RCE in Amsterdam, and Dr Francesca Caterina Izzo, of the University Ca' Foscari in Venice, identified the presence of amino acids typical of animal glue (alanine, glycine, proline, valine, glutamic acid), particularly hydroxyproline, a hydroxide found almost exclusively in collagen and therefore considered a marker for its presence. GC-MS analysis also revealed the presence of glucose, which can be ascribed to the use of sugar. The identification of palmitic, stearic and azelaic acids, with an azelaic/palmitic molar ratio below 0.2, led to the hypothesis that egg yolk was used.

25 The preparation layer of these paintings was executed in gesso bound in glue, as recommended by Paillot de Montabert for glue painting (Paillot de Montabert 1829, vol. 9, pp. 439–440).

26 '*Ce genre de peinture est le plus ancien de tous; mais il n'est pas le plus facile, parce que la dessiccation des couleurs ayant lieu très promptement, le peintre a fort peu de temps pour fonder et lier suavement ses teintes. Aussi cette peinture ne doit-elle être pratiquée que par des mains habiles et par des artistes surs de leur fait [...] Quant aux vastes peintures, c'est précisément ce procédé que réclament ces sortes de peintures [...] Une observation très essentielle, c'est que les teintes doivent toujours être tenues extrêmement hautes et très vigoureuses, parce qu'en séchant, elles s'affaiblissent au moins de moitié [...]. La belle détrempe demande à être peinte au premier coup [...] la peinture à détrempe est, à cet égard, plus difficile que la peinture à l' huile.*'

27 Del Vecchio defines *colla a bocca* as follows, '*Colla a bocca* is made either from *colla forte* (strong glue) or from Flemish glue dissolved in water, etc. Ground sugar is added to one of these two glues to half its weight and it is stirred in until the solution is reduced to the point where it can gel' ('*Tanto con la colla forte, quanto con quella di Fiandra disciolta nell'acqua ecc, si compone la colla a bocca. Ad una di queste due colle si unisce per metà del loro peso di zucchero macinato e si incorpora maneggiando sino a che si osservi una riduzione capace di gelarsi*') (Del Vecchio 1842, p. 110).

28 For Forni, Flemish glue 'is a kind of *colla forte* (strong glue) but with a better appearance than normal. It is made from parchment clippings, with the dry sheets of parchment cut up. It is used for glue painting and by gilders' ('*è una specie di colla forte, ma di più bella apparenza della comune e si fa coi ritagli di pergamena, riducendo la pergamena a secco e in lastre. Adoperasi nella pittura a colla e dai doratori*') (Forni 1866/edn 2004, p. 130).

29 This glue was then dried in thin strips. When it was used, it was 'soaked in water or wetted with saliva, then spread between the surfaces to be united: these are pressed with a smooth, ivory stave so that they stick together better, having first been covered with paper to prevent them from tearing' ('*bagnandola con dell'acqua o umettandola di saliva, poi strisciandola fra le superfici che si vogliono unire: le quali si premono con una stecca liscia d'avorio, perché meglio si aderiscano, avendole innanzi coperte con carta, affinché non si lacerino*') (Forni 1866/edn 2004, pp. 126–130).

30 '*Tre possono essere state le cause dell' annerimento dei quadri: la prima causa ne è stata la cattiva imprimitura, si per essere fatta d i materie troppo assorbenti, come di colore scuro; la seconda è l'abuso dell'olio cotto che hanno unito con i colori, e la terza è l'uso che hanno fatto di certi neri i quali crescono moltissimo in piccol lasso di tempo. [...] ma la causa primitiva e sola, è l'abuso dell'olio, essendo quello che domina in tutto, e dove ne resta assorbita la maggior quantità è più soggetto a divenir nero.*'

31 Forni records that, 'In Italy and France, and everywhere 60 years ago, pictures painted in tempera used to be restored with oil paints. Déon repeats several times in his book, cited above, that the use of any kind of drying oil is always detrimental to restorations, because it causes the newly laid paint to discolour, while the paint of the original has stopped changing with time. Nothing is so amazing, however, as to find Déon, after recommending, in part three, chapter V, p. 146 of the same short work, that retouchings should be built up in paints based on honey or gum, mistakenly saying that they can then be glazed or harmonised with paints based on drying oil' ('*In Italia e in Francia e dappertutto 60 anni fa si usava restaurare i quadri dipinti a tempera con colori ad olio. Il Déon ripete più volte nel suo libro già citato che l'uso di qualunque olio seccativo è dannoso a tutti i restauri, perché altera i colori messi di nuovo, mentre quelli della vecchia pittura son divenuti col tempo inalterabili. Nulla dimeno fa meraviglia come nella terza parte, cap. V, pag. 146 della stessa operetta mentre i Déon consiglia di preparare i ritocchi con i colori a miele o a gomma cada poi nell'errore dicendo che si possono velare o armonizzare con quelli a olio siccativo*') (Forni 1866/edn 2004, pp. 72–73).

32 Unfortunately, Forni does not name the foreign manufacturers that he has in mind, but the brands in question are most likely Winsor & Newton and Lefranc, since these were the foreign companies with the

widest distribution in Italy (Gioli 2009; Vinardi 2009).

33 See notes 10 and 11.

34 Secco Suardo noted, for example, 'Previously, when there were no restorers, it was artists who compensated for losses in paintings. As you would expect, they availed themselves of the same paints as they used for painting, but the shortcomings of the technique soon became obvious. With this method, as has been mentioned elsewhere, paints based on oil, laid over other matching paints, very soon change colour, becoming darker. Instead of taking on that radiance which graces old paintings, they lose all their vitality and get more and more dull. This is why retouchings, which when freshly applied matched the remnants of the original so well, quickly started to look like so many stains. Considering this to be caused by the oil, as in fact it was, a decision was made to use as little as possible in paints for restoration [...] For this reason, most restorers work with paints ground with turpentine and then tempered with varnish, which discolour much less.' He concludes, 'There are various systems for carrying out your retouchings, that is: in oil, in varnish, in tempera and in gum, and it is frequently advantageous to use more than one in the same painting' ('*Per lo addietro non eranvi restauratori, chi risarciva i dipinti erano i pittori, i quali, com'è naturale, valevansi dei medesimi colori che adoperavano per dipingere ma l'imperfezione di un tal metodo non tardò a palesarsi. Così come si è detto altrove i colori preparati ad olio sovrapposti ad altri colori simili ben presto si alternano di tinta, s'infoscano, ed invece di acquistare quello smalto che abbella i dipinti antichi, perdono ogni vivacità e divengono sempre più opachi. Per la qual cosa quei ritocchi che appena messi intonavano sì bene col rimanente in breve tempo apparivano come altrettante macchie. Ritenendo che ciò provenisse dall'olio come è di fatto si pensò di fare in modo che nei colori del restauro ve ne fosse il meno possibile [...] per il qual motivo dalla massima parte dei restauratori si adoperano dei colori macinati con l'acquaragia, poscia di stemperati nella vernice i quali si alterano assai meno' [...] 'per eseguire il loro restauro vi sono vari sistemi cioè a olio, a vernice, a tempera ed a gomma, e non rare volte giova impiegarne più d'uno sul medesimo quadro*') (Secco Suardo 1894/edn 1993, pp. 498–499).

35 Secco Suardo writes that, even if it is begun in tempera, retouching should always be glazed or at least patinated with an oleoresin (Secco Suardo 1894/edn 1993, pp. 535–537).

36 Pietro Selvatico cites specifically Eastlake's treatise in the translation by Bezzi (Selvatico 1870, p. 513; Eastlake 1849).

37 According to Selvatico, the early artists 'used to grind their pigments very finely in egg yolk, adding equal volumes of pigment and egg yolk and [...] fig clippings [...] served to dilute the egg yolk; and when this was used in the dry, southern countries, it resulted in temperas solid enough to withstand those common wreckers, air and water. This was the true tempera of the Italians' ('*usavano di macinare finissimamente i colori con tuorlo d'uovo, mettendo quantità pari d'uovo e di colore e [...] la tagliatura di fico [...] valeva a diluire il rosso d'uovo, e usata che fosse nei paesi meridionali non umidi, serviva a far tempere sode tanto da resistere ai dissolventi comuni, l'aria e l'acqua. Questa era la vera tempera degli italiani*') (Selvatico 1870, pp. 19–21).

38 According to Selvatico, 'The difficulty was to find a liquid which would seal the surface of the tempera in such a way that the oil and varnish glazes could be laid on top without causing disruption to the underlying paint.' In his opinion, the material which best met these needs was fish glue, since the bleached shellac in spirits of wine that he recommended for varnishing tempera came out too yellow (Selvatico 1870, p. 514).

39 Carlo Markò was of Hungarian origin, but had been living in Tuscany for a long time. Selvatico himself noted that 'the method for preparing this glue can be found in the writings of Mr. Ulisse Forni' (Selvatico 1870, p. 517), confirming the existence of a link between the texts that we have cited.