The ‘Triumphal Arch’ by Albrecht Dürer (1471-1528) is one of the most important European achievements in print-making. Designed by Dürer at the height of his career it was printed between 1517 and 1518 out of 195 woodblocks onto 35 sheets of paper to make a giant woodcut measuring nearly 4m x 3m (Fig 1). Predictably, considering the use and storage problems with the enormous and delicate material, not many copies have survived to our times.

Undertaking conservation or display of a work of this size inevitably becomes a major project and contemplating even standard treatment for the print becomes an exercise in resource planning, project planning, risk assessment and documentation. In these circumstances there is no point in ‘re-inventing the wheel’ and consultation with colleagues in a similar situation can have great benefits and save a lot of time.

In recent years conservators working in major European institutions had to address the conservation, display and storage of their copies of the Arch. For conservators in the Statens Museum for Kunst, Copenhagen and the British Museum, London, who have been conserving their prints over the past 18 months, information gathered from these fellow institutions has formed an important part of the decision-making process (Fig 2).

This talk will present an overview of these stimulating discussions about analysis, assessment, treatment, and display and storage options and the key benefits they brought to their respective projects.

A triumph of collaboration
Preserving and exhibiting the ‘Triumphal Arch’ by Albrecht Dürer

Fig 1: The Triumphal Arch by Albrecht Dürer, detail showing Maximilian I. (© Jakob Skou-Hansen)

Fig 2: Co-authors at a meeting 2014, examining the Arch at SMK in Copenhagen (© Jakob Skou-Hansen)
The history of drawing by hand on paper is also a history of copying and duplicating, of cutting out and putting back in. For centuries paper has allowed artists to visualize their compositions in variations, be it to try out aesthetic effects, or to prepare the technical processes of implementation for further techniques, for example prints.

Using concrete examples from the Department of Prints and Drawings at the Wallraf-Richartz-Museum & Fondation Corboud, it is possible to follow the development of the drawing as a concept — concetto — for the idea of a picture from the late sixteenth century until well into the nineteenth. In the process, novel techniques of design, transfer and duplication were introduced which innovatively expanded the traditional idea of artistic practice; from the early seventeenth century Italian design drawings, worked as collages, to the counter-proof, klecksography, tracing and all the way to mono-typing (Figs 1 and 2).

What all these techniques have in common is that they mobilized the artists’ inspiration in new ways. The unique morphology of paper provided the physical preconditions. Thanks to its ‘magic’, the medium of paper, as the sole authentic original, supplied characteristics that digital media today are seeking, retrospectively, to imitate.

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Fig 1: Technical examination of a drawing (© Costa Belibasakis)
Fig 2: Various drawings, cut up, counterproofed, copied, blotted and pasted over (© Thomas Klinke)
The identification of inks in old master drawings is a challenging task. When it comes to decision-making or risk assessment for conservation treatments, storage and display, or when art technological questions get involved, however it is crucial to determine materials more precisely.

For a very long time – and often until today – the classification of inks was limited to visual examination with the naked eye, possibly supported by magnifying glasses. The colour of the ink, brown (iron-gall ink) or black (carbon ink), is an important feature for identification, even though it is a very vague one. Additional characteristics like morphology of deposits, surface lustre, penetration behaviour or indication of iron-gall ink corrosion might support a more reliable visual classification. For further evidence scientific analysis of the elemental composition of inks is necessary. Micro-X-ray fluorescence ($\mu$XRF) has proved to be a very helpful tool, but interpreting the resulting data is not easy since its significance is limited to inorganic compounds. The $\mu$XRF analysis of an early drawing by Albrecht Dürer (Fig 1) almost resulted in the wrong conclusion that both inks, the black and brown ink, were identified as iron gall ink since both contained iron.

The conservator’s visual examination followed by an infrared reflectography (IRR) revealed a significant carbon content in the black ink (Fig 2). Subsequent research in historical treatises confirmed the practice of adding iron sulphate to black carbon inks or mixing carbon and iron-gall inks. As a consequence a combination of visual examination, imaging techniques and complementary analytic methods supplemented by art technological source research is highly recommended to avoid misinterpretations.

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Fig 1: Detail of ‘The Virgin and Child’ by A. Dürer, pen with brown and black ink, heightened with pink watercolour, 1485. XRF analysis revealed iron content in the black and the brown ink (© SMB, G. J. Dietz)

Fig 2: Digital IRR of Fig 1 solely showing the black, carbon-containing ink in Christ’s halo and the Virgin’s hair and preliminary drawing in charcoal in her face. Lines in pure iron-gall ink are not visible (© SMB, C. Schmidt)
212 blue gouaches are a main part of the original baroque interior decoration of the so called ‘Porcelain Room’ (Fig 1). They are carried out in Prussian blue and Permanent white on underlying sketches in graphite on hand-made rag paper. Each gouache is framed and glazed. Within a research project funded by the Austrian Science Fund (FWF) on East Asian interior decorations in Schönbrunn palace, which also includes the implementation of preservation plans in the ‘Porcelain Room’, the drawings were examined and conservation strategies for further permanent exhibition were established.

The drawings had been restored in 1978 because the paper showed severe brownish discoloration due to long term direct contact with the wooden backing of the frames. Discolouration could successfully be removed then by chlorine dioxide bleaching, washing and the introduction of an alkaline reserve. Housing was improved by inlaying acid-free heavyweight paper between originals and wooden backings, direct contact between paper object and glazing remained. When the sheets were examined in 2013, patterns of discoloration were the same as in 1978 (Fig 2). The inlayed papers showed no discolouration.

All materials examined were within a pH range from neutral to alkaline, and no chlorine residues could be detected. Several treatment options were tested and discussed. Priority was given to the removal of discolouration compounds. So far, the absence of Chlorine and sound mechanical properties of the papers led to a conservation strategy which concentrated on the optimization of mounting and re-housing. Precise documentation, digitalization, and long term photometric monitoring of selected objects were further focal areas of the conservation campaign.

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Fig 1: Part of west wall of the porcelain room during remounting (© SKB, photo: Hess)
Fig 2: Drawing MD056776 before conservation (© Bundesmobilienvwaltung, Schloss Schönbrunn, photo: Hess)
This study focuses on art technological aspects of eight cartoons from the collection of the Kupferstichkabinett of the Academy of Fine Arts, Vienna. The cartoons were created in 1871/72 by Eduard Bitterlich as templates for ceiling paintings in the reception hall of the Palais Epstein, one of the most prominent palais of Vienna’s Ringstraße. The cartoons are executed in charcoal and black chalk on machine made paper.

They were studied and compared with regard to their material composition, drawing technique, traces of usage and other technological features. Special attention was given to the fixation methods applied on the drawings which were carried out with various materials and different application techniques (Figs 1 and 2). Traces of fixatives were found on some drawings, but analytical methods provided conclusive results only in few cases.

In order to better understand practices of fixation, historic recipes from 19th and early 20th century written sources were collected and reconstructed, comparing their applicability, the effectiveness of fixatives and their ageing characteristics. Testing fixative materials and application methods on test papers helped to understand phenomena observed on the originals.

**Fig 1:** One of the cartoons by E. Bitterlich under UV-light, showing the applied fixative as fluorescing area (© Juliane Hofer)

**Fig 2:** Traces of the application by brush on one of the cartoons by E. Bitterlich (© Juliane Hofer)
Our knowledge on fixatives applied onto drawings is very limited since their identification requires specialized analytical equipment. A case-study of two pencil drawings by Thomas Fearnley gave us the unique possibility to study fixatives used by 19th century artists.

Thomas Fearnley (1802-1842) was a Norwegian romantic painter and gifted draughtsman. His short artistic life included several long journeys through Europe. Pencil, easily available to artists since the early 19th century, was convenient for drawing and sketching outdoors. Fearnley utilized this opportunity. The National Museum of Art, Architecture and Design in Oslo possesses about 750 of Fearnley’s drawings.

Today, many of Fearnley’s drawings are badly disfigured by a fixative. Areas where the fixative was applied are either severely discoloured, or on the contrary, locally protected (Fig 1). This discrepancy suggested the use of different fixatives. Attempts in the 1990s to remove the fixative(s) were unsuccessful. Identification of the applied fixative(s) would allow a sound conservation strategy to be developed.

While the two drawings appeared different in daylight, areas with fixative fluoresced similar in UV, 365 nm (Fig 2). Micro-chemical spot testing excluded starch. Gas chromatography – mass spectrometry (GC-MS), determined amino acids, galactose and glucose. No hydroxyproline was present, ruling out animal glue and, by absence of arabinose and rhamnose, Gum Arabic as well.

While phosphoric acid and calcium (XRF) suggested the use of milk, neither the ratio of galactose and glucose, nor the amino acids matched lactose and casein.

Tests with cow milk on reference papers showed that analysis of surface samples was misleading since part of the milk penetrates into the paper substrate and remains there. What is left on the surface perfectly matched the results of the GC-MS analysis of both Fearnley drawings. Why one paper was protected and the other not, is not yet established.

This was probably the first time that milk was identified as fixative on pencil drawings. This result was in agreement with various early 19th century sources, which advised the artists to use skimmed milk for this purpose. Easily available everywhere, milk was the choice of Thomas Fearnley himself when traveling and in need to protect his pencil drawings. The fixative is therefore an integral part of the artwork. Future research might reveal whether other artists applied this technique as well.
Although best known for his oil paintings, 19th-century artist John Constable also created an extensive catalog of drawings from nature. Of these, a large number were fixed by the artist (Fig 1). What is exceptional is the unique appearance of the fixative – a clear, non-uniform coating with an iridescent sparkle. Variations in its concentration suggest a pooling of liquid fix over the drawing surface with sharply defined areas where fixative is absent. Attempts to identify the fixative by ATR-IR, commonly used for surface coating analysis, were inconclusive but did indicate the presence of a proteinaceous material. As a result, this study presents a method of protein identification that is relatively new to conservation – peptide mass fingerprinting (PMF).

PMF uses enzymatic digestion to cleave proteins at specific amino acid sites, producing a mixture of peptides. Since protein sequences are unique, the mixture of peptides is unique and can be used as the basis of identification. The peptide mixture is analysed by MALDI-TOF-MS, resulting in a spectrum of characteristic marker ions – a 'peptide mass fingerprint.' Markers are compared with those from reference materials for identification of the protein source.

Samples consisting of small surface fibers from four Constable drawings were analysed and compared with PMFs from reference materials. Constable’s fixative was identified as fish-based, and other sources, such as gelatin, casein and ovalbumin, were conclusively ruled out (Fig 2). Correlating a specific protein with the visual characteristics of a surface coating leads to a more sympathetic and informed conservation treatment. The effort Constable made to finish and preserve his drawings is indicative of the value he placed on them.

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Fig 1: John Constable ‘Coleorton Hall, 1823,’ graphite drawing on wove paper (private collection) © 2015 John Slavin

Fig 2: PMF from fixative on a John Constable drawing indicating fish-based protein © 2015 Daniel P. Kirby
Friable media or weakened paper are stabilised using dilute adhesive solutions, treatments that are known as paint consolidation or paper resizing. The adhesive penetration behaviour is crucial to optimize the stabilisation effect and avoid colour changes or tidelines.

The penetration behaviour of gelatine and methylcellulose was studied with a fluorescence labelling method using fluorescent dyes (Texas Red® and Texas Red® C2-dichlorotriazine). It allowed visualization of the distribution of low-concentrated adhesives (0.5–1% w/v) required for aerosol application. The labelled adhesives were applied on specially prepared pigment-on-paper samples (Fig 1) and separate paper samples.

Fluorescence microscopy of sample thin sections revealed that the application technique has a significant influence on the distribution of dilute adhesives in porous paint and paper substrates. Intermediate drying between multiple aerosol applications diminished the penetration of a 1% w/v gelatine solution (Fig 2). The porosity of the substrate plays a vital role: aerosol-misted gelatine (0.5% w/v) penetrated surface-sized papers only to a small extent and was mainly distributed on the paper surface; it penetrated unsized papers in their entire thickness. In resizing paper, immersion offered less control over the degree of penetration of the adhesive than aerosol application: paper immersed in gelatine or methylcellulose (0.5% w/v), was invariably fully penetrated by the adhesives; at the same time, part of the adhesives were preferentially adsorbed on the paper surface.

The study describes key parameters that determine the adhesive distribution in powdery paint and paper. This simplifies the development of treatment protocols for aerosol application techniques and adapting the method to the particular requirements of individual treatment contexts.

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The project presents the decision-making process for preserving twenty large-format collages by Thomas Hirschhorn that are part of an artist room ‘Intensif-Station’ which is on permanent display at the Kunstsammlung Nordrhein-Westfalen. The collages feature cut-out magazine illustrations and digital print-outs from online sources, some of them photocopied for enlargement. All are adhered onto white paper. The collage images are surrounded by writing and drawing in red felt tip- and ballpoint pens (Fig 1).

The collages are wrapped entirely in florist plastic foil, which is secured on the reverse with brown self-adhesive packing tape. According to the artist’s stipulation, the works have been permanently exhibited under daylight fluorescent bulbs, six days a week (light levels ca. 100-850 lux) since 2010. The red media has faded significantly.

The project explored different conservation options, taking into account the opinions of the artist, curators and conservators, and the approach of other collections in dealing with the artist’s comparable works. The preservation solution reflects a compromise of the decision-making parties.

The artist selectively reworked the collages in his Paris studio. Prior to that, several red pens had been tested for their light fastness. The artist agreed to use one of the felt-tip pens that yielded good test results for reworking the faded collage parts (Fig 2). The works were documented in-house in advance; high-end digitization of the artist-reworked collages for documentation were carried out.

The artist’s assistant will assist the conservators in reinserting the collages in an appropriate foil package and reinstalling them at the Kunstsammlung.

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Fig 1: Detail before the revision (© Marlen Börngen)
Fig 2: Detail after the revision (© Marlen Börngen)
The Rijksmuseum (Amsterdam) houses an important collection of framed pastels from the 17th century to the 20th century.

In 2007 a conservation project was initiated in order to treat the 18th century pastels that would be exhibited after the museum’s renovation. Nine pastels by Johann Friederich Tischbein (1750-1812) and thirteen pastels by Jean-Etienne Liotard (1702-1789) were treated between 2007 and 2014.

A systematic methodology based on a thorough documentation was implemented. The old treatment reports from the Rijksmuseum painting studio provided us with an insight of former condition and conservation methods applied to pastels. Infrared reflectography and ultraviolet photography were used for the first time on these objects and attempts were made to identify the presence of fixatives on Liotard’s pastels. This initial work contributed to the conservation phase. This lecture focuses on the two most challenging conservation issues of this project:

Cleaning of the fragile powdery surface: Most of the frames were not properly sealed. This induced dust accumulation at the medium’s surface, and a former mould outbreak had left fluffy mycelia spots at the surface of most pastels.

Partial restretching of several vellum supports: Because the iron nails holding vellum onto the strainer were corroded, the pastels became partially loose. Tensions in the supports were unbalanced causing severe cockling (Fig 1).

New specific tools and techniques were developed and applied in the conservation of the objects (Fig 2). The treatments gave very satisfactory results with an improvement of the pastels’ planar condition and readability.

Fig 1: ‘Lady Tyrell’, Jean-Etienne Liotard, ca 1738, pastel on parchment, before and after cleaning and restretching. Raking light, SK-A-236 (© Rijksmuseum Amsterdam)

Fig 2: Suction tool for surface cleaning: Pasteur pipettes used to remove dust particles and mould mycelia from the medium. A few hairs are attached at the pipettes’ end (© Rijksmuseum Amsterdam)
When goats that glitter are not always good
An observation on the effects of Chloramine T on a watercolour

A framed water colour arrived at Amgueddfa Cymru – National Museum Wales as part of a bequest in 2010 depicting a young girl with goats. Curators supposed that the glitter was the artist’s intent, but it looked too clean and bright. It had been obviously treated, possibly bleached, and across the surface, particularly on the white goats, was a light dusting of transparent material giving the appearance of glitter (Figs 1 and 2).

The author set out to prove what the glittery material was and that it was not intentional. After consultation with colleagues a suggestion was made that it could have been caused by the use of Chloramine T. Analysis of the glittery material was carried out using FTIR and was confirmed as Para Toluene Sulphonamide – produced due to poor washing after the use of Chloramine T.

Chloramine T is not now widely used or taught in the field of paper conservation but can still be purchased on the internet for the use of cleaning paper. This paper presents a review of the history of Chloramine T in paper conservation and aims to highlight the phenomena of the glittering not as artist’s intent but as a conservator’s intervention. Previous research in this phenomena focused on the powdery material (not glittery) being a potential bio hazard. The difference in appearance could indicate how Chloramine T was used or misused. Although a treatment of the past it may still be in use, so future generations of conservators and curators should be made aware of the facts and be able to recognise it.

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590 demonstration banners originating from the big demonstration on 4th November 1989 at Berlin Alexanderplatz might range among the most significant objects representing contemporary history in the collections of the Stiftung Deutsches Historisches Museum, Berlin.

Intended for ephemeral use only, they were made of everyday material such as paper, cardboard, wallpaper, cloth, wooden boards and slats or broom sticks, fastened with ropes, sticky adhesive tapes, staples, nails or wire etc. Especially all non-paper elements bear increased risk of causing local pressure, tears or scratches on neighboured objects.

Strong traces of use occur on most of them. They are warped, worn, torn and generally often unstable. The uncomplicated ones without sticks, nails etc. lie flat in drawers, while for ca. 140 banners of large size or with ‘special needs’ an appropriate storage concept was to be developed (Fig 1).

The solution in 2014 was to store the banners standing upside down. An appropriate powdercoated steel shelf with open vertical compartments was purchased.

Because of the limited space available in the storage room, individual housing, preventing any further mechanical damage and giving protection against light and dust, had to be designed without large increase of volume and at minimum effort and cost (Fig 2).

Accurately fitting envelopes made of 180 x 245 cm corrugated museumboard in combination with archival paper, both in a dirt-preventing blue-grey colour, were preferred to Tyvek-envelopes to ensure more stability and physical protection. Magnetic locks were preferred to hook-and-loop fasteners for less pull on the material.

The enclosures were designed for easy use, i. e. easy opening and closing. Their light weight and plain surface allow easy sliding in and out of the shelf to facilitate handling by museum staff.

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C. Göppinger

1989 Berlin demonstration banners
A storage concept

Fig 1: Banners on Trolleys (© DHM, Göppinger)
Fig 2: New Storage Situation (© DHM, Göppinger)
In 1804 the scenic painter Alois Gleichenberger created a wallpaper that covered the walls of a historic ballroom in Graz (Austria). The painting was not carried out on plaster, as it had been on the ceiling, but on paper.

The wallpaper depicts architectural porticos and views of Mediterranean landscapes (Fig 1). This is certainly a very unusual occurrence and, to my knowledge, unique in Central Europe. The scenic painter Gleichenberger seemed to be more familiar with this media. The loose, relaxed painting technique of the artist is noteworthy.

It is a rare stroke of luck that the mounted wallpaper has been preserved for over 200 years. It is certainly worth taking a closer look at the techniques used. In describing the conservation the author would like to focus on the following aspects:

Methods of partial surface facing (according to the results of the MA thesis of K. Wildman) in practice, surface cleaning of soot that has heavily polluted the animal glue based colour and the remounting of the wallpaper.

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Fig 1: Total view of the west wall after conservation (© Krön)
June 18th 2015 is the 200th anniversary of the Battle of Waterloo, a decisive moment in European history. Wall paintings by the British Royal Academician, Daniel Maclise, were commissioned in 1858 for the newly built Palace of Westminster, London home of Parliament. The subject shows the commanders of the British and the Prussian allied armies meeting after the battle. Rare, full-scale drawings survive and were purchased from the artist by the Royal Academy of Arts. Because of their huge format and fragility they are kept in permanent off-site storage and have not been seen since 1972. In 2012-13, conservators and art historians began to study the drawings. Their appearance and condition gave cause for concern, even before a decision was made to exhibit the cartoons in 2015.

The author was responsible for devising a treatment campaign, to be carried out over a two-week period in August 2014, based in the Royal Academy Schools where Maclise himself was a student. This paper will present an account of the preparation for the project, relevant experience, research and planning, collaboration with curators, management of a team of conservators and art handlers, the treatment itself and the outcome. The cartoons were cleaned, stabilised, repaired and their appearance improved, while knowledge of the artist’s working methods and the technical history of the drawings emerged (Figs 1 and 2). The lecture will focus on the challenges of working on a virtually unknown object, huge and hard to handle, within a very limited timescale. Reconciling the requirement for careful conservation work with the constraints of time and place, as well as the unexpected interest from news media and historians, called for rigorous and swift decision making.

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Since the early 18th century, the French Compagnie des Indes introduced exquisite Chinese wallpapers to the French court. However, despite of being objects of remarkable quality and high value, only few original sources on their arrival in Europe exist, and moreover, no further research on their techniques of fabrication has been done.

Hence, our multi-institutional research project – based on the expertise of the Centre de Recherche et de Restauration des Musées de France (C2RMF), the Musée des Arts Décoratifs, as well as on the École du Louvre – tries to decode the original manufacturing practices of the notable, high-quality Chinese wallpapers.

Primarily wanting to avoid destructive measurement methods, the 3D digital microscopy (HIROX KH 8700) was used to detect the different layers of colour, their thickness ($\approx 10-20\,\mu m$), and the white shining ground layer ($\approx 100\,\mu m$) applied to isolate the paper and render it more solid (Figs 1 and 2). In addition, it can help to determine whether the colour has been applied mechanically or by hand.

The advantages of this technique are in particular its high precision and its rapidness. Nonetheless, it has to be taken into consideration that papers of large format are not suited perfectly to this technique. The best results, therefore, have been delivered by Chinese paper fragments of small or medium format.

Summing up, we ascertained technologically that the Arts Décoratifs’ Chinese wallpapers of the 18th century consist of three distinct components: (1) the paper base with a film of alum and glue, (2) the stabilizing and shining ground layer and (3) the colour coat.

Fig 1: The 3D microscopy on Chinese wallpaper using the HIROX KH 8700 technology (© Julia Bischoff, 2015)

Fig 2: Surface structure of the Chinese wallpaper showing 5 layers: the paper support with a transparent coating, the white ground layer, and two green paint layers (© Dominique Robcis, C2RMF Paris, 2015)
The cut-outs of Henri Matisse (1869-1954), created during the last decade of his life, are highly appreciated in art history, whereas little was known about the history, manufacture, condition and long term stability of these works. Therefore between 2009 and 2012 comprehensive research was done in an interdisciplinary conservation project at the Fondation Beyeler, Riehen/Basel (Switzerland).

Central was one of the largest cut-outs ‘Acanthes’ from 1953 (311 x 349 cm). Like many other cut-outs it consists of several layers of gouache painted and cut-out papers, which are glued onto a canvas and mounted on a stretcher. Extensive art technological research lead to a better understanding of the complex manufacture and structure of ‘Acanthes’ and the other paper cut-outs by connecting the fields of paper and paintings conservation, art history and science (Fig 1). Nearly one third of all cut-outs in collections worldwide were examined on site. To let the museum visitors participate at the conservators work, an exhibition gallery within the museum was rebuilt into a temporary conservation studio.

For the first time characteristics of the working methods and processes of Matisse were understood and reconstructed in detail and distinguished from later damages. For the long term stability more attention is given to the light sensitivity of paper and gouache as the colour balance is essential for the Matisse cut-outs. The combination of paper, canvas and glue is secondary.

Finally only small conservation treatments on ‘Acanthes’ were undertaken (Fig 2). A new frame and glazing were applied to meet both aesthetic and conservation requirements.

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Fig 1: Examining ‘Acanthes’ in raking light in the conservation studio (© Mark Niedermann)

Fig 2: The conservators Stephan Lohrengel and Markus Gross working on the edges of the cut-out (© Andri Pol)

Conserving ‘Acanthes’
A large-sized paper cut-out by Henri Matisse