## Master dyers to the Court of Sicily

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# under TECNICAL ANNEX – ANESSO TECNICO)

# 3. Master dyers to the Court of Sicily

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## Introduction

From antiquity onwards authors have been writing enthusiastically about the brilliance of colours obtained by natural dyestuffs. In particular dyeing with Tyrian purple has been a topic of many descriptions in historical sources. One of the earliest sources on dyeing are the papyri '*Leyden X* and *Papyrus Graecus Holmiensis* [1]. These manuscripts written in Greek, but originating from Egypt contain together with recipes for metallurgy, recipes for dyeing. The bulk of the manuscripts are dedicated to recipes for imitating Tyrian purple, the most expensive dyestuff ever. But recipes for dyeing blue with woad and red with madder and kermes are also mentioned [2]. The latter are the more common dyestuffs from which all shades of blue to red and in combination purple can be obtained. The manuscripts seem to be written by a scholar rather than by a practical dyer. It does, however, give an impression of the dyestuffs used at the time. The same dyestuffs are mentioned by Pliny the Elder († 79 AD) in his '*Historia Naturalis'*. From these two sources one can learn which dyestuffs were most in use at the beginning of our era.
For dyeing blue only one dyestuff was available. This was *indigotin*, which could be obtained from various plants from which woad (*Isatis tinctoria* L) and indigo (*Indigofera tinctoria* L) are the most well known[3]. The first was mainly used in Europe, the latter in the Far East. For yellow colours, weld (*Reseda luteola* L.) was used but for lower quality textiles, however, dyers broom (*Genista tinctoria* L.) and sawwort (*Serratula tinctoria* L.)[4]. Persian berries (*Rhamnus*-species) were also used. For red colours a broader range of plants could be used. Madder (*Rubia tinctorum* L.) indigenous in Europe, brazilwood (*Caesalpinia sappan* L.), imported from the Far East [5]. An important and expensive dyestuff was kermes (*Kermes vermilio* (Planchon)) and other coccus-type dyestuffs obtained from several scale insects were used[6]. To obtain purple shades -the colour of emperors and senators- Tyrian purple was used, obtained from various molluscs from which the *Boloinus brandaris* L. and the *Hexaplex trunculus* L. were the most important[7]. However, also orchil (various *lichen*- types) was used for dyeing purple shades[8]. This dyestuff was much cheaper then Tyrian purple but faded away in a very short time. A better quality purple, however cheaper then Tyrian purple, could be obtained by combining blue and red[9]. Black colours were mainly dyed with tannin containing plant materials. Together with an iron mordant a deep black colour could be obtained. The most important black dye was gallnuts; the excrescence brought about by the puncture of a very small species of wasp, *Cynips tinctoria* Oliv. and other species laying its eggs upon the leaves and young twigs of certain kinds of oak-trees, especially those of *Quercus infectoria* Oliv. Other black colours were obtained by alderbark (*Alnus glutinosa* L.) and Sicilian sumac (*Rhus coriaria* L.)[10].

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After the sack of Rome much of the knowledge about dyeing textiles seemed to have disappeared on the mainland of Europe. Byzantium, however, kept a highly developed textile industry where beautiful silk fabrics were produced and high quality dyeing seemed to be practised. It is difficult, however, to be sure of the precise production of these kind of centres because only a limited number of textiles have survived and even less are thoroughly investigated for the presence of their dyestuffs.
From literature it is known that in the 12th century, a Royal textile manufacture existed on Sicily. Arabian weavers and dyers were brought to Sicily to introduce their knowledge and make the most beautiful silk fabrics. The question could be raised whether their knowledge about weaving and dyeing was much different from Antiquity or from that of Byzantium? Which dyestuffs were available and which were used?
The exhibition *'Nobilis Officinae'* in Vienna and Palermo, where treasures from the Imperial workshops at Sicily from the 11th to the 13th century are presented gave an opportunity to investigate some of the most famous textiles. A larger part of the exhibition is focussed on silk textiles from the Royal textile manufactory in Sicily. Important textiles from the '*Schatzkammer*' in Vienna, from Sicily and many other museum collections are part of the exhibition. Within the framework of this exhibition, the Alb (Palermo, Royal workshop, 1181); the ~~Coronation~~ mantle (Palermo, Royal workshop, 1133-1134); the Tunicella (blue dalmatic, Sicily, Royal workshop, 1st half of 12th century); the gloves (Palermo, Royal workshop, before 1220); the Hose (Palermo, Royal workshop, 2nd half of 12th century) and shoes (sandalia) (originally Norman, but reworked in Germany, 1st quarter of 17th century; woven band: Palermo, 12th-13th century) have been investigated[11].

## The dyestuff analysis

The dyestuff analyses were concentrated on purple and red textile materials from the historic textiles. This was done because red and purple dyestuffs might give more information about the origin and date of the textiles. Blue and yellow dyestuffs are used in large parts of the world and are common in various regions giving no important information.
To gain as much information as possible about the objects, the warp and weft of the fabrics were investigated separately. In this way it can be found out whether the fabric was piece dyed or whether the yarns were dyed separately. For the same reason all samples were investigated under a stereo microscope with a magnification of 10□ prior to analysis. The samples were investigated to observe the colour and to identify whether the threads contained fibres with a different colour than the overall impression. If so, attempts were made to separate the threads and to analyse them separately. This investigation is non-destructive and has, therefore, no influence on the dyestuff analysis.

### Mordant dyestuffs

The greater part of natural dyestuffs belongs to the class of the mordant dyestuffs. In modern terminology these could also be called 'metal complex dyestuffs'. When dyeing with mordant dyestuffs, the textile material is treated in two steps. The textile is generally first treated with a metal salt solution (mordanting). In the past only a limited number of metal salts were available for this purpose. The one most frequently used was an alum solution, ($Al_2(SO_4)_3.K_2SO_4.24\ H_2O$), but iron sulphate ($FeSO_4.7H_2O$) and stannous chloride ($SnCl_2$) were also used. Following the mordanting with the metal salt solution, the second treatment involves a dye solution, a dye plant extract. Only after this second treatment is the final colour of the dyed fabric obtained[12].
To determine the mordants used, X-ray Fluorescence (XRF) detection was performed. For some samples, which were too small for XRF analyses, Scanning Electron Microscopy-

Energy Dispersive Spectroscopy (SEM-EDS) was carried out to determine the mordant used. This analysis is non-destructive as well.

### Analytical methods

There are many analytical methods available for the identification of natural dyestuffs. For blue dyestuffs a specific micro-chemical test is still used[13]. As most dyestuffs contain more than one colouring matter, methods to separate the different components are preferable. These are TLC (Thin-Layer Chromatography)[14] and HPLC (High Performance Liquid Chromatography)[15]. Although HPLC has replaced TLC in many aspects, the latter is still practised. The analytical possibilities of HPLC for the identification of dyestuffs have improved the identification and needs only a limited textile sample. Thus for the complicated analysis such as with the Coronation garments the preference was given to HPLC.
To be able to identify the dyestuff by HPLC the mordant used has to be removed. This is done by hydrolyses where the metal part and the organic dyestuff are separated.
The dyestuff analysis were performed with High Performance Liquid Chromatography coupled to Photo Diode Array detection (HPLC-PDA) according to ICN standard operation procedure (SOP) no. 36[16], which is derived from Wouters and Rosario-Chiniros[17].
Compounds are identified by comparison of the UV-VIS spectra and retention time with (known) reference materials, which data are stored in an HPLC-software library.
At the ICN, spectra of reference materials of most common dyestuffs are available.
Unfortunately, identification is not always possible, due to low concentration in the sample or lack of reference material. However, from the UV-VIS spectra the colour of the unknown compound can be deduced unless the unknown compounds is a degradation product, which has undergone a change of colour.

## Results of the dyestuff analysis

### The Alb (Schatzkammer, Wien, Inv.Nr. XIII 7)

This silk gown was used at the coronation of the kings and emperors of the Holy Roman Empire. The Alb is made of a plain white silk fabric and at the bottom seam, the yoke (neckline) and the sleeves the fabric is enriched with samite woven decorated textiles, embroidered with precious stones and pearls. There are Latin and Arabic inscriptions on the broad hem at the bottom. The inscriptions describe that the robe was made in Palermo in the Royal Court Workshop during the reign of William II (1153? -1189) in 1181[18].

The red silk from the ***yoke*** fabric (warp and weft) is weighted with galls, mordanted with alum and dyed with a coccus dye[19], in this case kermes (*Kermes vermilio* Planchon). The results of the dyestuff analysis show that the coccus-type used for the warp and weft is the same, however through slight differences in the composition of the dyestuff it can be concluded that they are dyed separately. (Figure 1: red silk from the neckline fabric)
The warp of the ***right upper arm border*** is made of dark brown-black silk and dyed with a mixture of dyestuffs. The main dyestuff used is galls dyed on an iron mordant. Traces of kermes on an alum mordant are present and also traces of Tyrian purple (only monobromoindigotin is present). The weft is composed of three threads, two are dark brown and one is bright purple. Although the colours of the threads are different the composition of the dyestuffs are almost the same. In both types of threads galls are used for weighting as well as dyeing. Together with that Tyrian purple is present. With the analytical methods used it is not possible to determine the percentage of the dyestuff used (colour depth). Thus it is very

possible that the dark brown fibres contain considerable more gall-dyestuff and less Tyrian purple then the bright purple thread. As Tyrian purple is extremely expensive, this is well feasible.
The warp of the ***left upper arm border*** is dark brown, with a purple glow. This warp is dyed very differently from the right upper arm warp thread. The main dyestuff is tannin containing plant, probably sumac or galls on an iron mordant. Also a trace of brazilwood (sappanwood, *Caesalpinia sappan* L.) is present. Brazilwood must have been imported from the Far East to Europe. It has been used frequently in medieval times.
The weft of the left arm border consists of dark-brown silk fibres with a purple glow. The dark brown fibres are dyed with tannin containing plant, sumac or galls, on an iron mordant. As a second dye Tyrian purple is used.
The warp threads of the ***right upper cuff*** are dark brown and dyed mainly with galls on an iron mordant. There is also a small amount of Tyrian purple present. The warp consists of dark brown threads and bright purple threads. In both types of thread tannin containing plants, probably galls on an iron mordant have been used together with Tyrian purple.
The warp of the ***right cuff*** (stitched addition) consists of red threads weighted with galls and dyed with kermes on an alum mordant. The warp is also red, weighted with galls and dyed with kermes on an alum mordant.
The warp of the ***left cuff*** (front) is dark brown and dyed with tannin containing plant material, probably galls on an iron mordant. The weft is made of dark brown and purple fibres. Tannin containing plant material was identified, as no iron was detected the tannin was used for the weighting process of the silk. Furthermore madder on an alum mordant together with Tyrian purple was present. As it was not possible to separate the fibres into threads, it is not possible to decide whether there was a mixture of Tyrian purple and madder used or that the threads composing the weft were dyed with madder and Tyrian purple respectively. Furthermore red weft threads from the left cuff were weighted with galls and dyed with a mixture of madder and kermes on alum mordant.
The warp of the ***walking slash*** consists of three light pink yarns. These are dyed with madder and possibly with orchil. The weft consists of a dark pink thread dyed with madder and Tyrian purple.
The warp of the ***hem border*** (front) consists of one pink thread, dyed with Tyrian purple and possibly orchil. The weft consists of purple and some pink fibres. It was not possible to identify different yarns. The dyestuffs present were madder and a trace of kermes on an alum mordant and Tyrian purple.

## *Conclusion*

The Alb is a very rich textile where **Tyrian purple** is used in abundance. In many of the various fabrics used for the decoration of the neckline, the arm cuffs and border the warp is dyed mainly with galls on an iron mordant which give a dark brown or black colour. Also Tyrian purple is identified in the warp, however, it is not clear whether this is contamination from the weft or whether it was used on the warp. As the warp is in general covered with the weft the use of a cheaper dyestuff is to be expected. In many fabrics the warp is dyed with slightly different combinations of dyestuffs. This means that the yarns are dyed in a different dyebath. Particularly with the use of Tyrian purple this could be due to the small amounts of Tyrian purple available. The warp is always weighted with galls, which points to a western origin. Closely related are the different borders of the right arm cuffs. They differ from the right arm cuffs. In the latter other dyestuffs are present such as madder and kermes. The lower hems and the slash again contain slightly different dyestuffs.
The Tyrian purple identified could be obtained from various types of molluscs. The most common for this area are the following[20].

***Bolinus brandaris*** (Linné, 1758) *(Murex brandaris* L.)
The spiny Dye-murex is easily recognisable by its grooves and spines at the outside of the shell. The shellfish can be found in shallow bays of the Mediterranean coast. It lives in coastal areas between 9 to 200 m depth. In the enzymatic process preceding the dyeing, mainly 6,6'-dibromoindigotin is formed and a small amount of *6,6'-dibromoindirubin*.

***Hexaplex trunculus*** **L**. (Linné, 1758) (*Murex trunculus* L., *Trunculariopsis trunculus*, *Phyllonotus trunculus*)
The banded Dye-murex is built stockier than the *Bolinus brandaris*. It can be found in the coastal areas, on cliffs, between the stones or muddy bottoms between 2 to 130 m depth. *Hexaplex trunculus* can be found in the eastern part of the Mediterranean; the Adriatic, the western Mediterranean at the northern and central coastal areas of North Africa, on the Atlantic coasts of Spain, Portugal and from Morocco to Guinea and on the Azores and the Canary Islands. In the enzymatic process preceding the dyeing, indigotin and 6,6'-dibromoindigotin are formed. Minor quantities of indirubin and other red indigoid dyestuffs can be present. From the analysis of the Tyrian purple of the Alb it is difficult to decide which of the two molluscs have been used. However, because of the presence of various compounds, such as indigotin, 6,6'-dibromoindigotin, indirubin and 6,6'-indirubin etc. it might probably be the *Hexaplex trunculus* L. (formerly called *Murex trunculus* L). This one gives the bluer shade.
Figure 2: purple silk from the right upper arm border.

## The 'Coronation' mantle (Schatzkammer, Wien, Inv.Nr. XIII

The 'coronation' mantle is embroidered with pearls and precious stones on a red silk fabric. It belongs to the set of robes used for the coronation of kings and emperors of the Holy Roman Empire. The red silk has an Arabic inscription around the hem of the mantle. This inscription gives the date of production of the Royal workshop in 528 (Islamic chronology) corresponding to the Christian year 1133/34. Thus this robe was made for Roger II of Sicily (1095-1154). The mantle consists of a red silk ground fabric and is lined with a yellow-orange fabric, which is again overlaid with three other silk materials. These well-known fabrics are: the Tree of Life cloth (Lebensbaumstoff); the Dragon cloth (Drachenstoff) and the Bird cloth (Vogelstoff). These fabrics are samites and attributed to the Sicilian royal workshop in Palermo and dated the first part of the 12th century.

The warp of the ***red silk ground fabric*** consists of a mixture of beige-yellow and red fibres. The are weighted with galls and dyed with brazilwood (sappanwood) and kermes on an alum mordant. Also a trace of woad is present. The weft consists of red silk, which is weighted with galls and dyed with kermes. Also a trace of woad is present. The identified woad might be contamination of other fibres from the embroidery. The blue yarn along the pearls was dyed with woad and another unknown dyestuff.
The warp of the ***Tree of Life cloth*** *(Lebensbaumstoff)* consists of two red yarns. The silk is weighted with galls and dyed with a mixture of madder and kermes. There is also a trace of iron present. Considering the colour of the textile and the low amount of iron, this can be caused by a contamination of the alum used and not specifically used as an iron mordant. The weft consists of three red yarns. The silk is weighted with galls and dyed with a mixture of madder and kermes on alum mordant.
The red warp of the ***Dragon cloth*** *(Drachenstoff)* consists of a reddish-pink yarn. This is weighted with tannin containing plant material. Also an unknown yellow dyestuff is present.

The latter might be part of the weighting agent, which could point to Sicilian sumac (*Rhus coriaria* L.). The silk is dyed with kermes on alum mordant. There are traces of woad present. The weft consists of one reddish-pink thread. The silk is weighted with galls and dyed with a mixture of kermes and weld on an alum mordant. The original colour must have been orange red. A second sample of the weft consists of two bright red yarns. A single black fibre is present, probably contamination. The silk is weighted with galls and dyed with a coccus dye on alum mordant. The coccus dyestuff in this textile could be a mixture of kermes (*Kermes vermilio* Planchon) and Armenian (*Porphyrophora hamelii* Brandt) or Polish cochineal (*Porphyrophora polonica* L.).
The warp of the ***Bird cloth*** *(Vogelstoff*) consists of red yarns, which are weighted with tannin containing plant material. It is dyed with a mixture of madder and kermes on alum mordant. Also an unknown yellow dyestuff is present. The latter might be part of the weighting agent, which could point to Sicilian sumac (*Rhus coriaria* L.). Two red samples are taken from the weft. One consists of red silk, weighted with galls and dyed with a mixture of kermes and weld (*Reseda luteola* L.). The other warp consists of one bright red thread. The silk is weighted with galls and dyed with a coccus dye on alum mordant. The coccus dyestuff in this textile could be a mixture of kermes (*Kermes vermilio* Planchon) and Armenian (*Porphyrophora hamelii* Brandt) or Polish cochineal (*Porphyrophora polonica* L.)

### *Conclusion*

The dyestuffs in the red silk ground fabric show an efficient use of the available raw materials. The warp of the fabric is dyed with a cheaper dyestuff, brazilwood, than the weft. This could have been practised because the weft covers most of the warp. Brazilwood would originally have had almost the same colour as kermes, but has faded into yellowish brown. Brazilwood fades from bluish-red into yellow-brown under the influence of light. As there is also a yellow dyestuff present, it could be supposed that the colour of the lining originally had an orange-red colour.
From the lining, the silk fabrics, the 'Dragon cloth' and the 'Bird cloth' seem to be related. The warp of both textiles has been weighted with the same tannin material. One of the weft yarns is dyed with a coccus dyestuff deviating from the others in the coronation mantle. It might be a mixture of different coccus dyes. In all the fabrics of the coronation mantel, the warp being the least visible in relation to the weft is dyed with cheaper dyestuffs.

## The Blue Tunicella (dalmatic) (Schatzkammer, Wien Inv.Nr. XIII 6)

The dalmatic is made of a blue samite, figured red samite with gold embroidery and decorated with precious stones, pearls and cloisonné enamel. The borders are tablet weaves. It is attributed to the Sicilian royal workshop and dated the first part of the 12th century.

The warp of the ***blue samite*** consists of dark blue fibres and is dyed with woad and madder. The warp consists of blue fibres, somewhat lighter than the warp. The silk is dyed with woad and madder. No weighting agent could be detected.
There were two samples taken from the warp of the ***hem border***. One consisted of two yellow-beige threads, with some red fibres, probably contamination from other parts. The silk is dyed with brazilwood (sappan wood, *Caesalpinia sappan*.L) and kermes on alum mordant. Also a trace of woad is present. The other sample consisted of two yellow-beige threads. These are dyed exactly the same as the other warp sample. No weighting agent could be detected.
There are two samples taken from the weft. One consists of red fibres and a small yellow thread. This silk is weighted with galls and dyed with kermes and madder on alum mordant.

The other warp sample consists of red fibres. The silk is weighted with galls and dyed with kermes on alum mordant. Also a trace of woad is present. In view of these results one can suppose that the warp consist of a red kermes dyed thread or of two madder dyed threads and a kermes dyed thread.
The warp of the ***right cuff*** consists of two yellow-beige threads. The silk is dyed with brazilwood (sappan wood, *Caesalpinia sappan*.L) and kermes on alum mordant. Traces of woad are also present. No weighting agent could be detected.
Two weft samples were taken. One consisted of red fibres and a single purple fibre (contamination?). The silk is weighted with galls and dyed with kermes on alum mordant. Also a trace of woad is present. The other warp sample consisted of red fibres and is weighted and dyed in the same way as the first weft sample.

### *Conclusion*

The dark blue samite is dyed in a very traditional way to obtain a purplish blue-black. On a ground of woad dyed silk, a second dyebath is used consisting of madder on alum mordant. This colour is called 'morello' in Italian[21] (moreit in Dutch[22]). This combination was used for many centuries to obtain a very fast and beautiful colour. This method was used for silk as well as for wool. The warps of the fabrics of the hem and the arm cuff are dyed with a relatively cheap dyestuff – brazilwood - with a lower amount of kermes. This can be concluded from the fact that the silk is now yellow-beige. Brazilwood has a relatively low lightfastness and will change colour from bluish red into yellow-brown or even beige. The warps of these fabrics are all dyed with kermes, a more expensive dyestuff. The traces of woad are probably contamination fibres from the ground fabric. It is interesting to note that all the warp yarns are not weighted, whereas the weft yarns are. This could mean that the silk warp yarns are not or only limitly degummed. Silk fibres contain a large amount of sericin, a resinous product, which is often removed enabling the fibres to be properly. Because the silk will loose strength as well as weight, it is treated with galls. However, for warp yarns the sericin is not always removed, this is to retain the strength and as the warp is often covered by the weft, a slightly unevenness in the dyeing is less important.
Because this phenomenon occurs in all the fabrics of the tunicella, it supports its strong relationship.

## The gloves (Schatzkammer, Wien Inv.Nr. XIII 11)

The gloves are made of woven bands of silk and gold. The gloves are attributed to Sicily and dated the 12/13th century.
The warp of the inner part of the left glove consists of an orange-red thread. The silk is weighted with galls and dyed with madder and kermes on alum mordant. The warp of the inner part of the right glove consists also of an orange-red thread. This silk is weighted with galls and dyed with kermes. The weft of the left glove (upper part) consists of red fibres, is weighted with galls and dyed with kermes on alum mordant. The weft of the right glove is the same.

## The Hose (Schatzkammer, Wien Inv.Nr. XIII 12)

The hose consists of a pair of stockings, made of red twill silk, gold thread and has a green silk border in ~~a~~ tapestry technique. The border has a Tulut inscription in gilt membrane. The hose is attributed to the Royal workshop in Palermo and dated to the 2nd half of the 12th century.
From both stockings warp and weft of the red silk is identified. The dyestuff combination of the red silk of the warp and of the weft is identical. It is weighted with galls and dyed with a coccus dye on alum mordant. The coccus dyestuff in this textile could be a mixture of kermes

(*Kermes vermilio* Planchon) and Armenian (*Porphyrophora hamelii* Brandt) or Polish cochineal (*Porphyrophora polonica* L.). This combination of coccus dyes is closely related to that of the 'Dragon cloth' and the 'bird cloth' of the mantle.

## The shoes (sandalia)

A Sicilian pair of shoes was remade in the 17th century; however the woven band comes from the very first or somewhat later Norman 'sandalia'. The dating of the remade is based on the construction and cut of the soles. The woven band is attributed to the Royal workshop in Palermo and dated 12th/13th century.
Samples were taken from the warp and weft of the red silk of the ground fabric of the left and right shoe. All red silk samples, warp and weft from both shoes give the same results. The red silk is weighted with galls and dyed with a coccus dye on alum mordant. The coccus dyestuff in this textile could be a mixture of kermes (*Kermes vermilio* Planchon) and Armenian (*Porphyrophora hamelii* Brandt) or Polish cochineal (*Porphyrophora polonica* L.).

### *Conclusion*

On the base of the available dyestuff analysis a tentative conclusion can be drawn that the ***'Dragon cloth'***; the ***'Bird cloth'***; the ground fabric of the ***Hose*** and of the ***shoes*** are closely related.

## Master dyers in Sicily?

Many of the dyestuffs identified in the coronation robes of the kings and emperors of the Holy Roman Empire belong to the most expensive dyestuffs available at that time, '**kermes and Tyrian purple**'.
However, Tyrian purple could only be found in the Alb. All other garments were dyed with combinations of kermes, madder, woad and brazilwood.
On the basis of the dyestuffs found, it is difficult to decide if the Royal workshop in Palermo had a specific attitude to the dyestuffs used. These were those available at that time and period and were used economically. A good example for this economical use of expensive dyestuffs is clear from use of Tyrian purple in the samite fabric used for decoration of the Alb. In these textiles the warp is always dyed with a cheaper material such as galls or Sicilian sumac on an iron mordant and this is combined with a variation of dyestuffs such as madder, orchil, brazilwood or kermes to give it a purple shade. As the warp in most cases is not visible this seems to be common practice in the workshops of this time. The weft is then dyed with Tyrian purple. This practice of using cheaper dyestuffs for non-visible yarns proves the quality and the knowledge of the dyers in the Royal workshop. No material is wasted unnecessary and the result is still a colourful and brilliant fabric. They were ***master dyers*** indeed!

### *Relation between various textiles*

One question is always asked: is it possible to identify the origin of a textile from the dyestuffs identified? Generally it is very difficult to do so. Many dyestuffs can be found over a large territory and related dye plants, such as the *Rubia*-species, only differ slightly in the composition of their colouring matters. The ratio between the colouring matters, such as alizarin and purpurin in madder (*Rubia tinctoria* L) can differ under the influence of the soil on which the plant grows, the temperature of the region and also by the method of dyeing. The use of mordants can influence these ratios also. On the other hand, if the dyestuff identified in two different textiles is the same; the combination of the various components in that dyestuff is comparable and therefore so is the ratio between these components, the conclusion might be drawn that these textiles are very closely related.

On the basis of the available dyestuffs analysis a tentative conclusion can be made that the 'Dragon cloth' (Drachenstoff), the Bird cloth' (Vogelstoff), the hose and the shoes are closely related. From the other textiles of the garments it is not possible to decide whether they are related or stand on their own.

### *Comparing the Royal Sicilian workshop with the Royal Byzantine weaving manufactory*

To compare the dyeing methods of Sicily and Byzantium is not easy. As stated before only a very limited number of historic textiles from accepted provenance have been investigated. Historical sources and literature on these workshops is almost non-existent and only one example from the author's experience can be compared. This is the **cope of Albinus from the cathedral in Bressanone** (Brixen, Italy). The cope is made of a purple coloured silk with two rows of large black eagles with yellow eyes, beaks and talons. In the beaks a yellow ring-shaped jewel is held. Between the eagles large black rosettes are placed. On the reverse side, narrow bands of tablet-woven gold thread form a cross and also cover the seams. The eagle fabric belongs to a group of fabrics, which are the most important products of the Byzantine royal weaving manufactory at the turn of the first millennium.
The dyestuffs of the cope were analysed with TLC (1991) and with the micro-chemical test for indigotin.
The ***yellowish-brown warp*** of the main fabric brazilwood was found. In the red-brown weft of that fabric brazilwood, gallnuts and orchil were found. No indigo was present. The ***figured part the warp*** had alternating beige and aubergine coloured areas. These parts corresponded to the weave pattern. Gallnuts and orchil were identified. As orchil fades in light the alternating colour could be explained. That part of the thread, which had been covered by crossing yarns, was not exposed to light and thus had not faded. In the dark red yarn from the weft madder together with a coccus dye, probably Polish cochineal (*Porphyrophora polonica* L.) and Tyrian purple could be detected. The ***green weft*** was dyed with a mixture of indigotin (woad) and weld (*Reseda luteola* L.) and it was weighted with gallnuts. The ***blue weft*** was dyed with indigotin, presumably woad (*Isatis tinctoria* L.). The ***beige weft*** contained no dyestuff; however, it was weighted with gallnuts [23].

The dyestuffs used for the cope are the same as those used for the Alb. In the Byzantine textile the same practice was applied as in Sicily to use cheaper dyestuff for the warp and more expensive for the (visible) weft. Also in this fabric the figured part is richer in dyestuffs and combinations of orchil and Tyrian purple have been used. However, the main fabric is a *fake purple*. A mixture of brazilwood and orchil, together with gallnuts has produced the purple. As the mordant is not identified in this research it is impossible to know whether the galls are used for weighting or to obtain a dark brown/black colour.

### *Conclusion*

There seems to be a little difference between the dyeing practice in Byzantium and Sicily. In both the workshops the dyestuffs used were available in the region and by importation. Cheaper dyestuffs were used for the –invisible- warp yarn, the richer dyestuffs were used for the more visible, figured parts. In these parts expensive dyestuffs such as coccus- dyes and Tyrian purple were used.
For a definite conclusion more historic textiles with a certain provenance must be investigated. It is possible, with modern analytical techniques, of more precise identification on smaller samples. Only a few milligrams (0,4-cm thread or less) are necessary for such analysis.

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