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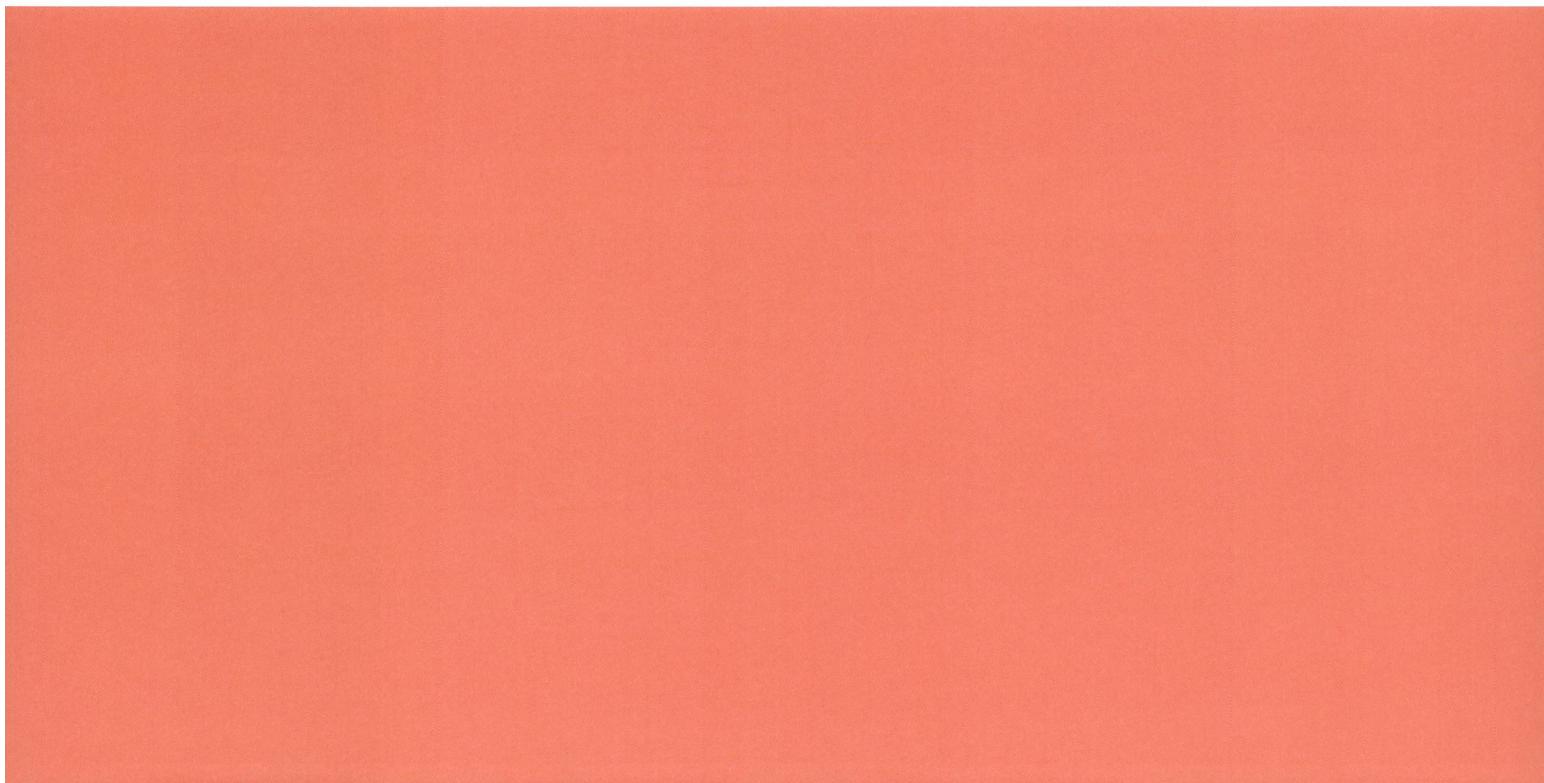
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Layered and *alla prima*: some examples of tempera painting techniques, 1850–1914

Wibke Neugebauer



INTRODUCTION

By the first half of the 19th century, scholars were already actively discussing historic tempera painting (see the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume). The art academies, in contrast, were still overwhelmingly teaching and practising painting in oils (Berger 1906d, pp. 37–38). It was only from the middle of the century that easel painters began to take an interest in tempera: while he may not have been the first to adopt the medium, subsequently Arnold Böcklin (1827–1901) was to become one of the most successful artists to experiment with this type of artists' paint. Between c. 1850 and the outbreak of the First World War, Böcklin's experiments decisively initiated a trend for the use of tempera in Munich, which was taken up by exponents of a variety of different schools of painting.¹ In addition to Böcklin, the influential painters of the Munich art scene working between 1850 and 1914 who are still known for their tempera painting are the Symbolist and Art Nouveau artist Franz von Stuck (1863–1928), the historicist painter Franz von Lenbach (1836–1904) and Wassily Kandinsky (1866–1944). Works in tempera by these painters were the focus of a research project lasting for several years at the Doerner Institut at the Bavarian State Paintings Collections in Munich.² The results presented here are based on the detailed art-technological investigations of representative tempera paintings and on an extensive evaluation of sources (Neugebauer 2016; Dietemann and Neugebauer 2014; Dietemann *et al.* 2014). In the present article, this body of data is extended by results from two diploma theses, undertaken in connection with this project, dealing with the tempera paintings of the Munich Symbolist Julius Exter (1863–1939) and the painters at the Worpswede artist colony, including Otto Modersohn (1865–1943) (Lutz 2011; Lutz 2014; Kruppa 2011).

'TEMPERA' AS A PAINTING MEDIUM BETWEEN 1850 AND 1914: AN ATTEMPT AT A CHARACTERISATION

An evaluation of contemporary sources showed that the tempera paints used in the period under consideration

were extremely diversified, characterised by a very broad spectrum of materials that were employed in numerous combinations. In the overwhelming majority of cases the common feature was the ability to dilute these paints with water (Neugebauer 2016, pp. 36–40, see also the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume).³ Consequently, in this study, the term 'tempera' will designate such paints and the single exception will be explicitly named. It is by means of this specific characteristic that tempera paints are distinguished from various other paint systems that could be diluted with oil, in this paper summarised under the term 'oil paint'.⁴ Between 1850 and 1914, apart from water, the most important diluent for tempera paints was glycerine, which evaporates only slowly and which is itself water-soluble. It had been discovered and synthesised at the end of the 18th century, but was probably only produced in large quantities from the middle of the 19th century and then used in commercial paint manufacture (Carlyle 2001, p. 182).⁵

Generally, painting techniques in the period under discussion were typified by a strongly historical orientation (Reinkowski-Häfner 2014; see also the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume). As Christian Friedrich Prange (1756–1836) had already noted in his appendix to Bouvier's *Anweisung zur Oehlmalerei* (*Instructions for Oil Painting*), in mid-19th-century painting manuals there were very few practical instructions relating to tempera (Bouvier 1828, p. 492).⁶ Artists were therefore reliant on other sources of information. On the one hand, they drew their inspiration from the paintings of antiquity, the Middle Ages and the Renaissance, but on the other, the living traditions in the field of contemporary decorative and mural painting also provided practical sources of information that were adapted and used, for example, by Arnold Böcklin (Reinkowski-Häfner 2012, p. 22). The reasons that contemporary artists were motivated to take up tempera painting were primarily a belief in the superior long-term stability of tempera paints in comparison to oil-based paints, an interest in a more rational working process (in comparison with the then usual

layered approach to painting in oils), and a desire for greater individual means of artistic expression (Neugebauer 2016, pp. 406, 410, 413, 417).

The following section presents the two typical systems of painting in tempera – layered painting and *alla prima* painting – and explains their respective technical challenges. Looking at specific cases, those individual aspects that are characteristic of the tempera painting methods of the selected artists are also examined.

LAYERED PAINTING

Layered painting involves the division of the painting process into distinct phases: underpainting and overpainting. According to Max Doerner (1870–1939), the underpainting served to provide a foundation in terms of composition and colour as well as the distribution of light and shade within the picture (Doerner 1921, p. 153). Different surface structures, for example areas of impasto, could also be laid-in at the underpainting stage. During the overpainting phase, the individual areas of the picture were then worked out in detail.

Tempera paints could be used either on their own in layered painting or combined with oil paints. In the contemporary literature on painting, both techniques were described and provided with historical exemplars.

Layered painting exclusively with tempera paints

Contemporary authors considered both antique paintings on mobile supports and Italian easel paintings of the 13th to the 15th century as historical exemplars for tempera painting in layers (Eastlake 1847, pp. 13–15; Reinkowski-Häfner 2012, pp. 13–14; see also the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume). The major advantages of this technique vis-à-vis layered oil painting lay in markedly reduced drying times and in the possibility of achieving different pictorial effects (see below, case study I).

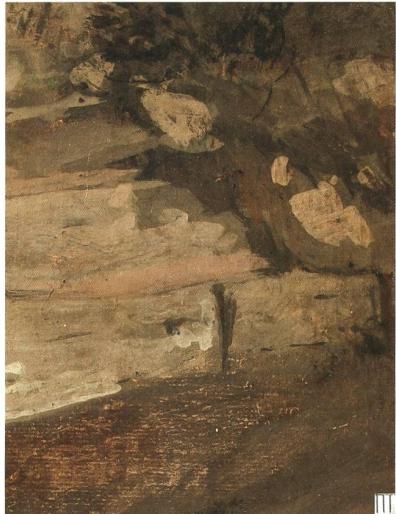
A particular challenge when using the layered technique with tempera is the fact that the underlying, dried paint layers can dissolve somewhat when a new layer is applied.⁷ To avoid this, various approaches have been employed: it is possible to apply the top layer in numerous short strokes, as practised by Italian tempera painters of the 14th and 15th centuries; this technique can be observed, for example, in some of Arnold Böcklin's paintings of the 1870s (Neugebauer 2016, pp. 114–127).⁸ Alternatively, artists could reduce the water-solubility of the underlying layer in one of two ways: by targeted denaturing (i.e. by rendering a water-soluble material insoluble) or by applying an intermediate, protective varnish,⁹ both of which allow for the use of freer brushwork in the overpainting than is possible with the short-stroke technique.

A targeted denaturing of protein-bound paint layers was made possible through the use of formaldehyde. In 1904, the chemist Wilhelm Ostwald (1853–1932) described the method of making a protein-glue-bound paint layer water-insoluble by spraying it with a dilute formaldehyde solution (Ostwald 1904, p. 142).¹⁰ This method was employed for example by Wassily Kandinsky, who in 1904 made a note that he had used a 2% formaldehyde solution to fix a 'glue tempera' (Kandinsky GMS 334). The denaturing effect of the application of such a solution had probably been known since the mid-1890s, when it appears to have been discovered and utilised in the context of photography (Pohlmann 2010b, p. 30; see also the contribution by Pohlmann, in this volume). Among the commercially produced tempera paints that contained formaldehyde were the '*pastösen* [sic] *Temperafarben*' ('impasto tempera paints'), which were used, for example, by the Munich artist Carl Gottlieb Bössenroth (1863–1935) (Pohlmann 2010b).

While formaldehyde was effective for denaturing proteins (the most popular tempera binders), it did not affect the solubility of the second largest group, the polysaccharides. For paints made with such media, there remained only the option to isolate the layers with varnish. This is illustrated using the two following case studies (presented in greater detail in Neugebauer 2016, pp. 208–218, 321–340).



1



2



3

Fig. 1 Arnold Böcklin, *Villa am Meer I* (Villa by the Sea I), 1864, paint on canvas support, 124.5 x 174.5 cm, Bavarian State Paintings Collections, Munich, Schack Collection, inv. no. 11528.

Fig. 2 *Villa am Meer I*: detail of the staircase, lower left. Here Böcklin dispensed with naturalistic modelling.

Fig. 3 *Villa am Meer I*: detail of the spray beneath the cypresses. The area is worked in multiple layers of pale blue paint, interspersed with layers of wax. The contours of the underlying brushstrokes are blurred as a result, while those on top are sharp and distinct. This creates an impression of depth.

Case study I: Arnold Böcklin, *Villa am Meer I* (Villa by the Sea I), 1864

In creating *Villa am Meer I* (Villa by the Sea I), Arnold Böcklin was heavily influenced by the murals of Pompeii (Fig. 1), therefore he attempted to achieve their specific decorative pictorial effects in his easel painting. His pupil Rudolf Schick (1840–1887) describes at some

length how Böcklin produced water-dilutable binder suspensions from pulverised incense and sandarac, which conformed to his ideas of the nature of antique binder systems (Schick 1901, pp. 75–77, 104).¹¹ When the painting was examined and the paint layers analysed using gas chromatography-mass spectrometry (GC-MS), in addition to the components mentioned by Schick, egg and drying oils¹² were also identified (see the contribution

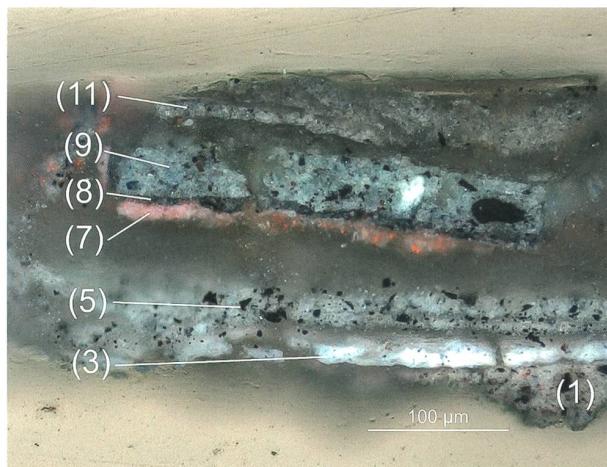


Fig. 4 *Villa am Meer I*: light microscope photograph of a cross-section of a sample from the sky; many layers of paint have been applied (1, 3, 5, 7, 8, 9, 11), which alternate with transparent applications of beeswax. Layer 12 is a later coat of varnish.

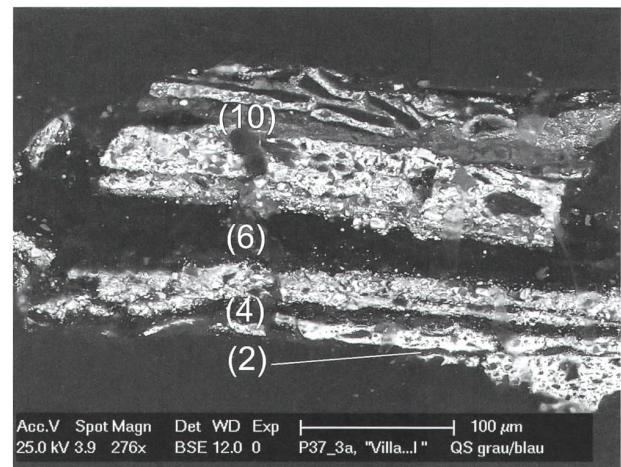


Fig. 5 *Villa am Meer I*: as Fig. 4 (scanning electron microscope, backscattered electron image). The transparent intermediate layers (2, 4, 6, 10) are clearly visible.

by Dietemann *et al.*, in this volume).¹³ Reconstruction attempts by Luise Lutz showed that such paints can be used in a similar fashion to watercolours (Lutz 2010, p. 10): they dry quickly, cannot be applied wet-in-wet, and thus allow no naturalistic modelling. Accordingly, the individual colour nuances in *Villa am Meer I* are directly juxtaposed (Fig. 2). This form of modelling allowed Böcklin to emphasise the individual areas of colour and mimic the decorative pictorial effects of the Pompeian paintings. Böcklin repeatedly added unpigmented intermediate layers of beeswax between the paint layers. These layers, in the interaction with the paint layers, create unusual optical effects: in the area of the sea spray, they build up to such a thick layer as to achieve a three-dimensional effect of depth (Fig. 3). The multilayered structure resulting from this procedure is reflected in a cross-section made from the paint layers (Figs 4 and 5). Böcklin also employed beeswax to finish his work (Schick 1901, p. 75). With its very smooth beeswax coated surface, *Villa am Meer I* resembles a mural painting in spite of its textile support.

As noted, compared with oil painting, this technique imposes technical limitations as it does not allow for the naturalistic modelling that can be achieved by smoothly

blending colour. However, smooth blending was not Böcklin's aim; instead, in this work he deliberately created a decorative pictorial effect. Despite his intentions, such effects were not consistent with contemporary taste. Böcklin's patron, Count Adolf Friedrich von Schack (1815–1894), saw it as a fault, which Böcklin was to 'correct' in a second version of the subject (see case study IV).¹⁴

Case study II: Franz von Stuck, *Der Krieg (War)*, 1894

Franz von Stuck's large-format painting *Der Krieg (War)* (Fig. 6) was created 30 years after Böcklin's *Villa am Meer I*. Unlike Böcklin, Stuck did not mix his own paint formulations, but instead purchased industrially produced temperas, 'Syntonosfarbe' (Syntonos paints), which he then modified by adding egg. According to the patent (DE78793, 13 June 1893), the Syntonos binder system mainly consisted of an oil-in-water (O/W) emulsion of gum arabic and linseed oil. It also contained water, glycerine and small quantities of other additives (see the contributions by Dietemann *et al.* and by Pohlmann *et al.*, in this volume). Syntonos paints had totally different properties from the suspension binders used by Böcklin: they were suitable for impasto



Fig. 6 Franz von Stuck, *Der Krieg* (War), 1894, paint on canvas support, 245.5 × 271 cm, Bavarian State Paintings Collections, Munich, Neue Pinakothek, inv. no. 7941.



Fig. 7 *Der Krieg*: macro detail of the flesh of a dying man at the bottom edge. The paint displays a strong craquelure. A surface texture characteristic of Syntonos paint is visible within the individual islands of colour.



Fig. 8 Detail of a brushstroke of Syntonos paint made by reconstruction of the formulation patented in 1894. The paint displays a texture similar to that seen in Fig. 7, but as yet no craquelure.

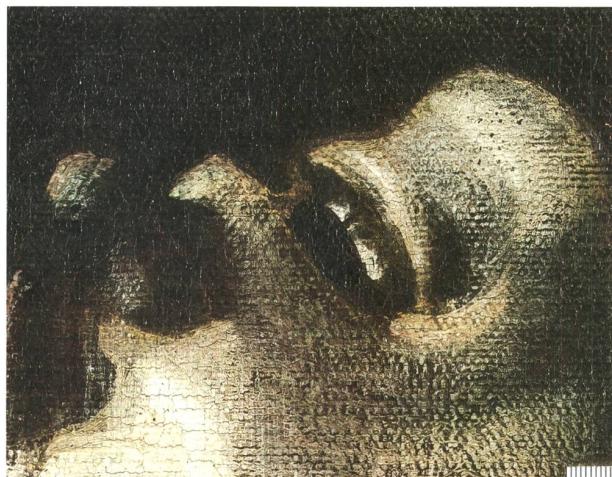


Fig. 9 *Der Krieg*: detail of the face of a dying man bottom right. The Syntonos paint allowed for naturalistic modelling.

application and according to the patent, they could be worked wet-in-wet, thus allowing relatively naturalistic modelling. Stuck understood how to employ these possibilities to good effect when depicting the dying men in the foreground of the composition (Fig. 9). Whether used pure or, as in the present case, mixed with egg (see the contribution by Dietemann *et al.*, in this volume), Syntonos paints display characteristic textures that were successfully reproduced in technical reconstruction attempts (Figs 7 and 8) (Neugebauer 2016, pp. 330–335) and which can be observed in other paintings by Stuck (Neugebauer 2016, pp. 146–156). Stuck applied his paints in numerous layers; after every two or three applications of paint, a transparent intermediate layer was laid.¹⁵ In the cross-sections prepared from samples taken from the painting, this extreme multi-layered structure can be clearly seen (see the contribution by Dietemann *et al.*, in this volume, Figs 2a–2d and 3a–3d).

In contrast to Böcklin's intent to create a decorative pictorial effect with *Villa am Meer I*, Stuck sought to create a picture that would look like an oil painting. The inventor of Syntonos paints, Wilhelm Beckmann (1871–?), marketed his products to appeal to painters used to working in oil, claiming that 'the picture painted with these paints cannot be distinguished from an oil painting, and has the advantage over the latter of not darkening with time' (DE78793, 13 June 1893).¹⁶ Accordingly, Stuck's contemporaries wrongly classified his paintings in Syntonos paints as 'oil paintings' on the basis of their visual appearance.¹⁷

These two examples illustrate just how different the properties of the painting materials and the combinations of materials used in layered tempera painting can be; the resulting pictorial effects were also very different and were consciously exploited as part of the two artists' individual artistic expression.

Layered painting using tempera in combination with oil paints

Tempera paints were often combined with oil paints. As will be shown, they were either used respectively in

successive layers or applied next to each other in one and the same layer. The motivation for the first of these procedures was, in many cases, the desire for both a time-saving technique and a stable alternative to underpainting in oils. Layering with oil paints was typical practice in the 19th century, but required long drying periods before work could proceed or the use of siccatives to speed up the process. Painters were aware of the problems that could arise if proper drying times were neglected and siccatives were used excessively, namely a strong tendency towards yellowing and cracking. In 1830, the man of letters, painter and chemist Jean-François Léonor Mérimée (1757–1835) listed the advantages of an underpainting using tempera paints as follows: acceleration of the painting process, avoidance of crack formation, greater brilliance of the colours and improved durability of the hues (Mérimée 1830, pp. 249–251).¹⁸

These advantages, however, brought new problems. The tempera paints of the underpainting could darken unevenly the moment they were overpainted with oils. Contemporary approaches to solving this difficulty consisted of the application of intermediate varnishes. Those soluble in alcohol (e.g. mastic) and water-soluble coatings such as '*Fischleim*' ('fish glue') (Schick 1901, p. 79) and other protein glues proved particularly useful as they dried quickly and resulted in only comparatively minor colour changes of the underlying tempera layer. Consequently they were also used for the same purpose in contemporary decorative painting (Fontana 2004, pp. 120–121). Once such a coating had been applied, the colours of the tempera underpainting were no longer subject to change.

From the early 1890s paint manufacturers took account of such difficulties by marketing harmonised product ranges including not only tempera, oil and resin paints, vehicles and varnishes, but also picture supports and grounds. An early example is the range offered by Alfons von Pereira-Arnstein (1845–1931; see the contribution by Beltlinger, in this volume).

When oil and tempera paints were applied next to each other in the same painting, artists were evidently often

less concerned with the speed of execution or better durability than with colour, brightness or material contrasts, as will be explained in case study IV. This technique drew upon the historical precedents of the Middle Ages and the Italian Renaissance which, according to the ideas prevalent at the time, consisted in the use of tempera paints for underpainting and oils in part or whole to finish the painting (Reinkowski-Häfner 2012, p. 14; see also the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume). Franz von Lenbach also employed this technique for the execution of his meticulous and true-to-scale copies of Italian Renaissance paintings, as discussed in the following case study (for more details see Neugebauer 2016, pp. 297–308).

Case Study III: Franz von Lenbach (copy after Titian), *Das Konzert* (The Concert), 1865

In his copy (Fig. 10) of Titian's *The Concert* of 1511, Franz von Lenbach attempted to imitate not only his predecessor's composition, but also to replicate his choice of materials and painting technique.¹⁹ According to his friend Ludwig von Hagn (1820–1898), to this end he used '*Wasserfarbe*' ('water paints').²⁰ GC-MS analyses have shown that the binder of these paints contains egg, copaiba balsam and drying oils. In some samples, glycerine was also identified (see the contribution by Dietemann *et al.*, in this volume).²¹ Originally, these components were presumably present as an O/W emulsion. As can be seen from a paint cross-section prepared from a sample from the work, Lenbach alternated multiple layers of tempera with layers of oil paints; the latter contain drying oils and copaiba balsam (see Figs 11 and 12). He used tempera for opaque and impasto paint applications and reserved the oil paints for glazes, which can be observed, for example, in the flesh tints (Fig. 13). The tempera paints play a crucial role in both the lay-in of the composition and the step-by-step modelling and structuring of the individual areas of colour. The oil paints were used both to copy the glazed passages of the original and to imitate its patina. At the same time, the oil-based intermediary layers separated the individual

tempera paint layers from one another thereby preventing them from dissolving when the next layer was applied. This procedure allowed an effective execution of the copy using painting materials that reflected contemporary concepts of the painting techniques of the Old Masters.

Case Study IV: Arnold Böcklin, *Villa am Meer II* (Villa by the Sea II), 1865

The same notions that people entertained about the painting technique and materials of the Italian Renaissance also informed the creation of the second version of *Villa am Meer II* (*Villa by the Sea II*) (Fig. 14), which Böcklin was commissioned to paint by Count von Schack, also in 1865, as a replacement for the first version (case study I, above) (Dietemann and Neugebauer 2014; Neugebauer 2016, pp. 219–232).²² However, Böcklin once again employed a painting technique which he regarded as historical in order to implement his own pictorial ideas; like the first version, this painting is no slavish imitation of historical models. As demonstrated by our analyses, in common with Lenbach, Böcklin worked with tempera paints containing egg, linseed oil, copaiba balsam and glycerine, which probably originally formed an O/W emulsion.²³ Likewise, in the oil-bound layers, walnut oil, copaiba balsam and egg were detected (established by GC-MS; the methods are described in detail in the contribution by Dietemann *et al.*, in this volume). The tempera and oil paints were applied both on top of, as well as next to, each other. As his pupil Schick suggested, he probably first underpainted the landscape in tempera before applying the later stages in oils (Schick 1901, p. 291). The tone of the underpainting, as observed under the stereomicroscope, is pale and still relatively undifferentiated, but the pastose paints already convey specific surface textures to the individual colour areas of the picture. Using the darker oil paints, he then executed the details of the landscape in a relatively naturalistic fashion, applying small patches of paint with glazes and colour tones modelled wet-in-wet (Fig. 14). According to Schick, the sea and sky were painted exclusively in tempera (Schick 1901, p. 291). Therefore these areas differ



Fig. 10 Franz von Lenbach, *Das Konzert* (*The Concert*) (after Titian), 1865, paint on canvas support, 109.8 × 123.2 cm, Bavarian State Paintings Collections, Munich, Schack Collection, inv. no. 11486.

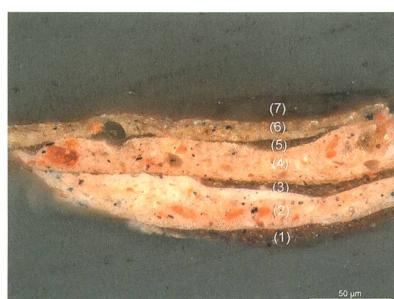


Fig. 11 *Das Konzert*: light microscope photograph of a cross-section of a sample from the flesh tint, left hand of the figure on the left. Brown glazes (1, 3, 5) alternate with opaque paint layers (2, 4, 6), followed by an application of varnish (7).

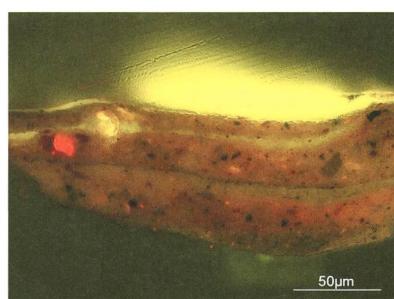


Fig. 12 *Das Konzert*: light microscope photograph of the same cross-section as Fig. 11 (UV fluorescence, filter 09), after staining for proteins with SYPRO Ruby. The opaque paint layers (2, 4, 6) have stained positively for proteins and display an orange fluorescence. The glazes (1, 3, 5) have not stained and do not fluoresce. The opaque layers have been shown to be tempera paints. GC-MS analysis indicates the presence of egg, copaiba balsam and drying oils; in some samples, glycerine was also identified. The glazes contain oil and copaiba balsam (GC-MS, see the contribution by Dietemann, in this volume).

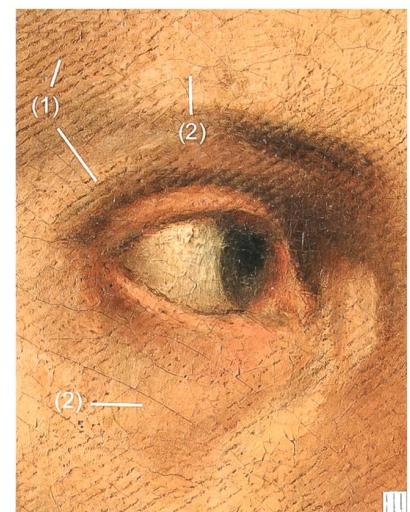


Fig. 13 *Das Konzert*: detail of the flesh tint: the glaze (1) applied over the opaque coats of paint has collected in the depressions in the surface and has a similar appearance to brownish dirt residues commonly found on old paintings. After applying the glazes, Lenbach continued working, with the result that this imitation patina is partially hidden beneath opaque paint layers (2).

visually from the landscape: they are paler in tone and less naturalistic in effect. In the sky especially, the large, undifferentiated areas of colour are conspicuous. The result is a striking contrast of pale zones, lacking in detail, that are rendered in tempera with darker zones of detailed composition and execution in oil. The combination of tempera and oil paints was thought to have been used by the painters of the Italian Renaissance (Merrifield 1849/edn 1967, p. cccix). Compared with the layered tempera painting that he had employed for the first version (case study I), this method had the advantage of being well suited to the creation of naturalistic modelling effects – as the client wished – at least in the areas painted in oils. As observed by the writer Adolf Frey, Böcklin's choice of technique was defined by a formulaic conception: while he viewed oils as appropriate for the reproduction of reality, he used tempera for the expression of abstract concepts, such as visions and moods (Frey 1912, p. 131; see also Neugebauer 2016, pp. 87, 88, 131).

A similar use of media may be seen in a later Symbolist work, the *Karfreitag* (*Good Friday*) triptych of Julius Exter, 1895 (Fig. 15) (Lutz 2011; Lutz 2014). Exter used the tripartite division of the triptych to establish contrast

between different planes of reality: the central image, a dark, naturalistically modelled scene of praying women, is rendered in oils over an underpainting in tempera. The angelic choirs (depicted in a decorative manner) in the wings are far removed from earthly reality, as is the vision of the crucified Christ in the central image. These elements are executed predominantly in tempera, thus heightening the contrast with the naturalistic detail of the praying women (Lutz 2014, pp. 50–52). The extent to which Exter was aware of the differentiated use of tempera and oil by Böcklin is unknown.

ALLA PRIMA PAINTING IN TEMPERA

Thus far the various approaches to using tempera paints in layered structures by subdividing the painting process into a number of steps have been examined. In contrast, tempera can also be used in the manner of *alla prima* painting, which aims to execute all aspects of painting – drawing, light/dark distribution, colour distribution and modelling – in their definitive form and in a single step (Doerner 1921, pp. 151, 153).²⁴ It allows for very different degrees of execution: on one end of

Fig. 14 Arnold Böcklin, *Villa am Meer II* (*Villa by the Sea II*), 1865, paint on canvas support, 123.4 × 73.2 cm, Bavarian State Paintings Collections, Munich, Schack Collection, inv. no. 11536.





Fig. 15 Julius Exter, triptych *Karfreatag* (Good Friday), 1895, paint on canvas support, 242 × 365.5 cm, Bavarian State Paintings Collections, Munich, Neue Pinakothek, inv. no. 7956 1-3.

the spectrum a sketchy effect, as is used for example in landscape studies, and on the other, highly detailed and realistic forms of painting, as practised, for example, by the Munich painter Wilhelm Leibl (1844–1900) (Laudenbacher 1994). Oil paints are particularly suited to *alla prima* painting and were often used in this manner in the 19th century as in earlier centuries. By 1900, some artists had also begun to employ tempera experimentally for *alla prima* work due explicitly to the desire to replace the use of oil, which had a potential to yellow, with tempera binders that were more colour-stable. Direct references to this may be found, for example, in contemporary sources such as Beckmann's patent for Syntonos paints among others (DE78793, 13 June 1893; Wurm c. 1907/1907, p. 8). For this purpose, the working

properties of the tempera needed to approach those of oils. Although a short drying time was useful for layered painting, *alla prima* painting required a longer time for manipulation in order to facilitate wet-in-wet modelling, body to allow an impasto paint application and minimal colour change during the drying and varnishing stages.

Tactics used to prolong drying times included moistening the canvas during the painting process and the use of particular formulations of tempera paints:²⁵ as has been seen from the example of Syntonos paint, viscous O/W emulsions with a high oil content were suitable for *alla prima* work as they allowed an impasto application. Their relatively high binder content also reduced

the degree of colour change during the drying and varnishing stages (Neugebauer 2016, pp. 331, 332). The addition of glycerine could further slow drying times, in order to allow for wet-in-wet modelling.

Another product, marketed under the brand name '*Temperafarbe*' (tempera paint) by the Munich paint manufacturer Richard Wurm, must be mentioned. Contrary to their name, these tube paints could not be diluted with water (Berberich 2012, p. 27). As is documented in numerous surviving letters and postcards to the manufacturer, they were used by many artists between about 1877 and 1917 (Reinkowski-Häfner 1994, p. 304; Berberich 2012). Material analyses of preserved tubes of these paints have shown that they contain drying oils, Japan wax, spike oil and other components, possibly derived from

soaps (Neugebauer 2016, p. 158).²⁶ It can be concluded from letters to the manufacturer that they could be worked with the accompanying fluid sold by Wurm under the brand name '*Malmittel*' (the generic German term for 'vehicle') but also with other vehicles such as mixtures of alcohols, fatty oils and essential oils (Berberich 2012, p. 27).²⁷ As statements by the artists and from a manufacturer's brochure dating from c. 1906/1907 make clear, Wurm's *Temperafarben* had different properties depending on the additive used, and the visual effects that could be achieved could differ (Wurm c. 1906/1907, pp. 8–9; Berberich 2012, pp. 25–31), therefore the still life by Otto Modersohn described below represents only one of a number of manifestations of these artist paints.²⁸

Case study V: Otto Modersohn, *Stillleben mit Eisvogel und Tasse* (*Still Life with Kingfisher and Cup*), 1906

Modersohn painted this still life (Fig. 16) in April 1906, when according to his diary entries he was experimenting intensively with Wurm's *Temperafarbe* (Kruppa 2011, pp. 89–90). Although no material analyses have been carried out on this painting to verify this, a comparison of its appearance with the descriptions of *Temperafarbe* in the above-mentioned sources suggests the use of this brand of paint.

On thin millboard that he had primed with a thin layer of reddish ground, Modersohn worked most of the painting *alla prima* (Kruppa 2011, pp. 89–92). The possibilities of impasto application and the wet-in-wet modelling of Wurm's paints, which are discussed repeatedly in the artist's letters and postcards mentioned above, can also be observed in the still life (Fig. 17). On 26 April 1906, Modersohn noted in his diary that the impasto application using those paints was 'wonderful', whereas 'with oils' it was 'only smeary' (Kruppa 2011, p. 92). After application, modelling the paints was still possible, for example with the brush handle or some other pointed object.²⁹ The picture was only varnished in the dark areas; the shine here is somewhat more noticeable. In the unvarnished areas, the surface is extremely matt – this too matches the

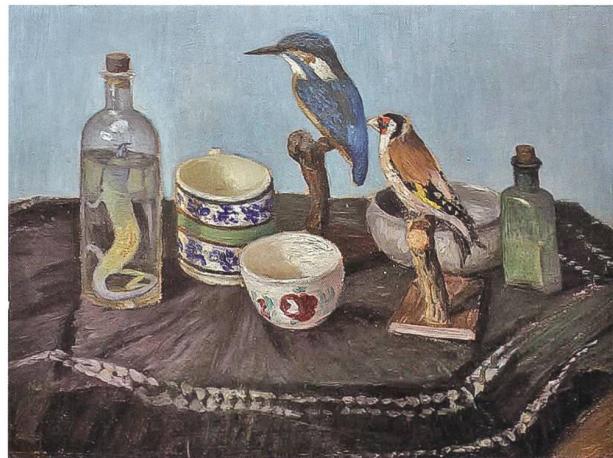


Fig. 16 Otto Modersohn, *Stillleben mit Eisvogel und Tasse* (*Still Life with Kingfisher and Cup*), 1906, paint on millboard, 35 x 46 cm, Paula Modersohn-Becker Stiftung, Bremen.



Fig. 17 *Stillleben mit Eisvogel und Tasse*: detail shows paint modelled wet-in-wet with a matt surface.

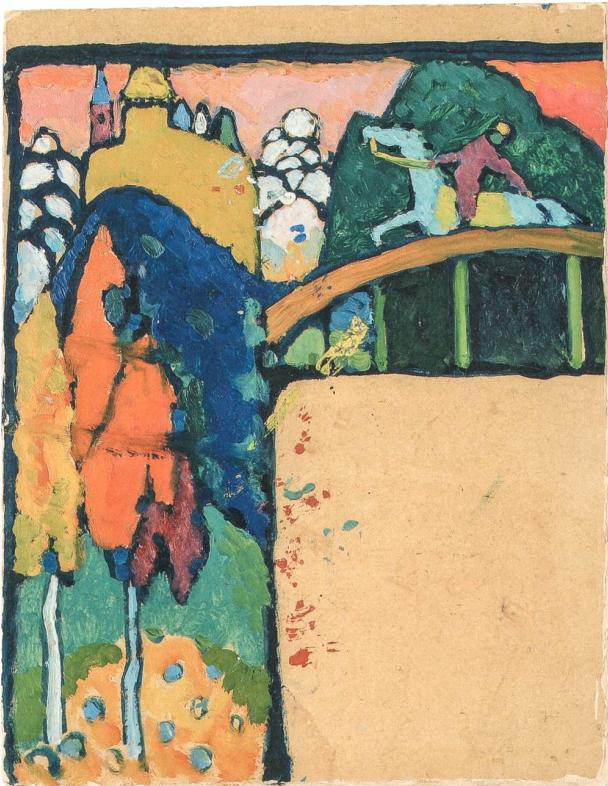


Fig. 18 Wassily Kandinsky, *Landschaft mit Reiter auf Brücke* (*Landscape with Horseman on a Bridge*), 1909/1910, paint on cardboard, 32.9 × 25.5 cm, Gabriele Münter-Stiftung, Städtische Galerie im Lenbachhaus, Munich, inv. no. GMS 775.

description of the surface character which, according to the artists' letters to Richard Wurm, could be achieved using the tube paints unthinned or with the addition of the accompanying *Malmittel* (Fig. 17).

While Modersohn was still striving for a relatively naturalistic representation of the motifs, the *alla prima* painting used from 1908 by Wassily Kandinsky in his Murnau landscapes is already being put to the service of other goals. The next example (described in greater detail in Neugebauer 2016, pp. 387–395) can be taken as representative of Kandinsky's painting technique during the Murnau period between 1908 and 1910, during which he gradually moved towards abstraction.



Fig. 19 *Landschaft mit Reiter auf Brücke*: detail in the dark blue zone showing dark blue, matt contours (1), areas filled with thinly applied, smooth paint (2) and impasto brushstrokes with a glossy surface, added last (3).

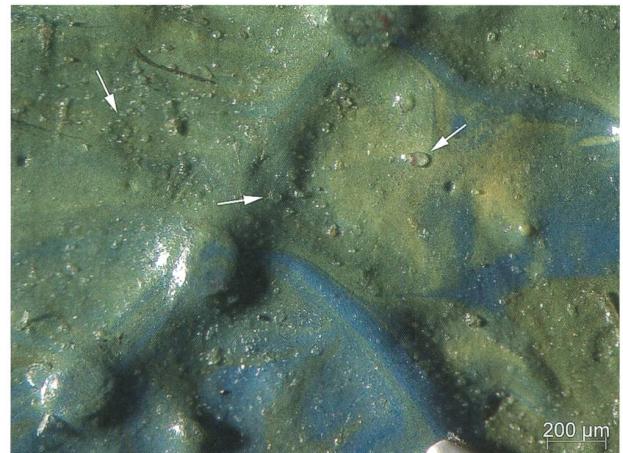


Fig. 20 *Landschaft mit Reiter auf Brücke*: detail in the meadow under the trees; the layer of varnish is extremely thin. Examination with a stereobinocular microscope reveals the presence of transparent inclusions (particles indicated with white arrows).

Case study VI: Wassily Kandinsky, *Landschaft mit Reiter auf einer Brücke* (*Landscape with Horseman on a Bridge*), 1909/1910

For *Landschaft mit Reiter auf einer Brücke* (*Landscape with Horseman on a Bridge*) (Fig. 18), Kandinsky used

pre-sized, unprimed cardboard as his support. The contours of the areas of paint were laid-in using a very thin, dark blue paint. Then he filled the areas with paint, leaving the contours visible for the most part (Fig. 19). Some of the areas of colour were painted wet-in-wet; in others, there is a large, predominantly monochrome area rendered in a smooth application which the artist, in a second step, then structured with impasto dabs of paint (Fig. 19).³⁰ Analyses indicate that he probably used tempera paints on the basis of saponified beeswax, with additions of oil, colophony and perhaps also egg (established by GC-MS; the methods are described in detail in the contribution by Dietemann *et al.*, in this volume). It is possible that this binder system was also inspired by contemporary notions of antique painting techniques, as had been described by the Munich painter and scholar in the field of painting technology research Ernst Berger (1857–1919) (Berger 1904a, p. 181; see also the contribution by Kinseher, in this volume).³¹

Kandinsky was evidently using large fields of colour in the hope of achieving a strong, luminous effect. At the same time, he varied the surface texture and the degree of gloss within the individual areas in order to create a lively surface. To the naked eye the painting looks unvarnished, but the microscope reveals an extremely thin coating in which transparent particles are embedded (Fig. 20).³² This coating, however, did not even out the existing variations in gloss and roughness. The nuances of the paint application and the subtle play between the different surface textures within the picture are characteristic of the paintings from Kandinsky's Murnau period and those from the subsequent transition to abstract painting.

CONCLUSION

Having looked into the structure of a group of representative tempera paintings from the period between 1850 and 1914, it remains to note that tempera paints were used both in layered and *alla prima* painting. As has been shown, the former in particular was based on

contemporary conceptions of historical painting techniques. At the same time, both in the sources and in the actual paintings, influences from the related artistic genres of mural and decorative painting can be seen.

The materials used for tempera painting and their combinations in the build-up of pictures were extremely varied, as the examples above have shown. The working characteristics of the tempera paints could be modified in a number of ways and adapted to varying manners of painting. Glycerine, due to its low volatility, allowed longer drying times and thus played an important role in many formulations.

These examples demonstrate that there is no 'typical' visual appearance that can be expected of tempera paintings of the period under consideration. Rather, using tempera paints, artists were able to achieve a wide gamut of effects, from a classic 'tempera-look' (using short, light brushstrokes) to a wet-in-wet modelled *alla prima* painting, that takes on the appearance traditionally associated with the use of oils. As a result, tempera paints expanded artists' technical scope for expression by adding new means of expression to the common oil painting. This, alongside improved durability and a more efficient work process, was ultimately the reason that tempera paints became popular. A decision to favour either tempera or oil paints could also – as was shown by way of Julius Exter's Symbolist work *Karfreitag* – be linked to the content of a painting and the visual statement the artist wished to make.

Despite the differences in their artistic aims, the artists investigated herein are linked by the fact that their painting techniques and the effects that could be attained by means of the painting materials they chose were important aspects of their artistic expression. Their sensitivity to the haptic, sensuous qualities of painting is, in a way, typical of the age: a similar interest in the expressive possibilities of the artistic material is reflected in the 'material-oriented aesthetic' which established itself in the 19th century, parallel to the 'material-hostile art theory' that had predominated earlier (Raff 2008, pp. 38–44).

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1 The First World War also represents an interruption in the development of painting technique, as the usual materials of tempera painting, such as hens' eggs, were no longer allowed to be used in commercial paint production (Anonymous 1918).

2 This article is based on the author's dissertation (Neugebauer 2016), which was made possible by a doctoral scholarship awarded by the Studienstiftung des Deutschen Volkes. It was the result of close collaboration with the interdisciplinary research project, funded by the Deutsche Forschungsgemeinschaft, Von Böcklin bis Kandinsky. Maltechnische und analytische Forschungen zu komplexen Bindemittelmischungen in der Münchner Temperamalerei um 1900 (Sachbeihilfeprojekt GZ DI 1575/1-1, funding period: 01 March 2009–29 February 2012). The project was carried out under the management of Dr Patrick Dietemann.

3 To date, two exceptions to the rule of water-dilutability are known: a product described as 'tempera paint' by the Munich paint manufacturer Richard Wurm, which is discussed in the present article, and the so-called 'oil tempera' by Karl Lupus (Neugebauer 2016, p. 37; see the contribution by Reinkowski-Häfner, 'Tempera: on the history of a technical term', in this volume).

4 These include paints that contain natural resins or wax as well as drying oils. Examples of diluents include turpentine or petroleum distillates. These oil paints were sometimes also modified in the period under consideration by the addition of aqueous binders, but were still described as oil paints, and consequently they are included under this term here (Reinkowski-Häfner 1994, p. 301).

5 For example, Winsor & Newton had used glycerine in their 'moist' water colours since 1847 (Carlyle 2001, p. 182).

6 According to Carlyle (2001, p. 211) one exception is the description in Mérimée (1830, pp. 130, 249–251).

7 Sensitivity to water after drying is variable between the different tempera

binders: among protein-bound tempera formulations, egg and casein-bound paints are far less water-sensitive after drying than films of hide glue. In the course of natural ageing, the proteins are denatured by external influences such as heat, air and light, and become less sensitive to water as a result. In contrast, paint layers bound with polysaccharides on the basis of vegetable gums or starch paste, as well as tempera paints with a high soap content, remain water-sensitive (they tend to swell) even in the long term (Mayer 1973, p. 237; Doerner 1921, pp. 165, 177).

8 This is true especially of paintings dating from Böcklin's stay in Munich (1871–1874) and Florence (1874–1885). Presumably in this case, the short-stroke application was a conscious compositional technique.

9 An intermediate varnish is a varnish applied between two paint layers, in other words before the completion of the painting process.

10 Ostwald describes the spraying of formaldehyde solutions on dried tempera paint layers. In addition, he discusses the possibility of adding hardeners to the wet paints. For discussion of such hardeners, see the contribution by Pohlmann, in this volume.

11 According to Hermann Kühn, the polysaccharide components of incense are dissolved in water in this process, and hence form the binder (Kühn 1977, p. 111). As Lutz's experiments showed, sandarac by contrast does not dissolve in water but, when pulverised, merely forms a filler that makes the paint more viscous and its surface more porous when dry (Lutz 2010, p. 8).

12 Linseed oil, walnut oil or poppy seed oil. As the binder also includes additions of materials containing fatty acids, as well as semi-drying and non-drying oils, beeswax and animal fat, precise identification using GC-MS was not possible.

13 Internal report of binding medium analysis by the Doerner Institut, Munich, no. 1272, 18 November 2013.

14 Schack wrote: 'in the execution it leaves much to be desired [...], there are no fine nuances, the picture looks like a half-finished underpainting' (*'in der Ausführung läßt sie [...] viel zu wünschen übrig, es fehlt an feineren Nuancen, das Bild sieht aus wie eine halbfertige Untermalung'*). Letter from Adolf Friedrich von Schack to Franz von Lenbach, 21 June 1864. Transcript (lacking call number) in the archive of the Bavarian State Paintings Collections, Munich.

15 The two intermediate layers found in a cross-section (see the contribution by Dietemann et al., in this volume, Figs 2a–2d) consist of different materials. The first transparent intermediate layer (4, 5) consists of two parts without clearly defined borders between them, but with differing material compositions: a lower proteinaceous part (4 in Figs 2a and 2d), and an upper, weakly pigmented part containing predominantly a mixture of gum arabic and oil (5 in Figs 2a and 2d). A second intermediate layer probably consists of a resin essence or oil-resin varnish (layer 8 in Fig. 2a). See also Neugebauer 2016, pp. 327, 328.

16 *'Das mit diesen Farben gemalte Bild [ist] von einem Olgemälde nicht zu unterscheiden und [hat] den Vorteil [...], daß es mit der Zeit nicht nachdunkelt wie dieses.'*

17 In an exhibition review in 1894, the art critic F. Fabricius stated: 'Stuck's works using the new water-soluble paint techniques are regarded as oil paintings here too, because they look like oil paintings' (*'Stuck's in neuer Wasserfarbentechnik ausgeführte Arbeiten gelten ja doch auch hier als Ölgemälde, weil sie wie Ölgemälereien aussehen'*) (Fabricius 1894).

18 Cracks can however also occur in layered tempera painting if the drying times of intermediate layers are not respected before applying more paint.

19 The painting is in the Palazzo Pitti, and at the time Lenbach made his copy it was still attributed to Giorgione (Rott 2004, p. 61).

20 Letter from Ludwig von Hagn to Franz von Lenbach, 11 January 1866. Transcript (without call number) in the archive of the Bavarian State Paintings Collections, Munich.

21 Internal report of binding media analysis, Doerner Institut, Munich, no. 1964, 25 June 2014.

22 The somewhat complicated reasons why Count Schack wished for a replacement of the first version are explained in Neugebauer 2016, pp. 219–232.

23 Internal report of binding medium analysis, Doerner Institut, Munich, no. 1330, 18 November 2013.

24 Ideally *alla prima* painting makes do with a single layer, but it can be built up from a number of layers, as long as these are left partly visible and thus contribute substantially to the final impression.

25 For example, according to Schick, Arnold Böcklin kept his canvases moist while he was painting (Schick 1901, p. 153). Later this was also practised in *plein-air* painting, as the painter Ludwig Dill (1848–1940) reported retrospectively of his time in the Dachau artist colony (1896–1899): 'We painted outside mostly in tempera, on canvas or on board. For this purpose, the painting surface has always to be kept moist, and so the assistants have to bring the water in buckets, often from a long way off. The constant moistening of the picture is extremely tiresome, but then again tempera has great advantages over oil!' ('Wir malten nämlich draußen meist in Temperafarbe, auf Leinwand oder Karton. Dazu muß der Malgrund immer naß gehalten werden, und dazu müssen die Malbuben das Wasser in den Eimern oft von weitem herschleppen. Das fortwährende Naßhalten des Bildes ist äußerst lästig, dafür bietet aber auch die Tempera große Vorzüge vor dem Öl!') (Ludwig 2008, pp. 92–93).

26 The tube paints that were examined are from the estate of Edward Munch, now in the collection of the Munch Museum in Oslo. The ingredients shown to be present, which could originally have been compo-

nents of soaps, are short-chain fatty acids, monoglycerides, oxo fatty acids and monoterpene fatty acid residues. The presence of aqueous binder components such as proteins and polysaccharides could not be ascertained using GC-MS and amino acid analysis (ion-exchange chromatography with post-column derivatisation) (Neugebauer 2016, p. 158).

27 The vehicle 'Malmittel' sold by Wurm may have consisted of a mixture of soft soap, alcohol and spike oil (Neugebauer 2016, pp. 158, 159). This composition of predominantly volatile components would also explain the quick-drying properties of the paints when thinned using this vehicle.

28 A systematic investigation of Wurm's *Temperafarbe*, which links the results of the binder analyses to the historic tube paints, information in sources, the results of investigations into the technique of individual paintings, binder analyses and technical reconstruction attempts has yet to be undertaken.

29 This is due to their particular consistency which, in the unthinned state, is described in letters to the manufacturer as viscous. These letters also praise the fact that the relief of the paint did not change during drying when it was applied as impasto (Berberich 2012, p. 29).

30 Even though this painting was not fully executed in a single layer, it still accords with the principle of *alla prima* painting: both the final colour impression and the drawing were laid down definitively from the outset and remain visible over large areas.

31 Future investigations will have to establish whether Kandinsky manufactured these paints himself or whether he used a commercial product.

32 The particles were identified as dolomite, quartz and chalk (internal pigment analysis report of the Doerner Institut, Munich, no. 6626, 8 January 2013). Such particles were used as matting agents in coatings (see Neugebauer 2016, pp. 164–167).