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Las colores de un Imperio. Hispanic production and international trade of pigments and pictorial materials in the sixteenth century

ABSTRACT

This paper aims to offer a a broad view of trade in painters' materials in the Spanish peninsula in the sixteenth century, from their production to their import and export. Factors such as their being documented in archival sources or their availability are also considered in establishing their multiple relationships in the contextual framework of growing globalization. Although they constituted uncategorized products in a very heterogeneous market, they have been grouped in pigments and colorants. Generally, their main uses had nothing to do with painting; some of them were would have fallen under the definition of dyes, others were used as medicines, and yet others were basic products for the glass and ceramic industries. This paper explores the presence and role of many of those substances in the development of Renaissance painting.

1. Introduction: between spices and gems

1.1 The merchant takeoff: Companies in the Mediterranean and "small globalization"

Due to its geographical position, the Iberian Peninsula had great relevance in the market and in the exchange of pigments and dyes, especially after the fourteenth century. It is a subject that, in comparison with the extensive Italian and Flemish documentation,

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has been little developed.[1] Due to the intense and fruitful commercial relationships with the Flemish and Italian territories,[2] the ports of the Crown of Aragon (especially those of Valencia and Barcelona) served as a platform for the exchange of materials that circulated throughout the Mediterranean, managed mainly by Catalans, Genovese, Tuscans, Lombards, and, to a lesser extent, Flemish merchants.[3] Still, in the Cantabrian ports, the reputable Basque and Castilian merchants operated together with Flemish tradesmen. A daily flux of foreign eastern merchandise arrived in the peninsula through their agency, while other materials, which had been extracted, processed, or manufactured in the Hispanic kingdoms, were exported throughout Europe, North Africa, and the Orient.[4]

Trade in pictorial materials and pigments was a secondary market, linked to the dying of textiles, the production of glass and ceramics, or closely connected with medicine and the pharmacists' trade. It did not constitute any kind of independent trade form, nor was it a suitable specialization for merchants. There were no tradesmen who specialized in a wholesale or bulk movement of pigments and dyes, nor does there seem to have been any type of specialization in artists' materials. An analysis of the *valute* sheets – or ships' loading bills – of those centuries sheds light on the heterogeneity of merchandise that moved with each trip; from grain or nuts to various minerals, from the finest spices to ingots or metal bars, from fabrics of all kinds to drugs, from waxes and oils to pearls. This situation, which is so well represented in the Datini archive (documenting the Pratese merchant's trade from the fourteenth century until the beginning of the fifteenth century), seems to be analogous in all other merchant companies.

Paradoxically, the great volume of commerce on Hispanic soil was not dominated by the locals. Instead, there was a complex network of companies in which foreign capital played a decisive role. In fact, a significant number of merchants were foreigners who operated through branches or agents in different territories. Catalans, Castilians, Gauls, Italians, and Flemings formed a dense business fabric of collaborative competition in which the Italians held a key position through the settlement of their *compagnie* in the Mediterranean coastal territories of the Iberian Peninsula. These companies usually acted through a specific type of representative (*fattori*) who knew their city of residence

1 A good example could be that of Jo Kirby, Susie Nash, Joanna Cannon, eds., *Trade in Artists Materials. Markets and Commerce in Europe to 1700* (London: Archetype, 2010).

2 Throughout the paper, in order to simplify, modern country names were adopted because the actual borders of those countries bear no resemblance to the political situation in Early Modern Europe, especially in Tables 1 and 2.

3 David Luis, *Valencia e Italia en el siglo XV: rutas, mercados y hombres de negocios en el espacio económico del Mediterráneo occidental* (Valencia: Fundación Caixa Castelló, 1996); Dolors Pifarré, *El comerç internacional de Barcelona i el Mar del Nord (Bruges) al final del segle XIV* (Barcelona: Publicacions de l'Abadia de Montserrat, 2002).

4 The rise of the Catalan-Aragonese trade left important testimonies, such as the so-called *Catalan Atlas of 1375* (Bibliothèque Nationale de France a [BNF, Esp. 30]), written by the Mallorcan Jewish cartographer Abraham Cresques, or the *Libre de conexenses de spícies e de de avissaments de pessos, canes e massures de diverses terres*, a text from the fourteenth century which is fundamental for the study of medieval commerce. Miguel Gual Camarena, *El primer manual hispánico de mercadería (siglo XIV)* (Barcelona: CSIC, 1981).

well, spoke the local language, and functioned as intermediaries working on commission; this assured them greater control over transactions.[5]

1.2 From America to Asia through Europe: The Great Globalization[6]

After 1500, the tables turned and the situation radically changed, first with the new route to America, and then with the rise of alternative ways to reach Asia. New products from those continents started to be available in Spain and Portugal, later reaching the main fairs and markets of the rest of Europe.[7] If previous centuries had seen an important and decisive Italian contribution in the development of commercial practices, the early sixteenth century saw the beginning of significant Castilian, Portuguese, and Flemish input in a global exchange of artistic materials. The fertile relations of Flanders with the Hispanic territories of Castile and Aragon took place in a socioeconomic framework of an exchange of merchandise. After the late fourteenth century, these ties brought luxury products to the peninsula, including fabrics, tapestries, books, paintings, but also pigments. This relationship intensified towards the end of the fifteenth century, when Hispanic traders began to settle in Bruges, Antwerp, Bergen op Zoom and Middelburg, even getting involved in local politics – a phenomenon that would grow during the next century.[8] Moreover, in the first half of the fifteenth century there is also evidence of Flemish notaries who mastered the Castilian language. This is logical if one considers the large Hispanic clientele – Castilians, Aragonese and, especially Valencians – that constituted a relatively organized colony in cities such as Antwerp, Bruges, and Leuven.[9] Both Valencia and Barcelona – dyeing centers – maintained very fluid mercantile and cultural relations with Flanders, especially in the exchange of products linked to textiles and dyes.[10] The Spanish and Portuguese crowns were the main partners of the Flemish in the trade of some materials, among which those for “artistic” use. But the Flemish also started expanding towards the Atlantic. The strategic position of their colonies supplied cities

5 A good example can be found in Angela Orlandi, *Mercaderies i diners: la correspondència datiniana entre València i Mallorca (1395-1398)* (Valencia: Universitat de València, 2008).

6 About the controversy and debate on Globalization in the sixteenth century: Pieter Emmer, The myth of early globalization: the Atlantic economy, 1500–1800, in *European Review*, 11, (2003), 37-47.

7 A fundamental research network on this topic is: Textiles, Trade, and Taste: Portugal and Asia in the Sixteenth and Seventeenth Centuries.

8 Werner Verbeke, Aragón y Flandes: un reencuentro, in María García Soria, María Bayón Perales, eds., *Aragón y Flandes: un encuentro artístico* (siglos XV-XVII), (Zaragoza: Prensas de la Universidad de Zaragoza, 2015), 27.

9 Raymond Fagel, *De Hispano-Vlaamse wereld: de contacten tussen Spanjaarden en Nederlanders, 1496-1555* (Brussels: University Nijmegen, 1996).

10 Pifarré, *El comerç internacional*.

such as Antwerp with exotic pigments and dyes, disrupting the dependence on Iberian dealers.[11]

To a lesser extent, commerce also became a two-way exchange. In the same way that some pictorial and artistic materials were imported from America or Asia to Spain, others were shipped to those distant ports. Indeed, Seville commonly dealt in artists' materials to send to America, for example. But not only those that were unavailable overseas were exported: even those which could be found in America were shipped from Spain as if the colors issued from Castile were a guarantee of quality.[12] Given the complex mercantile landscape, it is necessary to inspect the pigments or colorants involved in detail to understand specific aspects of production, in addition to trade movements related to the peninsular context, offering a concise yet somewhat detailed analysis for each one (Figs. 1-4).

Fig. 1: The main mineral pigments available in the sixteenth century in the Hispanic Empire. 1-2 orpiment; 3-4 realgar; 5 lead-tin yellow; massicot (litharge); 7 yellow ocher; 8 Siena earth; 9-11 red-earth; 12 almagra; 13 gilding clay; 14 roasted Siena earth; 15 umber earth ; 16-17 calcium carbonate; 18 white lead; 19 lead roll covered with lead carbonate; 20 ultramarine; 21 lapis lazuli; 22 smalt; 23-25 azurite; 25 chrysocolla; 26-27 malachite; 28 green earth from Verona; 29 verdigris; 30 minium; 31 vermilion; 32 cinnabar mineral from Almadén; 33 cinnabar; 34 asphalt; 35 black earth; 36 smoke black; 37 chacoal black.

11 Filip Vermeylen, The Colour of Money: Dealing with Pigments in Sixteenth-Century Antwerp, in Jo Kirby, et al, *Trade in artists' materials*, 356-365.

12 José María Sanchez & María Dolores Quiñones, Materiales pictóricos enviados a América en el siglo XVI, in *Anales del Instituto de Investigaciones Estéticas*, 95 (2009) 45-67.

2. Towards a map of the main artistic materials available in the international market at the end of the sixteenth century

2.1 Pigments

White lead (*albayalde*) was a fundamental pigment, not just because it was the only white that could be used both for oil and tempera techniques, but because it could serve as a matrix for some soluble dyes (such as brazilwood, arzica or indigo), and also because of its drying properties. In Spain, locally produced white lead was very common, at least since the late Middle Ages, although such production was insufficient for the important demand of it. In fact, until the fifteenth century, white lead was mainly made in Pisa, hence the Italians were the main suppliers in the territory goverened by the Crown of Aragon. Meanwhile in the Castilian Crown territory, Italian lead carbonate competed with the same material originating from Flanders, although sometimes it was a re-export of the Tuscan pigment. Already during the sixteenth century, the Venetian industry acquired prominence and, towards 1600, the main supply of white lead became Venetian, as the sources show.[13]

Lead/tin yellow (*genulí, hornaza* or *massicot*) was a relatively new pigment at the end of the sixteenth century. Classical sources do not mention the material, and it appeared for the first time in a recipe book called *Segreti per colori* (also known as the *Manoscritto Bolognese*) in the fourteenth century. [14] This lead stannate was a product of the activity of the glass industry, in which it also played a coloring role, and it was manufactured in Flanders, Bohemia, and Venice. Since both Venetian and Flemish merchants traded in it, demonyms like “from Murano”, “Venice” or “Flanders” were very common.[15]

Although commonly employed in Spain during the fourteenth and fifteenth centuries, the use of orpiment in painting had declined. In Venice, however, the pigment was still used. The progressive abandonment of this golden yellow was due to several factors; especially its poor response to oil – a binder in which it took a long time to dry, but also its instability, caused by the chemical reactions with common colors copper- or lead-based colors. This pigment could be found naturally or could be produced by sulfation of arse-

13 Rocío Bruquetas, *Técnicas y materiales de la pintura española en los Siglos de Oro* (Madrid: Fundación de Apoyo a la Historia del Arte Hispánico, 2002), 129-130. Barbara Berry & Louisa Mathew, Lead white from Venice. A whiter shade of pale, in Marika Spring, ed., *Studying Old Master paintings. Technology and Practice. The National Gallery Technical Bulletin 30th Anniversary Conference Postprints* (LondonArchetype, 2011), 245.

14 Mary P. Merrifield, *Medieval and Renaissance treatises on the arts of painting* (London: Dover, 1967), 528-531.

15 Bruquetas, *Técnicas y Materiales*, 132-133.

nic. Although minor quantities were made in Europe in places like Austria or Saxony,[16] in the Middle Ages it had generally been appreciated for being an exotic pigment. Thanks to trading treatises, we know that this product was imported mainly from ports in the East. It typically came from Kurdistan or Syria, but it was also a traditional product of China.[17]

Much less precious, but much more relevant, was ochre. This was the most common yellow pigment due to its wide availability, which entailed a low price, but also due to its stability and compatibility with other pigments. Ochre was obtained by the levigation of earth, and it could be found everywhere, so was produced locally. Hence, it was a pigment that largely did not form part of the international trade.[18] However, some varieties of Italian and Flemish ochres also reached the peninsula, such as *terra di Siena*.

A key pigment was minium. This orange/red lead was known mainly as *azarcón*, a term used by the Muslims of the peninsula who traditionally produced it. With its reddish-orange hue, this was one of the most intense and saturated pigments available to painters. It was traditionally made at the same geographic points as white lead, since in essence it is obtained by burning cerussite. Nevertheless, the ease of production made it a relatively inexpensive pigment, which was thus made almost everywhere. Until the fifteenth century, Pisa was the main provider which, as in the case of lead white, was progressively replaced by the Venice throughout the sixteenth century, although imports never fully managed to outsell local products, which were usually cheaper.[19]

Red earth received various names, among which the most popular was *almagre* or *almagra*. It was produced everywhere, so it could be found as *Tierra de Sevilla, Venecia*, *Levante*, etc. The colors of such varieties, in essence, do not differ significantly. The Iberian Peninsula was rich in these types of earth, hence there was little international trade, since local or regional varieties prevailed. Even in spite of this, some trading treatises, such as the aforementioned handbook titled *Libre de conexenses*, already record *almagra* among the products of the international market, although without a common name.[20] Besides its known use in painting, *almagra* was used to attain glazes in pottery. Among other red earth pigments, there was bole (*bol*), i.e. gilders clay, and the so-called sanguine stone, which was used mostly for drawing. Both pigments are red clays with high contents in ferric oxides, but they are of diverse composition. Another variety of red earth

16 Günter Grundmann and Mark Richter, Types of dry-process artificial arsenic sulfide pigments in cultural heritage, in *Fatto d'Archimia. Los pigmentos artificiales en las técnicas pictóricas* (Madrid: MECD, 2012) 124, 137-138.

17 Bruquetas, *Técnicas y Materiales*, 137.

18 David Thompson, *The materials and techniques of Medieval painting* (London: Dover, 1956), 176.

19 Bruquetas, *Técnicas y Materiales*, 165.

20 Gual, El primer manual, 27. Already at the end of the sixteenth century, it is consigned in the Manoscritto Padovano as *terra spagnola*: Merrifield, Medieval and Renaissance, 697. During those same years, it appears in the manuscript called Reglas para pintar (Rules for painting) designated as red earth from Venice. Rocío Bruquetas, Reglas para pintar. Un manuscrito anónimo de finales del s. XVI, in *PH: Boletín del Instituo Andaluz del Patrimonio Histórico*, 24/6 (1998), 33-44.

was *pavonazo*, with a slightly darker color, sometimes called *rojo inglés* or *pavonazo de Flandes*, thus indicating its origin.[21]

The most important mineral colors that were produced in Spain were cinnabar and its alchemical equivalent: vermilion. Almadén cinnabar had been known, mined, and exported since Roman times, and classical sources already testify to its importance.[22] Muslims were the driving force behind the great activity of the Almadén mine, and they maintained it until the times of the Christian Conquest when it passed into the hands of the Order of Calatrava. In the fourteenth century, it was leased, first to Catalan merchants and later to the Genoese. During that period a substantial amount of the mineral was exported to the entire Mediterranean. The production volume remained, with peaks and troughs during the fifteenth century. The other great moment of exploitation of this mineral was during the middle of the sixteenth century, when the mine was leased to the Fuggers. After a period of inactivity at the mine, this family of German businessmen again promoted abundant extraction.[23] However, cinnabar was also mined in America, where it was plentiful; for example, in New Spain (Mexico), and Huancavelica (Peru),[24] from where it was sent to Europe, although in relatively minor quantities. Although cinnabar mines were eventually operated in other European territories, such as those in Mount Amiata (Tuscany), or Idria (Slovenia), towards the end of the seventeenth century Spanish cinnabar and vermilion were still considered the best. However, they were already beginning to see competition from those arriving from China, imported by the Dutch.[25] Artificial vermilion was much more common for painters' purposes than the mineral, and it could be produced using various methods. Among them, the dry method stood out from which various formulas were collected since the Middle Ages in recipe books, consisting of mixing sulfur and mercury in different proportions.[26]

Azurite (*azul*) was the favorite blue of most painters during the sixteenth century. Although in Spain there were important deposits that served to supply a certain local demand, (especially in Castile), until 1500, a good part of what was used came from foreign origins, mainly from central Europe.[27] The Catalan name *atzur d'Alemania* suggests that much of it was imported from Germany, but it also came from Hungary and even Armenia. The discovery of azurite mines in Santo Domingo (Dominican Republic) – already re-

21 Bruquetas, *Técnicas y Materiales*, 167.

22 Thompson, *The materials*, 102-103.

23 Bruquetas, *Técnicas y Materiales*, 163.

24 Sánchez & Quiñones, Materiales pictóricos, 58.

25 Julio Sánchez, *De minería, metalurgia y comercio de metales* (Salamanca: Instituto Tecnológico Geominero de España, 1989), 308-324.

26 Merrifield, *Medieval and Renaissance*, 479-506

27 Bruquetas, *Técnicas y Materiales*, 146.

ported by Christopher Columbus – would lead to providing important exports to Europe, supplying mainly Spanish painters.[28]

Ironically, precious ultramarine was a pigment of lesser importance in Early Modern Spain because of its very exclusive color, and it was used only on very few occasions. The name derived from its remote origin: it was extracted in the mines of Badakhshan in Afghanistan and then shipped to Venice. The trade in lapis lazuli, (in powder or mostly in fragments of ore) had begun before the fourteenth century, but it was in paintings of the first half of the fifteenth century that the pigment became a nearly indispensable material. Many contracts for Hispanic altarpieces specify and typify its use, along with other expensive materials such as gold and sometimes silver, carmine or azurite. It reached particular importance in the territory governed by the Crown of Aragon since 1400. However, since the fall of Constantinople, its use declined significantly because it was difficult to find.[29] In fact, even in Valencia or Barcelona, finding it after 1480 was difficult. Pacheco, already in the seventeenth century said about it: *ni se usa en España ni tienen los pintores della caudal para usarlo*.[30]

The problem of the scarcity of lapis lazuli was, in part, solved with the introduction of smalt (*esmalte*, or *zaffre*). This blue pigment was made of glass, and despite its intense and vibrant tone, it had a much more moderate price than ultramarine. Although it was already known in the fourteenth century, due to its use in ceramics as well as for glass manufacturing, its application as a pigment did not really begin until the end of the fifteenth century, although its trade became well-known already in the sixteenth. Although *zaffre* was produced in Spain in small quantities, smalt mostly arrived from Murano and Venice in Italian ships. However, it also was imported from the Rhineland and Saxony through trade with Flanders, an analogous situation to the one described for lead-tin yellow, since both were produced in the same places.[31]

Verdigris, on the other hand, was the fundamental green of the palette of Spanish Renaissance painters. It was made everywhere, although it was almost always locally produced in small quantities. That explains why the recipes for this pigment are so frequent and varied in the recipe books.[32] Green of Spain was one of its common denominations during the Middle Ages, although the most popular was that of *Vert de Grece*, which ended up giving it the name. However, since the fourteenth century its main production center

28 Rocío Bruquetas, Azul fino de pintores: obtención, comercio y uso de la azurita en la pintura española, in *In sapientia libertas: escritos en homenaje al profesor Alfonso E. Pérez Sánchez* (Madrid: Museo del Prado, 2007), 148-157.

29 Joan Ainaud, *La Pintura Catalana. De l'Esplendor del Gòtic al Barroc* (Barcelona: Skira, 1989), 30.

30 "Neither it is used in Spain, nor have the Spaniards means to use it." Francisco Pacheco, *Arte de la pintura, su antigüedad y grandezas* (Madrid: Cátedra, 1990), 485.

31 Sergio Diodato, *I buoni colori di una volta* (Florence: Edizioni Menabò, 2012), 393.

32 Jo Kirby, *The price of quality: factors influencing the cost of pigments during the Renaissance, in Revaluing Renaissance Art* (London: Routledge, 2017), 38.

was Montpellier[33] even though the product, in spite of its extraction in a neighboring location, often arrived through Flemish merchants.[34]

Malachite and chrysocolla minerals, (two natural forms of carbonate and copper silicate, respectively) had, in artistic terms, a much smaller impact than verdigris. In general, they were called *verde montaña*, or *verde açul*. It is not known for sure if such a name was applied to malachite, chrysocolla, or both indistinctly, but the words have rarely been preserved in Spanish sources.[35] In fact, in the territory governed by the Crown of Aragon for example, there is no data on its use nor is there a word in the vernacular languages to distinguish it from verdigris.

Unlike ochre and red earth (both very abundant in Hispanic soil), green earth varieties are much rarer, so they were often imported from Italy – traditionally their main producer. The main deposits of these green pigments were in Tuscany and the Veneto, and, without doubt, it was the so-called "earth of Verona" – the most popular pigment of its type. Venetians monopolized its trade throughout the sixteenth century.[36]

Other mineral pigments had some relevance after 1500. Among them, one of the most notable was asphalt (*espalto*), which came from the Dead Sea. Although it began to be used in the 15th century, it did not reach its maximum popularity until the following centuries, due to Venetian influence. Also, black earth (mainly from Flanders) became an important material, although data on these pigments are very scarce.

Table 1: Pigments and minerals [I)]

Pigment	Spanish nomenclatures	Fifteenth century			Sixteenth century		
		Main Producers	Spanish production	Main Traders	Main Producers	Spanish production	Main Traders
Azurite	Azul, Azul fino, atzur, adzur d'Alemania, azul de Santo Domingo	Hungary Germany	Yes	Flanders	Spain (S.Domingo) Hungary	Yes	Castile Flanders
Ultramarine Blue	atzur de Acre, azur ultramarino	Afghanistan	No	Italy Crown of Aragon	Afghanistan	No	Flanders Italy
Smalt	Esmalte, zafre, zaffre, azur	Germany (Saxony)	Yes	Flemish Italians	Saxony Venice	Yes	Flanders Italy
Copper Blues	Azul de cenizas, azul de costras, blavet	Everywhere	Yes	-	Everywhere	Yes	-
Lead White	Albayalde, cerusa, blanco de Pisa, Blaquete, Blanquet	Italy (Pisa)	Yes	Italy Crown of Aragon	Flanders Italy (Venice)	Yes	Flanders Italy

33 Hermann Kühn, Verdigris and copper resinate, in *Studies in Conservation*, 1/ 15 (1970), 13.

34 Vermeylen, The Colour of Money, 360.

35 Bruquetas, Técnicas y materiales, 152.

36 Thomspon, The materials, 176.

Lead/tin Yellow	Genulí, Massicote, hornaza, groc	Flanders Italy (Venice)	No	Flemish Italy	Flanders Italy (Venice)	No	Flanders Italy
Orpiment	Oropimente, jalde, arsénico, sandáraca orpiment groc	Kurdistan	No	Italy Crown of Aragon	Saxony, Poland China, Kurdistan	No	Flanders
Realgar	Rejalgar, orpiment roig, sandáraca	Kurdistan	No	Italy Crown of Aragon	Saxony, Poland China, Kurdistan	No	Flanders Castile
Ochre	Ocre, tierra	Italy Everywhere	Yes	-	Italy Everywhere	Yes	-
Verdigris	Cardenillo, verdete, verdet, verd' d'aram	Evrywhere Hungary Germany	Yes	Italy	Everywhere Hungary Germany	Yes	Flanders
Malaquite	Verde montaña	Everywhere	Yes	-	Everywhere	Yes	-
Green earth	Verde tierra, verd terrer	Italy (Verona) Everywhere	Yes	Italy (Venice)	Italy (Verona) Everywhere	Yes	Italy (Venice)
Cinnabar	Cinabrio	Spain Italy	Yes	Crown of Aragon Italy	Spain Italy	Yes	Castile
Vermillion	Bermellón, vermelló	Spain Everywhere	Yes	Crown of Aragon Italy	Spain Everywhere		Castile Italy
Minium	Azarcón, minio atzerquó, mini, cercó	Italy (Pisa)	Yes	Italy Flanders	Italy Flanders	Yes	Italy Flanders
Red earth	Almagra, mangre,	Everywhere	Yes	-	Everywhere	Yes	-
Umber	Sombra, Tierra Sombra	Italy Everywhere	Yes	Italy (Venice)	Italy Everywhere	Yes	Italy (Venice)
Bole	Bolo, bol	Everywhere	Yes	Italy	Everywhere	Yes	Italy
Asphalt	Espalto, betún	Judea	No	Italy (Venice)	Judea	No	Italy (Venice)
Calcium carbonate	Blanco de lavar	Everywhere	Yes	-	Everywhere	Yes	-

I) As stated in footnote 2, modern country names were used to simplify, indicating where possible the name of the actual city or the main state that produced or distributed the pigment, even if it was not the only one in the territory. For example: lead white was made in several Italian cities, in Florence, Pisa, Montepulciano, Siena, Genoa or Venice, but the main producer was definitely Pisa, followed by Venice, at least until the second half of the sixteenth century. In the cases in which there is no indication, the generic modern name of the country was used, which means that there were several the cities or regions which produced a pigment, and none of them really stood out.

Fig. 2: Table 1 of the main mineral pigments and their trade during the fifteenth and sixteenth centuries.

2.2 Colorants

Colorants were an important economic engine in European medieval societies and, beyond their uses as dyes, they also played an important role in painting, which has been

often underestimated.[37] Unlike the developments with regard to pigments, the discovery of America and the new Asian routes had a decisive impact on international trade (Figures 3-4).

Fig. 3: The main lakes, dyes and other organic substances available in the sixteenth century in the Hispanic Empire. 1 Shavings of Brazil; 2 Brazil lake; 3 Campeche wood; 4 pink lake; 5 madder roots; 6 madder lake; cocchineal crimson; 8 Florence Crimson; 9 Spanish Crimson; 10 American cochineal powder; 11 American cochineal; 12; Grain; 13 lac-dye; 14 lac-dye lake; 15 shellac; 16 weld; 17 weld lake; 18 sap- green; 19 dragons-blood; 20 pieces of woad; 21 woad seeds; 22 woad powder; 23 Indigo from Iran; 24 American indigo; 25 wax; 26 fruit gum; 27 amber; 28 mastic resin; 29 gum Arabic; 30 colophony; 31 saffron in solution; 32 safflower; 33-34 oak galls; 35 ink. ©Photograph: Marta Raïch/ Miquel Herrero-Cortell. CAEM, UDL.

Grana (coccus ilicis) was undoubtedly a typically Spanish dye. A variety of kermes, cultivated in the Iberian Peninsula since the High Middle Ages, it is an insect that grows in bushes of the oak family. Since the end of the fourteenth century, the shipping of this colorant to Italy and Flanders, where the textile industry had reached an important level of development, was very important.[38] *Grana* was an expensive dye, mainly grown in the south of Valencia (although, as the documents attested, the Andalusian and Castilian varieties, were also appreciated). Somewhat cheaper, on the other hand, was the one coming from the Maghreb, which in times of scarcity of Spanish grana helped to supply

37 Lakes, for example, had a great relevance from the XV century since they served to complement the mineral palette while allowing the attainment of effects of transparencies and glazes, not previously developed. Perhaps the most relevant group of lakes were the red ones, which could be obtained from animal dyes (Lac-Dye, Cochineal, Kermes) or vegetables (Madder and Brazilwood).

38 The abundant shipments of this dye made by foreign companies (such as Datini) give an idea of its importance in the market. Orlandi, Mercaderies i diners.

the enormous demand.[39] The change in textile fashion towards the end of the fifteenth century, which imposed the use of black colors, and the introduction of the American cochineal, led to a loss of importance for this dye in later centuries.

In fact, the discovery of America led to the importation of a red dye that would reach even greater success, the *Grana de Indias* or American cochineal (*Coccus Cacti*). This dye was obtained from an insect, well adapted to arid places with high temperatures, that was cultivated in the so-called *nopal* cactus. It was able to surpass the coloring possibilities of *kermes*, and it was also capable of producing more intense colors which could vary between red and purple. This versatility, together with its great stability made it quickly appreciated by Europeans. But the arrival of this dye in Spain had enormous economic impact: it quickly affected the trade of the traditional *grana*. At least since 1536, to counteract the brutal competition, the cactus began to be introduced also in Europe, precisely in the territories where, until then, *grana* had been produced. However, the dye produced on European soil could never compete with the one coming from America, perhaps because of the working conditions of the enslaved indigenous laborers, but especially due to its incomparable production volume.[40]

The madder root dye was the most important vegetable red until the sixteenth century. Its main producers cultivated the root throughout Europe, Flanders, and Romania, according to Datini's lists. Madder dye allowed a range of colors from orange, warm reds or pinks, to browns or crimson tones. However, although their production and trade continued during the following centuries, they were partially affected by the enormous abundance of brazilwood.

Among the specimens of brazilwood that were available in the international market, the first were those from Asia, which were already known and marketed at least since the fourteenth century (*verzino*). As quite rightly pointed out, the importance of brazilwood lakes for medieval dyers was huge.[41] After the discovery of America, new varieties like *Palo del Brasil, Pernambuco*, and *Campeche* were added to the international market.[42] Brazilwoods were mainly responsible for pink color lakes like *roseta*.

Closely related to pictorial purposes but with a lower overall economic impact was lac-dye (*laca*). This highly prized product was the secretion of an insect, of which there were at least two varieties: the red one (perhaps the most predominant) and the yellow one, also called shellac. It was imported from India and other areas of Asia. So-called Dragon's Blood (*sangre de drago*) had much less importance; although it was a precious material

39 Juan Vicente García, Los colores del textil. Los tintes y el teñido de los paños en la valencia medieval, in *L'Histoire à la source: acter, compter, enregistrer (Catalogne, Savoie, Italie, XII e -XV e siècle)*, (Saboya: Université Savoie Mont Blanc, 2017), 287.

40 Bruquetas, *Técnicas y materiales*, 152.

41 Thompson, *The materials*, 116-120.

42 Pascale Villegas & Rosa Torras, La extracción y exportación del palo de tinte a manos de colonos extranjeros, in *Secuencia*, 90 (2014), 79-93.

used in miniatures during the Middle Ages, it became less popular in the Modern Age. However, all the aforementioned red substances (from *grana* to *sangre de drago*) allowed the attainment of red lakes called generically *carmín.*[43] Its composition was frequently a mixture of several colorants.

Since the Middle Ages, indigo and woad were the main blue dyes, which became two economic engines. They are extracts of two different plant families, the first from *Indigofera*, the second *Isatis tinctoria*; however, they share the same coloring agent, indigotin. Indigo was produced in the Persian Gulf area, and the one from Baghdad was the most prized. Oriental indigo circulated abundantly in Europe in the Middle Ages, as shown by the manuals of merchandise and other sources.[44] Despite its brighter color, its use in painting might have been more restricted than that of woad. This was perhaps due to its high price, a result of the considerable costs incurred in its production and shipping, together with added levies and tariffs. Thus, woad was the king of blue dyes. It was produced throughout Europe, especially in Toulouse and Lombardy. With the discovery of America, Mesoamerican Indigo, which was already widely used among the natives, became part of the trade circuit, although it was mainly used by Spaniards.[45] However, the main competitor for European woad was still the long-used Oriental Indigo, whose intense blue was unrivaled. After the discovery of the marine routes to India, the Portuguese imported Eastern Indigo at a lower cost than European woad. This brought about the approval of measures to protect European woad plantations, especially in France and Germany, which resulted in a ban on the Asian and American blues.

Much less important, due to their instability, were yellow and green dyes among which, undoubtedly, saffron stood out. Although it was produced in various places in southern Europe, the most famous type was Hispanic (mainly from the territory of the Crown of Aragon), as attested by sources. Saffron was used in gilding and as a yellow dye to modify some pigments like verdigris or cinnabar. Quite similar was safflower, although this was mainly used for dyeing fabrics. The dyers' broom and the weld (*orchica*) were mainly used for textile staining, although yellow weld lakes were also produced with them. Because they are plants scattered throughout Europe, their trade was relatively insignificant. A vegetal sap green lake called *verde vejiga* was very common among painters despite the fact that it was not very lightfast.

Oak galls were the main source for the production of metallogic inks from the Middle Ages onwards, in combination with iron and copper sulfates. Not only were they of crucial importance for the development of this product, but also for textile staining of black, brown, gray, and brown colors. They were mainly collected in Central Europe, although they could be found in many mountain locations.

43 Bruquetas, *Técnicas y Materiales*, 156-162.

44 Thompson, *The materials*, 135-140.

45 Francisco Zamora, Central American Indigo. Globalization and socioeconomic effects (16th-17th centuries) in *Análise Social*, 224, (2017), 584-607.

Table 2 : Colorants, lakes and dyes

Dyes/ Lakes/ Colorants	Spanish nomenclatures	Fifteenth century			Sixteenth century		
		Main Producers	Peninsular production	Main Traders	Main Producers	Peninsular production	Main Traders
Kermes	Grana, grana cochinilla	Spain Poland	Yes	Crown of Aragon Castile Italy	Spain Italy	Yes	Italy Castile Crown of Aragon
Cochineal	Grana de Indias, cochinilla del nopal	-	No	-	Spanish -America	Yes	Castile
Crimson	Carmín de Yndias	-	No	-	Spain	Yes	Castile
	Carmín de Florencia	Italy	No	Italy (Florence)	Italy	No	Italy (Venice)
Lake	Laca	India	No	Italy	India	No	Italy Portugal Flanders
Madder	Rubia	Flanders Romania Everywhere	Yes	Flanders Italy	Flanders Romania	Yes	Flanders Italy
Brasilwood	Palo brasil, palo rojo, verçino	India (Other Asian territories)	No	Italy (Venice)	Spanish -America	Yes	Castile Portugal
Drangons-blood	Sangre de Drago, Sangre de dragón	India (Other Asian territories)	No	Italy (Venice)	India (Other Asian territories)	No	Italy (Venice)
Orchile	Orchilla	Spain	No	Crown of Aragon Italy	Spain		
Safflower	Saflor, azaflor	Spain	Yes	Crown of Aragon Italy	Safflower	Yes	Crown of Aragon Italy
Saffron	Azafrán, Zanfrán	Spain Italy	Yes	Crown of Aragon Castile	Spain Italy	Yes	Crown of Aragon Castile
Weld	Archica, reseda	Everywhere	Yes	-	Everywhere	Yes	-
Dyer's Broom	Genista, retama de tintoreros	Everywhere	Yes	-	Everywhere	Yes	-
Indigo	Índigo, Añil	Persian Gulf	No	Italy Crown of Aragon	Span-ish-America Persian Gulf	No	Castile Portugal Italy
Pastel	Paste, Añil	Italy France	Yes	Italy Castile	Italy France	Yes	Italy Flanders
Sap Green	Verde vejiga	Italy France	-	Italy (Venice)	Italy France	-	Italy (Venice)
Oak galls	Agallas	Romania	Yes	Flanders Italy	Romania	Yes	Flanders Italy

Fig. 4: The main colorants dyes and lakes and their trade during the fifteenth and sixteenth centuries.

Conclusions

The small globalization of the Mediterranean after 1400, followed by the Great Globalization in and after the sixteenth century led to important changes in the trade of artists'

materials. The discovery of Atlantic and Pacific routes changed the rules of trade; the coastal territories that had been points of manufacture, supply, and exportation of pictorial materials became practically distributors. It was an important alteration of the pattern of commerce which had remained almost unchanged since the fourteenth century. Despite the fact that some pigments and lakes were widespread and cheap, some others were luxury items. Prices depended on several factors, like shortage and availability, supply and demand, origin, production difficulty or tariffs (Figure 3).[46]

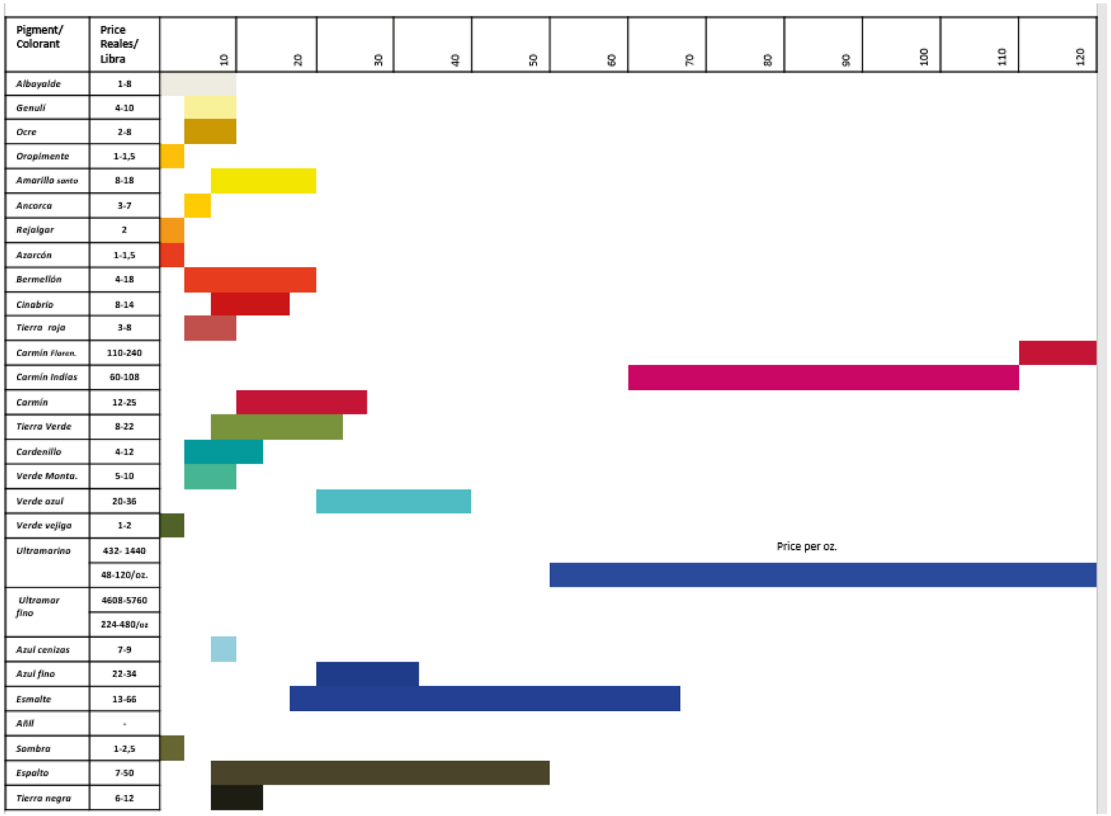

Fig. 5: Prices of the pigments, colorants and dyes in the last decade of the sixteenth century, according to Bruquetas and Sanchez & Quiñones.

The discovery of America led to the entry of various products on the market among which cochineal stood out, to the point that it came to eclipse the trade of Valencian *grana*. However, overseas cochineal would also begin to be cultivated in those same areas a few years later, to counteract the economic impact caused by the importation of such dye. In the peninsular territory, "Indian" azurite progressively replaced the same material produced in other parts of Europe. For example, the famous Baghdad indigo suffered a recession due to the tariffs that favored the production of European woad. Madder, cultivated both in Spain and in Flanders, suffered from the competition of brazilwood. Also, the high cost of lapis lazuli towards the end of the fifteenth century led painters to adopt smalt. At the same time, apothecaries specializing in artistic materials (*vendicolori*) emerged in Venice. Throughout the century, Venice became the largest producer of pigments and dyes, supplanting important traditional centers such as Marseille or Pisa.

46 Jo Kirby, The price of quality, 35-58.

Pigments and dyes not only renewed the artists' palette, replenishing it with new colors, but their production, exportation, and distribution acted as important levers in the economic engine of empire.[47]

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