Chapter 2
Materials From Natural Sources and Those Prepared in the Iconographer's Studio or in the Peasant Household

The materials used by ancient iconographers in the Southeuropean area and which are described in the painter's manuals and in *miscellanea* were found in the surrounding nature (ores, local flora) or in the peasant household (beeswax, linseed oil, tallow, soap, vinegar, ethylic solutions). Some materials (pigments, resins, some solvents, siccatives, fillers, dehydrating agents, flocculants) were prepared in their workshops or in those of other iconographers, local or foreign.

The same types of sources for raw materials as those mentioned in the *hermeneias* were used by painters in other parts of Europe during Antiquity and Middle Ages, not only by the iconographers in Byzantium, as stated in most publications. An example is that of cinnabar which was extracted from ores, as mentioned in the writings of Pliny and Theophrastus[1] and in the *hermeneias.* The preparation of synthetic cinnabar (see Sect. 3.1) as described in the Romanian painter's manuals is very similar to the process used by the Chinese beginning in the first centuries of the last millennium [1]. The same was true in the case of white lead[2] (called "icon white" by iconographers). When it was prepared in the painter's workshop, the technology was the same as that practiced in European and Chinese Antiquity [2]. Even the names used in different areas of Europe were similar (*ceruza*—in the Romanian area, *Venetian white, Nottingham white, Vienna white, Cremnitz/Kremnitz white, ceruza*—in Hungarian, *cerussa*—in Latin, hydrocerussite—in modern times, for the complex mineral). At the same time, the way this process is described in different *hermeneias* has the interesting and original ring of an old technical tradition specific for a certain area and bearing the preferences of each artisan involved in the compilation of the technical manuscripts.

The differences in names can appear in connection with different commercial sources for the materials used by iconographers. This situation was influenced by the ever-changing socio-political conditions in Southeastern Europe. Differences in materials acquired from commercial sources would result in variable compositions and technical characteristic of the compound of interest, depending on the source available at a certain time.

[1] Theophrastus of Eresos (lived around 300 AD) and is known especially for his treatise *De Lapidibus* (History of Stones), the earliest book on minerals.

[2] White or light grey mineral, occurring naturally, with the chemical formula $2PbCO_3 \cdot Pb(OH)_2$.

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In the technical part of *hermeneias* materials are characterized sparingly, unlike what is offered in similar technical publications at the present. In such a manuscript [3], for painting on mother-of-pearl, it was recommended to prime the surface using a "watery egg (an aqueous solution of egg) for the paint to be accepted". At other times, the elaborators of painter's manuals indicated only one or two characteristics of a material, whatever was easy to unequivocally evaluate by one of the five senses. A glue used in wood joining needed to be "strong" (high concentration) [4] while an ochre used for hair and beards needed to be "burned" (converted by roasting into a darker red Fe_2O_3) [3], and a lime was supposed to be not slaked (not hydrated) [5].

Sometimes a raw material was defined by indicating the town, country, or geographical area it was obtained from. That was the case when the material was from natural sources, or when it had been prepared in another workshop, either domestic or foreign. An ochre needed for the recipe of a standard color *Panselinos' sarca* was *Venice ochre* [3], a second ochre, part of another standard color (*proplasma*) was known as *ochre from St. Anna* [5], while yet another ochre needed for an adhesive was *Tarigrad* (Constantinople) *ochre*.

The iconographers were very knowledgeable and their guidelines did not leave room for any misunderstanding. In a Romanian technical manuscript [6] two different recipe components needed to be obtained from Constantinople (today's Istanbul), a "white earth" (chalk), needed to prepare a *poliment,* is said to be from "Ipu's slum" (a neighborhood in Constantinople). This is meant to differentiate it from *Tarigrad ochre*, another material imported from Constantinople and mentioned in the same manuscript. Yet another ochre (*Thassos ochre*) was different from the *Tarigrad ochre* due to a darker red color (higher content of Fe_2O_3). Use of such a name shows, beside the commercial connections in this part of the world at the time the handbooks were elaborated, the same deep knowledge of the materials and their properties. When *Venice turpentine* is needed in a varnish recipe, it is indicated that it would result in an enamel-like look of the painted layers (due to high acidity index of the raw material).

For easily accessible materials, *hermeneias'* elaborators did not bother to specify from where to obtain them. Limestone (natural calcium carbonate, $CaCO_3$) necessary for many primers, ox bile necessary for some adhesives used in gilding, brandy and spirit needed for varnishes, all were considered well known and easy to find. This attitude is common to authors of painting manuals in the entire medieval world. Cennino Cennini in his Handbook [7] does not specify from where limestone or gypsum (calcium sulfate) can be obtained in the same manner as Dionysius of Fourna[3] [8] and Theophylus Presbyter [9].

Conversely, for some materials the manuals give a trove of information, necessary and a proof that the anonymous elaborator had a remarkable capacity to observe and a matching technical ability, drawing on the experience of several generations of artisans. An example can be found in a manuscript [10] which describes, among other processes, how to make a glue necessary to make grounds,

[3] Dionysius of Fourna (*c.*1670–c.1744) was an Eastern Orthodox author of a *hermeneia* (compiled at Mt. Athos 1730–1734) and painter of icons and churches.

Fig. 2.1 Romanian icon on glass (beginning of nineteenth century) showing garments and flowers painted using cinnabar containing paints. Photo: M.D. Leonida

including the conditions required, and the fact that it has to be prepared immediately before use (otherwise it destabilizes the ground). The pieces of leather used to extract collagen needed to be "well tanned", preferably ox leather ("the best"), and the water used for the extraction had to be "clean" (without suspensions). A sketchy, comparative discussion of pieces of leather from different sources can also be found therein, complete with economical considerations.

Concerning gypsum from natural sources, a manuscript [3] recommended choosing white and shiny pieces (with no colored impurities and well crystallized), a very pure material which the centuries-long tradition considered to be the most desirable for primer preparations. Similarly, a *bole*[4] needed to be shiny and, when used as a filler, it had to be "not sandy" (low content of silicates) and "not too red" (low content of Fe_2O_3) [3]. The latter was a requirement also when it was used to warm up the color of the gold leaf, in gilding (see Sect. 4.2).

For the cinnabar (native mercury sulfide HgS) used by Romanian iconographers of the past to paint in red garments (Fig. 2.1) of different characters, among other names, the painter's handbooks use "tzinober stone" which probably refers to German or Austrian sources (*Zinnober* in German) and what the popular etymology made of the borrowed name. When describing this inorganic compound, the elaborator of a *hermeneia* mentions large crystals with a bluish tint, easy to evaluate by sight and characteristic for a pure HgS [10]. The dangers due to adulteration with minium (Pb_3O_4), red-orange as well but cheaper and prone to darkening, are also discussed therein (see Sect. 3.1).

[4] A red earth composed of iron oxide and clay, used in gilding (in water) as a ground. Also known as *Armenian bole* and *poliment.*

Other materials found in natural deposits beside ochre, chalk, and cinnabar were zinc sulfate ($ZnSO_4$—used as a siccative for linseed oil), reactants used in chemical syntheses conducted by the artisans in their workshops (mercury, sulfur, copper, lead), and iron sulfate (*copperas*[5]) used in the recipes of different inks.

Materials used as solvents (concentrated ethylic solutions such as brandy), concentrated acetic acid solutions used as disinfectants, "strong vinegar", beeswax, tallow, soap, bovine bile, eggs, linseed oil for varnishes, fillers such as straws and oakum used in mortars, horse dung (providing heat and carbon dioxide during its fermentation), all these were obtained from their own peasant household. The technical part of the handbooks offers detailed characterizations of the materials obtained by different unitary operations in the household. For example the vinegar used in the preparation of lead white ("icon white") has to be "strong" (high acetic acid concentration) [3]. This is proof that the iconographers' experience recorded the direct dependence of the reaction kinetics on the concentration of the reactant. For spirits, the concentration required for a certain application is sometimes stated qualitatively as "very strong brandy" for a varnish [10] or more specifically by indicating the number of distillations required for the alcohol to reach the desired concentration in the aqueous solution. All these recommendations are offered in a moving, archaic language which, on thorough examination, stands the test of time and makes the statements easily translatable into the language of present day science. In a *"hermeneia"* [3] it is mentioned that a "strong brandy" was obtained "from another brandy (double distillation)" and an alcoholic varnish (see Chap. 6) required "very strong brandy ….. which was turned out four times" (obtained by four successive distillations). For a slaked lime recommended for a mortar, the consistency (viscosity) had to be that of a clay suspension and, when tasted, "had to be neither bitter, nor tart" [11].

Among the materials prepared using chemical processes in iconographers' workshops we mention white pigments, different varieties of lime white [12], lead white (basic lead carbonate), synthetic cinnabar (*vermillion*), copper acetate (*verdigris*, "lawn green", "brass green"), and slaked lime.

Among the materials collected from nature were: flax seeds used to extract linseed oils (for paints and varnishes, see Chap. 6), balsam (resin collected by tapping pine trees) which was used to obtain turpentine[6] by distillation, and colophony. When the materials were harvested from organs of local flora, the *hermeneias* were indicating the period during which they had to be obtained for optimal performance. A Romanian manuscript [10] recommends to use garlic cloves harvested in June-July to allow them to develop and reach the highest content of the protein needed when their juice was used as adhesive in gilding (see Sect. 4.4). A Greek *hermeneia* [8]

[5] Ferrous sulfate ($FeSO_4$), known since ancient times as copperas and as green vitriol (due to the blue-green color of its heptahydrate). Upon heating, loses the crystallization water and becomes a dark brown solid.

[6] Colorless solvent obtained by distillation of pine resin in ancient Greece and Rome; it was obtained by boiling pine pitch covered by a sheepskin, fleece side down. The liquid condensed on the fleece was harvested by wringing the sheepskin periodically.

recommended to do the harvesting in June which implies the same calendar guidance in both cases since Greece lies at a more southern latitude than Romania.

Beside the imported materials already discussed, revealing in their names their place of origin, other materials and raw materials were imported as well. But always, the only materials imported were those which had no autochthonous source, such as specific pigments (*vermillion*, some ochres, *ceruse*), exotic resins (dammar, sandarac, aloe, shellac), spermaceti, or indigo.

In general, the technical part of the painter's manuals displays a very diverse list of materials and raw materials, compiled after a centuries-long practice of maintaining connections with peers from other parts of the Orthodox East, which was handed down from generation to generation within the closed circle of iconographers.

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