Hidden history behind the colorants of banners

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Abstract The cultural heritage agency of the Netherlands investigates historic textiles with modern analytical techniques, several historic banners are being analysed in order to determine the origin of their colorants and to highlight their context in the periods in which the banners were made. The investigated banners are; the oldest flag of Amsterdam recovered from Nova Zembla after being left by Dutch explorer William Barents, also an early 17th century flag of the city of Middelburg, further one British Royal African Company flag from fort Cormantine (1665 at present in Ghana), two Swedish war ensigns from the 1658 battle of the Sound, furthermore six British ensigns from the 17th century Anglo-Dutch wars; trophies of different historic sea battles, and last a 19th century Imperial fleet ensign of the German Confederation and the 1565 silk embroidered embellished with gold brocade Gonfalon of the city of Milan. In these mentioned periods a great variety of organic colorant sources were used for dyeing; The aim of this paper is to improve the knowledge of use of organic dyes in banners. Identifying the colorants used in these banners not only tell us about the degradation of the fibres or discoloration phenomena of the dyes, but as well about trading routes of the epoch of these countries or cities and the methods that were used for achieving the rich colours of banner.

Introduction

The Cultural Heritage Agency of the Netherlands (RCE)[i] is part of the Dutch ministry of culture, education and science. Our mission is to help other parties to get the best out of heritage. The agency is the link between policymakers, academics and practitioners. We provide advice, knowledge and information, and perform certain statutory duties assigned to us. Within the agency different departments are involved in listing, preserving, sustainably developing and providing access to the most valuable heritage in our country.

The RCE possesses a state-of-the-art laboratory devoted to conservation science. In the past two years several applications for research analysis have involved banners and standards; these analyses can help not only in restoration and preventive-conservation issues but also adds knowledge about the object's origin and making.

The flags and standard discussed in this paper are all analysed by means of High Performance Liquid Chromatography with a Photo Diode Array detector (HPLC-PDA). With this technique, colorants which are first dissolved are separated from each other. To dissolve these dyes a sample preparation in needed using acids to extract the dye from the textile fibre. Although this is an invasive technique, only small samples, typically 3 to 10 mm, are needed for dyestuff identification. After separation, the dyes are guided through a PDA detector which records the UV-VIS absorption spectrum for each individual component. Based on this spectrum, information can be obtained regarding the colour and dye class. However, comparing the spectra obtained with those of known reference materials lead to the identification of the most relevant dyes used in Europe. At RCE a reference collection is available of 10.000 different materials, including binding media, pigments, resins, glue, synthetic dyes and pigment and of course natural dyes. The HPLC-PDA result is normally presented in a graph called chromatogram in which the identified components, based on their PDA spectra, are indicated. In some cases a Scanning Electron Microscope with Energy-dispersive X-ray detector (SEM-EDX) is used to determine the condition of the fibre and identify mordants, metals which are used to bind these dyes to the textile fibre. The exact analytical procedures are described in the analytical protocols, HPLC-PDA protocol ICN.[ii]

For natural dyes, three different dyeing procedures could be used depending of the dye molecule itself. The easiest way is direct dyeing, by this the dye is extracted from the dye plant in (warm) water, filtered to remove the plant fibres and next the textile is brought into the dye bath and dyeing occur via hydrophobic interaction. The wash and light fastness is in general poor for these dyes. The most used dyeing mechanism is mordant dyeing. Following this procedure, the textile is first inserted in a bath with metal salts. For this coordination metals such as aluminium, iron, tin, chrome and cupper are needed which bind to the textile fibre. The mordanted textile is then put in the dye bath and the dyes forms a bond with the metal, which serves as a bridge between the textile fibre and the dye. The wash and light fastness is much better compared to direct dyes; about 80% of the natural used are mordant dyes. The most complicated dyeing technique is the vat dye, called as a reduction reaction is performed in a vat (i.e. the dye bath). This is done with indigoids, which will be discussed below. The main components of these dyes are not soluble in water; therefore they are reduced using fermentation (or nowadays reducing chemicals) and converted into their water soluble leuco-form. The textile is inserted into the dye bath after this reduction step and the leuco-dyes are bound to the textile fibres. Once this textile is exposed to air, the dye is oxidised and form a very stable dye bound to the textile fibre via hydrophobic interaction. In this paper, it will be shown that all three dyeing techniques were used.

The banners could be seen as isolated cases from different places and periods, however what binds them in this paper is their common history behind their colorants. The aim of this paper is, therefore, to improve knowledge regarding the use of dyes in historical banners.

Nova Zembla, the frozen flag of Amsterdam (1596)

In the spring of 1596 two ships of the town council of Amsterdam were sent on voyage in search of a northeast passage to Asia under command of Dutch cartographer and explorer William Barents. For Barents this would be his third and last voyage.[iii] They set sail on May 10th under the flag of Amsterdam (a horizontal striped red, black and red with three saltires in white in the middle), on this journey they discovered and mapped for the first time Bear Island and Spitsbergen. After reaching the island of Nova Zembla, they rounded the cape and continued their journey in a south-easterly direction. The Kara Sea's ice quickly surrounded them and they failed to avoid being trapped in the ice and stranded. A save house called 'Het Behouden

Huys' was built from the ships lumber in order to sit out the winter. To cope with the cold they used merchant fabrics which were on board of the ship to tailor extra blankets and clothing to keep them warm. In June, the next year they took to the sea in two self-made rafts. Barents died at sea before reaching the main land Europe where they were rescued by a Russian merchant boat.[iv]

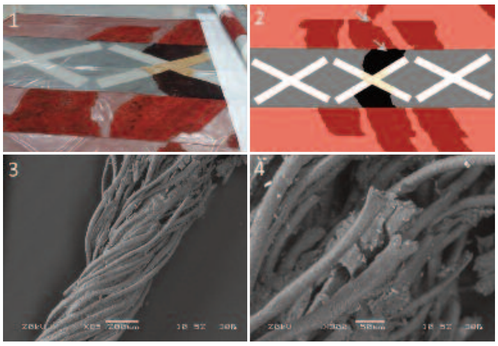

Figure 1
- 1596 Flag of Amsterdam (Size: 275cm x 480cm | Obj.no. NG-NM-7748)
- Illustration of flag and sample place (Obj.no. NG-NM-7748)
- SEM image Black sample 85x magnification
- SEM image Black sample 300x magnification

The 1876 Nova Zembla expedition led by Charles Gardiner collected many items from the save house, including several wool fragments of the flag of Amsterdam that survived the 280 winters. These objects are now part of the collection of the Rijksmuseum of Amsterdam. The wool fragments of the flag were reconstructed on a modern support and impregnated with synthetic glue.[v] Like many consolidated flags in the Netherlands since the end of the 1960's until the beginning of the 1980's the glue used was a polyvinyl polymer.[vi] The now degrading resin is releasing acetic acid; an agent that can accelerate degradation of organic fibres and can affect some colorants within the flags.

This flag is kept at the Rijksmuseum storage rolled with foam-wrap on both sides (fig. 3 - 1 and fig.4) on to a tube. Two samples of 4 mm are taken from the red and the black strips of the flag (fig. 3- 2), because it is very likely that the white wool saltires are not dyed, they were not sampled. From the electron microscope images of the black sample, we can see how the wool fibres with the recognizable characteristic scales have suffered minor degradation; however the synthetic glue that penetrated the threads is breaking down as one can see in figure 3-4 (fig. 3 - 3 & 3 - 4).

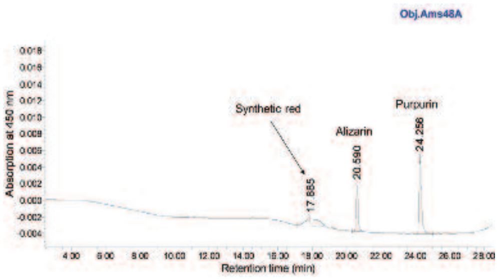

Figure 2 HPLC-PDA Chromatogram: Red sample from the Amsterdam flag

In figure 1, a typical result is shown of the analysis of the red sample. The two main components were identified as alizarin and purpurin, which indicates the use of madder roots (Rubia tinctorum L.) as red dye. In addition a synthetic red colorant was found which could not be identified. From literature research it appears that synthetic colorants were often added to polyvinyl acetate glue during the restoration, this in order to colour the white Tergal support material underneath, dyes used were from the Cibacet series of Ciba Geigy.[vii] Although the glue remains were removed by dissolving them in dimethylformamide prior to the acid extraction of the textile fibre, traces of the synthetic colorants were still visible in the chromatograms. This could due to the fact that not all the glue was removed or is an indication that the synthetic colorant has also penetrated the wool fibres and that therefore it could proof difficult to remove without affecting the original colorant in future restoration.

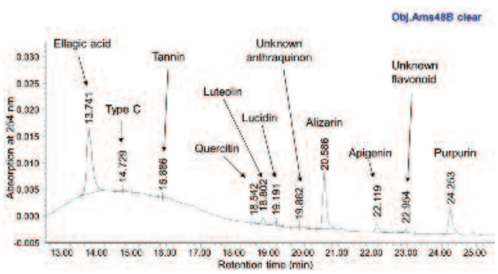

Figure 3 HPLC-PDA Chromatogram: Black sample from the Amsterdam flag

The black sample showed a very complicated combination of dyes as is shown in figure 3. Alder bark was identified by the presence of ellagic acid and quercetin which was used in this period to dye wool black or grey with the used of iron salts. Since the combination of iron and tannins or alder bark was regarded having a corrosive effect on wool it was severely regulated in many European regions.[viii] In this SEM-EDX spectrum (figure 4) we can see the presence of iron and aluminium in the black sample, which both could serve as a mordant to bind the dye to the textile fibre.

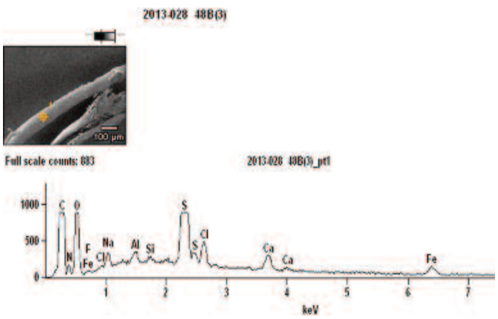

Figure 4 EDX spectrum of Black sample from the Amsterdam flag (with SEM image of measured spot)

Next, madder was identified by means of alizarin and purpurin, just as in the red sample. The ratio of alizarin and purpurin in both samples are different, this could be due to the quality or/and provenance of the madder roots or using a different dyeing recipe. Sources suggest that around this period madder was imported to Holland by Dutch hanseatic merchants; the roots came mainly from Breslau (Poland).[ix] Madder was also grown locally in the Zeeland, here there were different qualities gained and marketed; the thickest madder roots, thoroughly stripped from smaller hairy roots was targeted as the highest quality, The roots of all sizes but less thoroughly stripped were of fine quality and then the medium fine from smaller roots discarded in the production of the highest quality, the least quality small roots and bark particles attached to earth was called mull this last was used in the dyeing of brown shades.[x]
Another red dye was identified as redwood by the presence of a marker labelled as "Type C". This component does not show any colour but is typical for Caesalpinia species. In redwood dye, the colour is due to brazilein, this is a very fugitive dye and often degraded.[xi]

Redwood is also known as brazilwood and was imported from both Asia and Latin America. As a result, Brazilwood was already used in Europe prior to the discovery of the New World. Brazilwood, was imported in Holland from the Portuguese colony in the New World in this period. When the Portuguese discovered the east coast of South America in 1500, they found brazilwood trees (the same dye but another species), these trees were already known to Europeans from their trips to the East Indies. The Portuguese word 'brasa' meaning glowing coal or ember, lead them to name this land 'Terra do Brasil', when they realized it was a whole forest of these trees. The trans-Atlantic trade in brazilwood climaxed before 1600 and was followed by a sharp decline due to over-harvesting and the decimation of the native population by disease and mistreatment.[xii]

Next to the red and black dyes, the yellow components luteolin and apigenin were found which point out to the use of weld (Reseda luteola L.). The yellow dyeing plant weld is a culture crop favoured by European dyers since early middle ages. It was known to dyers that mordanted wool with iron turned the yellow dye brown while on alum a golden yellow colour can be obtained.[xiii]

The mix of all these colorants created a deep black, this made the black cloth in the Amsterdam ships flag reasonably more valuable that the other dyed fabrics used in this flag.

To summarize, the dye sources of the black sample are identified as a mixture of yellow from weld (Reseda luteola L.), madder roots (Rubia tinctorum L.), black alder tree bark (Alnus glutinosa L.) and brazilwood (Caesalpinia species). The SEM-EDX (figure 4) analysis could identify the mordants use in the dyeing procedure, being iron and aluminium salts.

Swedish flags from the battle of the Sound - 1658

Like all the flags and banners in the Rijksmuseum storage, two Swedish flags are kept in a dark, low in oxygen and climate regulated environment. They are catalogued as blue with yellow Scandinavian cross, 17th century Swedish flags, obtained by the Dutch navy during the battle of the Sound.[xiv]

In the 17th century, trade in the Baltic Sea was crucial for the Dutch economy. The Baltic Sea connects to the North Sea through a series of seaways. The deepest and

Figure 5: Textile storage of the Rijksmuseum
with rolled flags around tubes

most navigated is called the Sound, merchant ships passing this strait paid toll for the ships tonnage, so it was in Dutch interest to keep these prices low. During the second Northern War (between Denmark and Sweden) the Army of King Karl X Gustav of Sweden, had invaded Denmark and had Copenhagen under siege. Gustav's purpose was to obtain the west side the Sound and at the same time put Denmark into a position of dependence while Dutch trade in the Baltic would be at his mercy.[xv]
The Dutch States General refused to surrender Baltic trading to the whims of the Swedes and decided to equip a war fleet to free the passage of the Sound. In October of 1658 the Dutch fleet set sail. The fleet consisted of 35 warships and more than twenty transport vessels carrying extra troops to support the Danish armies. The Dutch fleet was led by Lieutenant-Admiral Jacob van Wassenaer Obdam.[xvi]
The naval battle took place on the 8 of November of 1658, although the Dutch fleet had a lower number of ships and guns than the Swedish, they manage to defeat the Swedish and capture 5 Swedish ships, among others; the flagship Pelikanen (or Pelican) and merchant ship the Morgonstjärna.

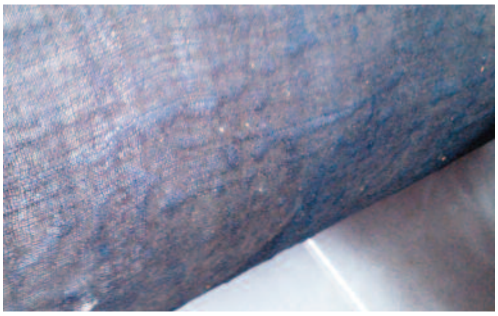

Figure 6 Blisters visible on Swedish flag's surface
(Obj.no. NG-MC-1889-83-23)

The two flags captured from this naval battle are the oldest known conserved flags of Sweden. The flags are consolidated on tulle support with the use of synthetic glue. In this case no synthetic dyes were added to the glue. When rolling out the flags of the tubes one could perceive a strong smell of rancid-butter, suggesting that the synthetic glue used is polyvinyl butyral although this is to be confirmed by chemical analysis. Also after rolling out; blisters were discovered in the textile.

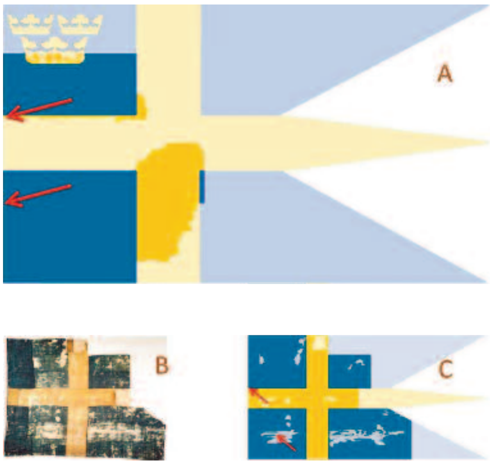

Figure 7
A. Illustration of largest flag probably from the larger flagship the Pelikanen with indication of the sample place (fragment size: 430cm x 330cm | Obj.no. NG-MC-1889-83-23)
B. Smaller Swedish flag image probably from a smaller merchant ship as the Morgonstjärna (fragment size: 350 cm x 380cm | Obj.no. NG-MC-1889-83-24)
C. Illustration of smaller flag (B.) with indication of the sample place (Obj.no. NG-MC-1889-83-24)

When polyvinyl butyral degrades, it releases butyric acid, this vapour could create bubbles during deterioration. If these bubbles cannot escape due to the airtight layering they get trapped in this rolled flag, it may have caused the blisters and when unrolled the concentrated acid dispersed releasing the smelly vapours. The synthetic glue used should be further studied.
Four small samples were taken for chromatographic analyses of the colorants. The largest flag was difficult to sample due to the hardened glue which was used in excess, in contrary to the smaller flag.

In the blue samples of both flags indigotin was found which, together with its isomer indirubin and the degradation product isatin indicates the use of an indigoid dye. There are two possible plant sources; indigo (Indigofera spp.) or woad (Isatis tinctoria L) which cannot be distinguished from each other by chemical analysis. The introduction of indigo in the Western and Northern European markets started in the 15th century after the discovery of the sea route to the Far East. In the 16th century a fierce opposition to the use of indigo started. This opposition was initiated by producers of woad, which was a commercially important product, as well as by the municipal government who protected their interests. Indigo was then absolutely forbidden and classified as a devilish product. By the beginning of the 17th century the use of indigo was getting more accepted since this contained a higher dyestuff concentration and was therefore cheaper. In the course of the 17th century woad was replaced by indigo. [xvii]

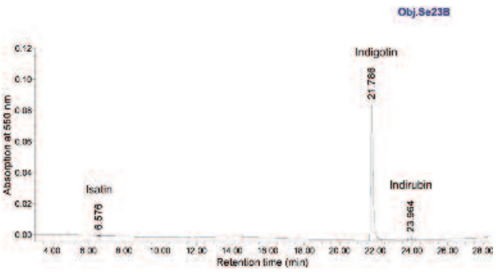

Figure 8 HPLC-PDA chromatogram: Blue sample from larger Swedish flag

The high level of trade traffic between The Baltic area and Western Europe suggests that indigo was also available for Swedish dyers.
The woad powder available in the periods before the flags were dyed was produced in the next manner; 'woad leafs were boiled until they became pasty, the paste was agglomerated into balls and left to air-dry and ferment for a few months. The now fermented (couched) woad balls were turned into powder and sold'.[xviii] This powder when used in a dye vat have traces of flavonoids and other plant minor components that also attaches to the wool and can be detected in a chromatographic systems.[xix] Because indigo is normally prepared in such a way that only the indigoids are extracted, the side components are less or not found in the analysis (fig. 8). In the 17th century this way of preparing indigo, through pigmentation was done in India, Iran, Ceylon and Central American factories.[xx] It is in the Napoleonic War that woad was used to prepare Indigo pigment in Europe, because of the Continental blockade and limited import from India. Chromatograms of dyed wool with indigo or woad pigment have often a relative high peak of the colorant indigotin, the isomer indirubin and the marker isatin is also often found in low concentrations. Since in this sample no plant flavonoids are present (fig. 8) it is likely that these flags are dyed blue with an indigo or woad pigment. Based on the dating indigo is most likely.

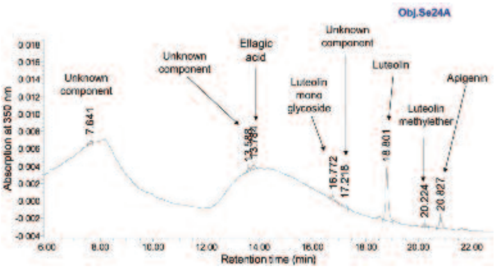

Figure 9 HPLC-PDA chromatogram: Blue sample from smaller Swedish flag

Both yellow samples from the different flags were dyed with the extract of weld (Reseda luteola L.) due to the presence of the components luteolin, apigenin, luteolin methyl ether and several other flavonoids. The presence of tannin was proven by means of ellagic acid in low concentration was detected as well (fig.9).

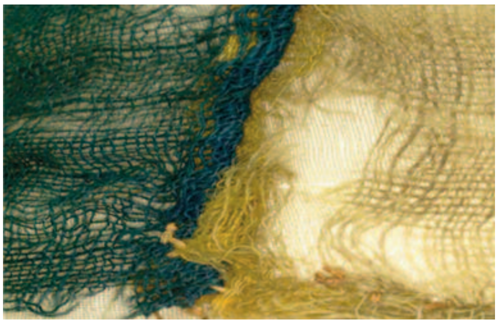

Figure 10 Smaller Swedish flag less faded yellow and blue near the seams (Obj.no. NG-MC-1889-83-24)

Tannin and weld is not a common combination on wool fibres, probably because tannins are typically used to dye blacks and browns when adding a ferrous salt. In this case it could not be used for darkening the yellow shade, because the concentration is too low to have a significant effect and it is believed that no iron salts were used in this dye. The tannin could be cross contamination or could be an after treatment with tannin extract of gallnuts to soften the yellow nuance as has been noticed through dyeing experiments performed at RCE.[xxi]
Because natural colorants are not lightfast these are not the original shades of the flag. To get a glimpse, one have to look where less light reached the fabric, this is often between the seams (see fig. 10).

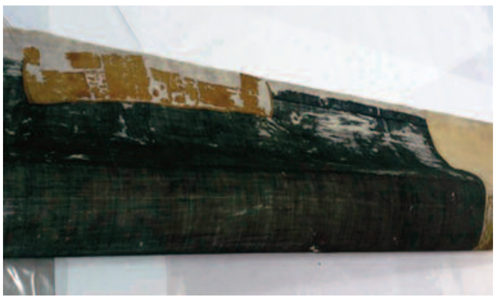

Figure 11 Larger Swedish flag fragment with yellowish remains of crown (Obj.no. NG-MC-1889-83-23)

The largest flag fragment has, at the hoist side in the upper blue quadrant, yellowish remains of what was catalogued as parts of one royal crown by Brandhof.[xxii] However when looking at Swedish heraldry; three crowns would have been a better deduction because it has been a symbol to this country since the 14th century.

However, the problem was that the three crowns would not fit the missing two blue strips if all three crowns are of the same size. Illustration 'A' in figure 7 gives a sugges-

tion of how the three crowns could be arranged to fit. Nowadays these crowns are part of the lesser coat of arms of Sweden where two smaller crowns are above a slightly bigger one. And a few other examples could be found in historic numismatic collections of Swedish coins where the three crowns are often depicted. Peter van de Velde, a Dutch painter of naval battles, painted in the 1670's the battle of the Sound where he depicted the Swedish ensigns with three yellow crowns.

Figure 12 Sea battle at Helsingør in the Sound… by Peter van de Velde - with close-up of Swedish flag with three crowns (Rijksmuseum Collection |Obj.no. SK-A-3271)

Fort Cormantine 1665

Another flag fragment investigated consists of a St George's Cross within a double border of red and white chequers. The flag fragment is part of the Rijksmuseum collection and is catalogued as an English Guinea Jack from fort Cormantine 1665.[xxiii]

The English trading post Cormantine on a hill near Abandze (nowadays in Ghana) situated on the African Gold Coast was built by Nicholas Crispe, the primary stockholder of the private Guinea Company; the company was active in trading gold since 1631-32.[xxiv] Around 1640 the growth of different plantations in the West Indies needed much labour, and human trafficking started to become lucrative. Here they bought among others sugar and redwood to be returned to England, these goods were only allowed to enter England by ships flying the English flag. After the first Anglo-Dutch wars this ordinance was introduced to boycott Dutch monopoly of the seas.

Fort Cormantine was adopted as the headquarters of the Company of Royal Adventurers Trading to Africa (also called Royal African Company) in 1661, with as head of the company James II Duke of York and as commander of the fortress Francis Selwyn. In 1664 English Admiral Robert Holmes engaged several Dutch ships in the Gulf of Guinea and captured here several Dutch forts.[xxv] The flag is therefore not the Guinea Jack as catalogued by Brandhof in 1977, but the flag of the Company of Royal Adventurers Trading to Africa.

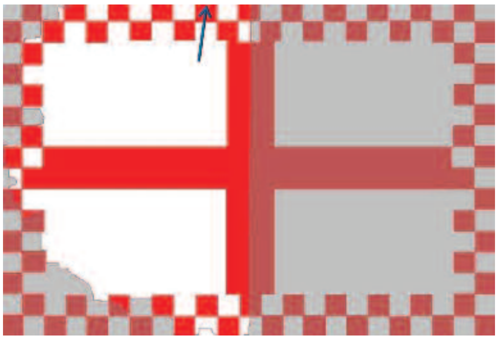

Figure 13 Illustration of Fort Cormantine flag with sample place indicate with the blue arrow (fragment size 425cm × 315cm | Obj.no. NG-MC-1889-83-8)

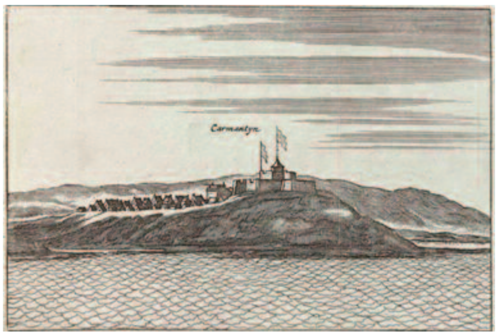

Figure 14 Engraving of the English Fort Cormantine 1665 (Rijksmuseum collection | Obj.no. RP-P-OB-47.402)

Dutch Admiral Michiel Adriaenszoon de Ruyter sailed to the Gold Coast in order to recover the Dutch losses; he also gained Fort Cormantine in February 1665 from Commander Francis Selwyn. [xxvi]

Two flags fragments captured during this event are now in the Rijksmuseum collection and were sampled for analysis. During the examination it became clear that colour variation was observed in the red parts of the flag.

Colorants analysis of the red colorant reveals that this flags were dyed with a mix of two red sources; madder (Rubia tinctorum L.) and brazilwood (such as Caesalpinia sappan L. or Caesalpina echinata Lam.).

15th century Florentine master dyers used standard colour shade names. These names were adopted by western European dyers in France, England and the Netherlands and were used even until the 19th century. Among the reds; madder alone could provide 12 different standard red shades out of the 19 offered by dyers to their clients.[xxvii] When a madder dye-bath was followed by a nuancing of brazilwood four more colours could be obtained named: Royal-Red, Pink Paris, Dry Rose and an imita-

Figure 15 Detail image of local colour differences, a darker bluer shade (right side) is seen where the glue was thicker applied (obj.no. NG-MC-1889-83-8)

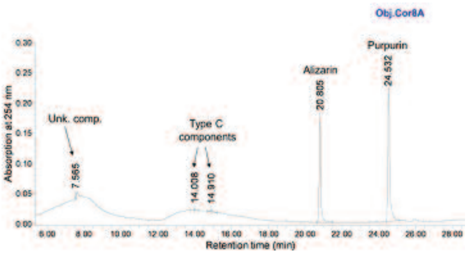

Figure 16 HPLC-PDA chromatogram: Red sample the Fort Cormantine flag 17th Century Anglo-Dutch wars

tion of Perse blue (Persechino).[xxviii] It is very likely that dyers were looking obtain a more vermilion red shade (Royal-Red) by treating the madder ground cloth with a bath of brazilwood. However, an alternative explanation could be that the warp and weft are differently. Often cheaper dyes such as brazilwood were used for the warp while more expensive dyes such as madder were used for the weft.

The Dutch control over the trading routes over the seas and monopolies in some cases led to several maritime encounters in the 17th century between the English and the Dutch. The first war was fought between the Commonwealth of England and the Dutch Republic (1552-54). The second war started after the English restoration of the monarchy (1665-1667). One more followed in that century (1672-74). Several English ensigns in possession of the Rijksmuseum are catalogued as from 17th century. Because none of these flags are ensigns of the Commonwealth of England (flags of the Interregnum 1649-1660) they are less likely to be from after the restoration of 1660, except for the St. George ensign that was used throughout the 17th century.

Some of these flags have had a conservation treatment in the past that is probably causing colour variations. The preliminary study to this flags consisted in looking if the red colorants used in this flags could be affected by previous restorations, because the red coloured strips are sometimes not distinguishable from the white strips.

The red colorant of six of the thirteen, English ensigns were analysed by means of high performance chromatography.

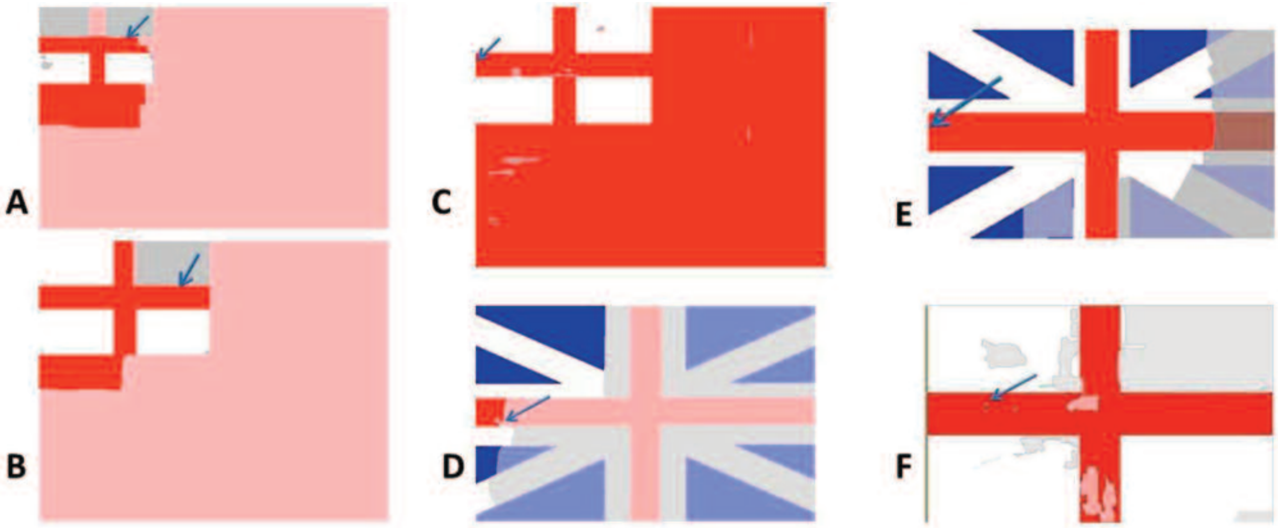

Figure 16 HPLC-PDA chromatogram: Red sample the Fort Cormantine flag 17th Century Anglo-Dutch wars

A Red ensign |Fragment size 220cm × 475cm | Obj.no. NG-MC-1889-83-12
B Red ensign |Fragment size | Obj.no. NG-MC-1889-83-15 (not restored)
C Red ensign |Size 325cm × 395cm | Obj.no. NG-MC-1889-83-13
D Union Flag |Fragment size 400cm × 230cm |Obj.no. NG-MC-1889-83-9
E Union Flag | Fragment size 325cm × 440cm |Obj.no. NG-MC-1889-83-10
F St. George Ensign | size 355cm × 445cm | Obj.no. NG-MC-1889-83-6

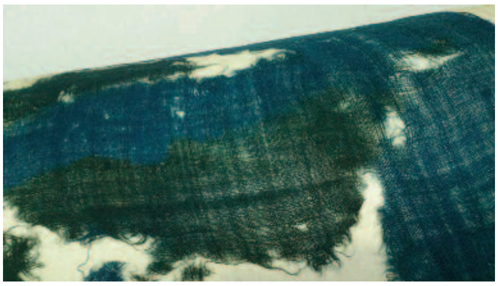

Figure 18 Detail of local colour change in blue fragment (Rijksmuseum collection)

No blue samples were taken but in a few cases it is visually clear that these blues have endured colour changes as well. It is not yet known what causes this change. The analyses identified the uses of madder and brazilwood. The red ensign "A" was dyed exclusively with brazilwood, the flags B, C and D were dyed with a mix of madder and redwood and the flags E and F were dyed only with madder (however with different alizarin and purpurin ratios, this could mean different qualities of madder). It is not certain whether these choices of colorants used had to do with fluctuating market prices during the war, or if these were ordinances of the use of certain dyes in the 17th century English flags, neither has been taken into account yet that woven textiles sometimes possesses a warp and a weft dyed in different ways. What can be said is that some of the flags are dyed with the same sources and have the same hues.

Figure 19 Burning of the English fleet at Chatham by Peter van de Velde, with close-up of the HMS Royal Charles (Rijksmuseum Collection | Obj.no. SK-A-307)

These flags clustered by hue should be further studied. For instance the cloth (a coloured strip is sewn from multiple long cloths) width of flag A (Red ensign) is 26cm and that of flag F (St George ensign) is 30cm. If this flags strips were manufactures from the same loom; they would proximally have the same width. Also weaving technics analysis would give a better inside in the making of this flags.
If one is able to cluster those flags that were manufacture in a similar period and workshop, one could possibly find out more of their origin. If the three flags with mixed dyes Madder-Brazilwood could be proven to be from the same workshop and the same period; flags B, C and D, have the right size to belong to one single ship. The Union flag (ca. 5m x 7m) at the bowsprit pole, the smaller red ensign (ca. 3m x 4m) at the fore top mast and the red ensign (ca. 6m x 7m) at the rear. As depicted by Peter van de Velde of the burning of the English fleet at Chatham (Fig.20). In this painting we can appreciate a sailor hoisting a Dutch flag at the tallest top mast.

17th century flag of Middelburg

A severely damaged 17th century ship flag is sampled in order to analyse the colourants underneath its blackened surface. In the description of the illustrated 1977 Brandhof Rijksmuseum catalogue is 'A woolen yellow over white over red horizontal striped ship flag where the yellow stripe is completely missing.'[xxix] The sampling, as often is done with historical textile objects, is taken from an inconspicuous area, and in the case of flags it could be taken from the seams at the hoist. In this case it appeared that the yellow stripe was mistaken for red.

Figure 20 Detail of damaged Middelburg ship flag (left) well-preserved yellow in the border (right) (Rijksmuseum Collection |NG-MC-1889-83-22)

The city of Middelburg, capital of the Zeeland province, became one of the most important merchant cities and the second largest port of the Dutch Republic. The cities merchants had an active role in the 17th century slave trade to South America goods as sugar and brazilwood was brought back to the Republic.[xxx] The admiralty of Zeeland laid near Middelburg an extensive infrastructure for slipways and dry-docks for the construction and maintenance of large ships. Merchant ships built for the Dutch East Indian Company (VOC) and the Dutch West India Company (WIC) were often armed with guns defend their goods for enemies.[xxxi] These vessels were sometimes

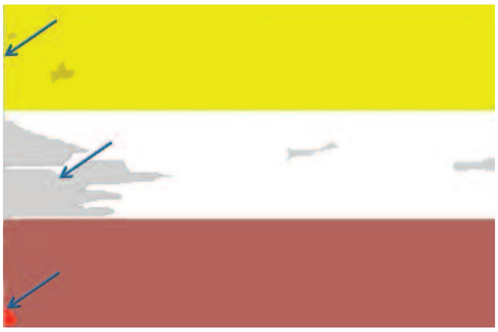

Figure 21 Illustration of the Middelburg ships flag, sample spot indicated with blue arrows (grey areas are missing)

used for defending the Republic at times of War.
Thanks to the Dutch National Archives efforts of VOC and WIC documents digitalization, complete databases of 17th century ships are available.[xxxii] Together with scientific analysis technics made it possible identify the possible origin of this flag. Chromatographic analysis identified the colorant source as weld for the yellow strip, the white strip was analysed as well to be sure that this blackened wool did not have any organic colorants as was the case. The red sample was dyed with the extract of madder. The fact that no brazilwood dye is found in the red stripe could suggest that it was dyed after the loss their colony of New Holland in 1654 when the import of the colorant was severely reduced and the prices of this colorant increased.

Figure 22 Engraving of the Battle of Lowestoft - 1667 (Rijksmuseum Collection Obj. RP-P-OB-77.513)

The flag is the only ship flag of the 17th century in the possession of the Rijksmuseum that did not belong to the Dutch enemies. The size (385 cm × 490 cm) tells us that it did not belong to a small ship. The absence in the white strip of a VOC or WIC cypher, along with the initial of chamber it belonged to, suggest that the ship was not on a merchant mission but was deployed by the Admiralty of Zeeland for another mission. This fact shortens the list of possible ships. When looking in the databases of 17th century Dutch ships, for a ship that had been lost in action only one matched this refined search; the East Indiaman Oranje. Built in 1643 for the Chamber of Zeeland at the Middelburg shipyard, with a carrying capacity of 1200 ton, was one of the largest ships. [xxxiii]

In 1665 the Oranje was hired by the Admiralty of Zeeland under command of Bastiaan Senten and deployed to the battle of Lowestoft on the 13th of June in 1665. When the Dutch flagship the Eendracht was brought to explode by the HMS Royal Charles through firing to the powder magazine, the 500 manned crew was killed along with Lieutenant- Admiral Wassenaer van Obdam. The Dutch fleet decided to withdraw, the Oranje already in flames barred heroically the way for any English pursuers. The Oranje fought, burned and sunk. After this sea battle VOC ships were no longer systematically hired for war purpose.
The Middelburg ship flag could come from this historic event, however proving this scientifically could be a challenge because the blackened surface cannot yet be identified as fire damage.
German Confederation war ensign of the imperial fleet 1848
This 19th century war ensign of the 1848 imperial fleet is part of the collection of the German Historic Museum in Berlin. The flag is in a relative good condition compared to the previously discussed 17th century flags. The main problem with this flag is that the once yellow strip has suffered discoloration as is shown in figure 23.

Figure 23 Imperial fleet ensign (A) Illustration of the Imperial fleet ensign (B) (DHM collection | Cat.no. Mlo06839)

The flag is 84 cm by 109 cm and has a black, red and yellowish strip, with a double-headed eagle in a yellowish canton. The appearance of the yellow strip suggests that it has suffered significant discoloration in the course of the years. Identification of the three colours present in the strips is done by means of HPLC-PDA and SEM-EDX.
In the black sample haematein was detected this proves that the flag was dyed with

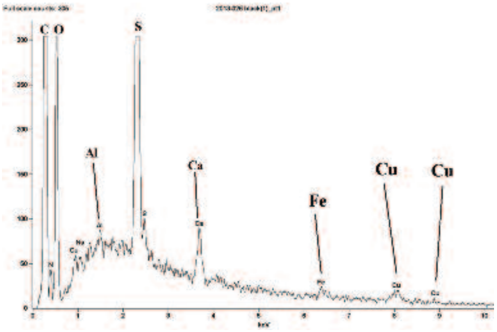

Figure 24 EDX spectrum: Black sample of German confederation imperial fleet ensign

the extract of logwood, obtained from the heartwood of the logwood tree (Haematoxylum campchianum L.), of the pea family (Fabaceae) which is native to Central America and the West Indies. Logwood was used the 17th and 18th century for dyeing blue cheaper textiles. In the 19th century logwood was used frequently for dyeing weighted silk black. In the early 19th century, Chevreul isolated the main colorant haematein from logwood; this logwood-extract was brought onto the marked between 1830 and 1840.[xxxiv - xxxv]

Logwood dyes are dark blue, but when a copper salt is added to the dye reaction a black complex is formed which is light faster than non complexed logwood dye. In the EDX spectrum of the black sample we can see that copper and iron is present in these fibres (fig. 24). Logwood on an iron mordant the light fastness is very good, comparable to blue wool standard 5-6 (Colour Index 1971), No light fastness data on copper mordanted dyed wool with logwood extract was found.

Cardon points out that 'By the 19th century, all members of high society – the middle classes, priests, judges, lawyers and even fashionable tail-coated dandies – were wearing black. In an age when all dyes were still natural and 95% plant based, the dyeing of necessary hundreds of kilometres of black cloth represented an extraordinary technical achievement'.[xxxvi]

The red dye source of the red sample was identified as a mix of two insect dyes. First, carminic acid was found as main component which, along with flavokermesic acid, kermesic acid and typical markers labelled dcII, dcIV and and dcVII, indicates the use of cochineal. Cochineal is obtained from the egg carrying cocooned female beetles of the Dactylopius coccus Costa., which are found on different varieties of cacti, including *Opuntia cochinillifera* Mill. Cochineal was first imported to Europe from the Americas (where it is native) since 1518; it was broadly used until about 1870.[xxxvii]
Next to the cochineal components, laccaic acid B, laccaic acid C, three laccaic acid equivalents and one side component, often present in lac dye at low concentration, were found, which points out to the use of lac dye. Lac dye is a resinous secretion developed by the scale insect *Kerria lacca* Kerr. a native to Bengal, Siam, southern India and the Moluccas. Lac dye was used since the middle ages in Europe as pigment in paintings, miniatures and to dye for silk. However as a wool textile dyestuff it was imported by the British for the first time in 1790 and used until ca. 1870.[xxxviii]
Light fastness research of lac dye and domestic cochineal on wool mordanted both with alum or tin reveals that it has a good to very good light fastness.

The yellow dye source in the discoloured strip is identified as quercitron oak, by the presence of quercetin in higher concentration, quercitrin and kaempferol traces. The quercitron oak is indigenous to the southern and middle part of the United States.[xl]
Extract of quercitron came onto the European marked at the end of the 18th century. The tree was introduced in Germany (Bavaria) at around 1818.[xli] When dyed with quercitron extract, pre-mordanted wool with aluminium salts result in golden-yellow and pre-mordanted with tin in a tawny yellow.[xlii]

Furthermore it can be concluded that the discoloration of the yellow strip is due to the poor light fastness of the quercitron oak,[xliii] but new suspicions of the flag being ironed in the past, the heat might have accelerated the discoloration process of the

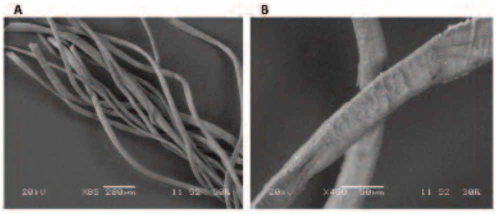

Figure 26 SEM images: A. Yellow sample 85x magnification | B. Black sample 450x magnification

Figure 27 Gonfalon of the city of Milan (Castello Sforzeco |Size 530cm x 370cm |Cat. 27 / Inv. Arazzi I)

Figure 28 Detail image of St Ambrose's chasuble (Castello Sforzeco collection |Size 530cm x 370cm |Cat. 27 / Inv. Arazzi I)

yellow colorant when looking at the SEM images the wool fibres are flattened rather than tubular (see fig. 26 A & B).

The gonfalon of the city of Milan 1565

Gonfalons are known since Italian medieval times. They are hanged from a horizontal bar and often show the coat of arms of allegiances. Later it became common for ecclesiastical processions. Gonfalons have a shared history with flags and ensigns but are of course different. They are symbols of sworn allegiances. However the most important differences are the handcraft and qualities of the textiles. Many flags as seen in this paper are manufactured in general with simple materials and cheaper dyes, something that makes them dynamically attached to subtle local trade changes. A glaring contrast with gonfalons that are luxurious items manufactured with the best materials often from many different places of the world.
Within the scope of the PSL project (Silk Production in Lombardy project[xliv]) several silk textiles are analysed to identify the silk fabrics produced in Lombardy between the 15th to the 20th century. Within the framework of this project research involved, among many other textiles, the 1565 standard of St. Ambrose (the gonfalon of the city of Milan). It was studied in a multidisciplinary level concerning the history of the object, the embroidery techniques and identification of materials used.

The gonfalon of the city of Milan is a silk embroidered and embellished with silver and gold filé threads (see fig. 27). Each side features Saint Ambrose, at his feet sprawl two Aryans he banned from the city, the columns are decorated with four episodes from the life of St Ambrose. The standard has a scalloped bottom border with appliquéd of city crests. St Ambrose is depicted wearing a mitre, a chasuble (in which the vertical beam of the cross is divided into panels framing St Barnabas, St Paul and St Peter, with the Annunciation at the intersection) (see fig. 28), underneath a dalmatic and he is wearing gloves embellished with a small red silk and gold filé tassel.[xlv]
The design for the gonfalon of St. Ambrose was made by Giuseppe Meda and Giuseppe Arcimboldi in 1663, the handwork was done by embroiderers Scipione Delfinone and Camillo Pusterla, the 'gold brocade raised with gold over gold' was provided by the merchant Francesco Favagrossa, whose job was to supply all the silk fabric needed to make the impressive banner. [xlvi -xlvii] - The Standard of the city of Milan is 530cm by 370cm and it is housed at the Sforza Castle in Milan, it is part of the collection of the Museum of Ancient Art.

The gonfalon has undergone numerous interventions and restorations, the earliest dating back to 1576. Analysis of the gold filé silk core from the original bouclé weft and one from a restoration bouclé performed by means of HPLC-PDA revealed the differences in colorants used.
The dyestuff found in the restored gold filé silk core is weld (*Reseda Luteola* L.), a yellow dyeing plant of common use in Europe.
The original gold filé silk core was dyed with the organic colorant known as berberin. The European barberry (*Berberis vulgaris* L.), one source of berberin, never had any

importance as a textile dye source, probably because of its poor light fastness and since other dyes with a better quality were easily available. However the most likely source used is from the Amur cork tree (*Phellodendron amurense* Rupr. Rutaceae). Amour cork is native to, inner Manchuria, the Russian Far East and Japan. Here concentrated berberin extract were available and was used mainly for dyeing dyeing silk. [xlviii - xlix]

The 15th and16th century Milanese silk textiles industry had to import all of the raw material, the silk, the dyes, the mordants and the precious metals. As example, constructing the gold filé thread filled with dyed silk would have been a laborious enterprise and makes these kinds of textiles extremely precious.

Conclusion

Combining scientific analysis with historical sources can lead to new insides in the making and history of these objects. The colorants in historic banner, although cheaper than most precious textile art works, are dynamically interlinked with their period in time. Saying this, madder, weld, indigo and redwood where commonly used in all type of textile objects. The flags are often of anonymous makers unlike gonfalons.

In the case of the Italian gonfalons consciousness of the symbolic values of these objects started already in early times, probably because of their flamboyancy or luxurious elaboration. These objects represent sworn allegiances that are guard to the death and play a symbolic role the daily life of the people of these periods; people like the cloth maker, the spinners and the dyers.

Restoration efforts and experiments in the past to flags, although sincere, have introduced new problems, that affect their current integrity. In the restoration ethics of these flags a place for untreated/unwashed places or spots should be included in their conservations efforts of these textiles to help future scientific research and not wash away the historic evidences of this objects.

Notes

i Abbreviation (from Dutch): Rijksdienst voor het Cultureel Erfgoed

ii Joosten I. and Bommel M.R. van, 2008 pag. 433-466

iii Hacquebord. pag. 250

iv Hacquebord. pag. 250

v Brandhof, M. van den, 1977 pag. 64

vi Boersma F., 1996 pag. 69 – 83

vii Boersma F., 1996 pag. 69 – 83

viii Hofenk de Graaff, J.H., pag. 294

ix Frencken, H.G.Th., pag. 143

x Cardon, D., 2007 pag. 110-111

xi Norwik, W., 1997-98 pag. 129-144

xii Naylor, Robert 1983, pag. 472

xiii Cardon, D., 2007 pag. 189

xiv Brandhof, M. van den, 1977 pag. 76

xv Anderson, R. C., 1883 pag. 81

xvi Koninklijk Marine, 2010 pag. 35

xvii Hofenk de Graaff, J.H., pag. 246-247

xviii Cardon, D., 2007 pag. 368-371

xix Hartl, A., 2011 DHA30

xx Cardon, D., 2007 pag. 368-371

xxi Dyeing experiment RCE (ANPG) May 2013

xxii Brandhof, M. van den, 1977 pag. 76

xxiii Brandhof, M. van den, 1977 pag. 59

xxiv Porter, R, pag. 57-77

xxv Zook, G.F., 1919 pag. 8-29

xxvi Barreveld, D.J. Drs,. 2013 chap. 7

xxvii Cardon, D., 2007 pag. 115

xxviii Cardon, D., 2007 pag. 115

xxix Brandhof, M. van den, 1977 pag. 64

xxx Paeise, R., 2008 pag. 19

xxxi Paeise, R., 2008 pag. 162

xxxii Database VOC Ships 2013

xxxiii Database VOC Ships 2013

xxxiv Hofenk de Graaff, J.H., 2004 pag. 235

xxxv Cardon, D., 2007 pag. 270

xxxvi Cardon D., pag 270

xxxvii Hofenk de Graaff, J.H., pag. 77 and 85

xxxviii Hofenk de Graaff, J.H., pag. 77 and 85

xxxix Padfield, T. and Landi, S, tab. II pag. 185

xl Hofenk de Graaff, J.H. 2004 pag. 189-193

xli Leuchs, J. C. 1829 pag. 468-470

xlii Leuchs, J. C. 1829 pag. 468-470

xliii Padfield tab. II pag. 185

xliv Buss, Ch.,(project leader)2012 pag. 10

xlv Buss, Ch.,2012, pag. 127

xlvi Buss, Ch.,2012, pag. 127 &131

xlvii Buss, Ch.,2012, pag. 61

xlviii Cardon, D., 2007 pag. 187-189

xlix Hofenk de Graaff, J.H., pag. 171-173

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Art Proaño shows the Award for Best Paper of the 25th ICV Congress he was presented with at the closing dinner in the Laurens Kerk.

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