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The Egmont-Master-Phenomenon - X-Ray Fluorescence Spectrometric and paper studies for Art History Research

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The Egmont-Master-Phenomenon - X-Ray Fluorescence Spectrometric and paper studies for Art History Research

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- Reference materials

Abstract
The aim of the research project “Typology of Dutch drawing” was to establish an interdisciplinary approach for investigation of heterogeneous drawing collections. To define a type common to a group of drawings we determine uniting elements based on style and use of identical materials. To that aim we investigated about 750 Dutch drawings of the 16th century at the Dresden Kupferstich-Kabinett using art historical and scientific methods. In this work we present a detailed analysis of 30 drawings ascribed to Egmont Master.

Introduction

In this paper we demonstrate a new interdisciplinary approach for the art historical research. The central idea of the project was less to answer specific questions of individual objects, but rather to form groups based on ink and paper analysis and compare these with groups based on art history research (see **fig.1**).[1]

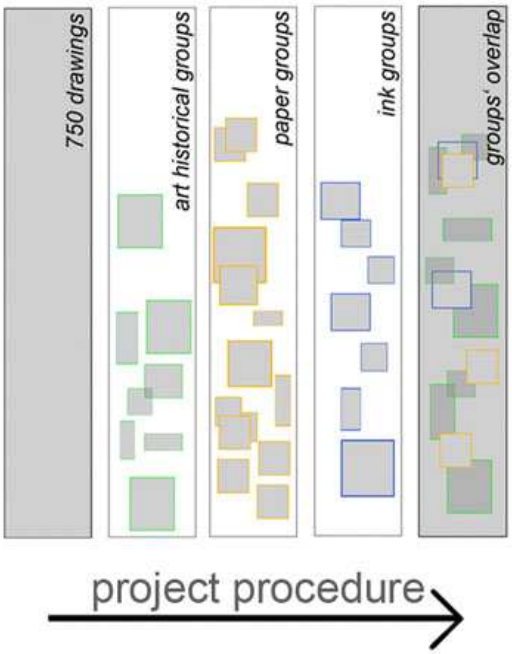

figure 1

Schematic project procedure of "Typology of Dutch drawing"

Choosing defining elements such as time, ink and paper composition as presented in the fig.1, we analysed a selection of the drawings attributed to the Egmont-Master. The name Egmont-Master or rather Master of the Egmont Albums' appeared in 1958 by in the art-historical discussion, after Philip Pouncey (1910-1990) had discovered four characteristic similarly executed pen drawings in a collectors book that belonged to the Earl of Egmont, John Percival (1683-1748). Hereafter, further drawings ascribed to this master appeared in other museums and in the art trade business. It is noteworthy that nothing but drawings could be ascribed to this master until now. Our results indicate clearly that one person could not have produced the whole collection.

Experimental

Art historical investigation

Before our scientific investigation, there was a art historical analysis of all Egmont-Master drawings. Subsequently, several style groups formed together with the associated scientific issues.

Paper investigation

In art historical research of drawings, etchings and other art on paper, analysis of the paper structure plays an important role. In the last century in paper analysis, special attention is paid to watermarks, which are the imprint of figures made from metal on the mould or sieve that was used during the paper production process. It helps answering questions concern-

ing their dating, authenticity, series- or work relationships, four-side-trims, localizations, extensions or restorations etc.[2] At latest since the 1860s paper dating is done by visual inspection of the watermarks contained in the papers. Watermark-based dating is based on the “degree of kinship”. Watermarks can correlate to another as “identical” (i.e., congruent), ‚similar’ (shows the same wire figure but there are some damages or movements) or only by ‚the same type of motifs’. We can take over the dating from one document to another document, drawing etc. with a certain time tolerance if we detect identical and – with some limitations – also similar watermarks. The time tolerance is due to the period of usage of the mould used for the paper production. The lifetime of a mould (used pair wise) was limited at about 800 reams, or about 400,000 sheets of paper operating capacity on average. A normal (and all the year working) paper mill requires two mould pairs every year (in the 16th century). As for common qualities and formats we are assuming in our days that these papers were consumed at that time in one to four years after their production.[3]
After any renewal of moulds and their watermarks there was a small, but very noticeable changes in the dimensions of the watermarks from their predecessors and successors and in different distances of the chain lines especially.[3]
The possibilities of localization by watermarks are limited. The quality of a paper plays a decisive role. Costs for transport and duties could much more easily include in prices for higher-priced papers than in inexpensive and simple quality papers. Only this, for example, could explain the extensive dissemination of Italian papers in the Frankfurt and Nuremberg area, or the wide geographical spread of Basel papers down the Rhine into the ‚Low Countries’. On the other hand, there is some evidence that a majority of simple quality papers has been consumed in the surroundings of a certain paper mill. Also, it can be assumed that an artist on his travels purchased and used locally available paper.

Watermark imaging

The popular request of a computer-based watermark comparison of x-ray images was not technically feasible, even in 2010.[4] From the 1940s till the mid 1980s different x-ray imaging methods, like electron-radiography, beta radiography and soft-x-ray methods, were employed to make the paper structure visible.[5] A drawback is that rather expensive x-ray devices are needed. For that very reason, the generation of x-ray imagery is limited for financial reasons. Apart from this, film- and film-less x-ray-imaging methods are in general limited to smaller formats, which is no problem for smaller prints, but drawings from the renaissance or baroque would not fit. A more simple solution in order to make the paper structure visible is the use of backlight techniques. The backlight imaging method is so easy to use that researchers can create an image almost real-time. It is portable, can be easily deployed in locations around the globe and has in contrast to x-ray imagery no problem with such large formats up to A0. If you compare X-ray to backlight imaging, x-ray clearly outperforms backlight. Nevertheless, the contrast of backlight imaging shows to be about 80% of the x-ray contrast, which is an amount of contrast that would be enough for certain applications. On the other hand, backlight is a promising technique for the reason of its simplicity.[6]
To create an image of the paper structures of an art object we use backlight foils to produce a monotonic light. The paper placed on such a backlight foil is imaged with a digital camera. The image shows the paper structure and the drawing. Then we make a picture of the drawing without the backlight foil. By ‘subtracting’ one images from another and by application of image enhancement techniques we obtain a new picture that shows mainly paper structure and watermarks (**fig.2**).[6]

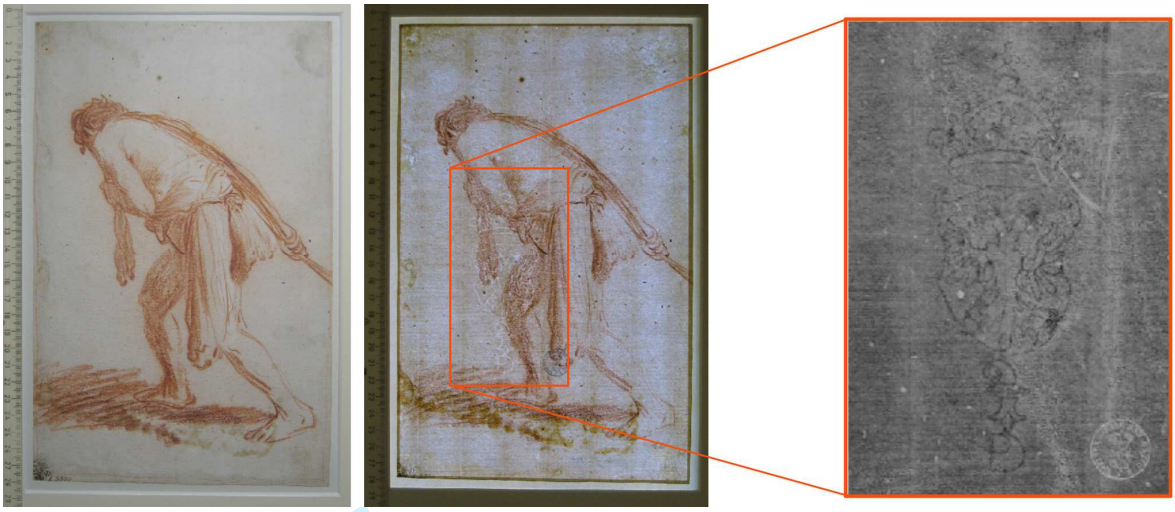

figure 2

Workflow of image subtraction methode (left: reflected light image, center: transmitted light image, right: part with watermark after a image subtraction)

X-ray fluorescence analysis

In this work we analyzed the materials that constitue the drawing, e.g. inks, paper and pigments. No classifying elements could be detected in the group of chalk drawings. Similarly, inorganic contamination of the paper could not be used for grouping since paper were dressed individually prior to the execution of drawings.

Iron gall inks however, allow classification according to their relative ink composition. Analysis of the drawing C1971-13 „Jahwe gives Moses the Tablets of the Law“ illustrates our method.

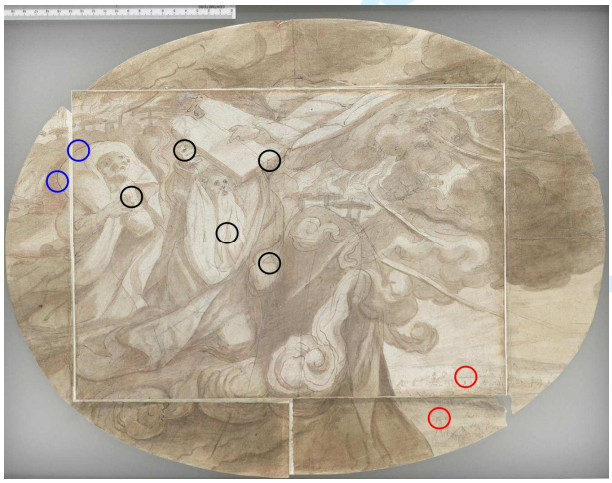

figure 3

“Jahwe gives Moses the Tablets of the Law”, Kupferstichkabinett, SKD, Signature: C1971-13; coloured circles indicate different measuring points.

The original scene executed in black ink and red chalk had a rectangular format. It was transformed into a horizontally oval one by addition of four pieces, (**fig.3**). The analysis revealed three different types to iron gall ink characterized by the degree of Zn and Mn contamination (**fig.4**). Hence, we conclude: the central drawing was executed in one ink type whereas the supplements were performed with other inks. At the borders the original ink was traced the later one’s to produce an optical unity.

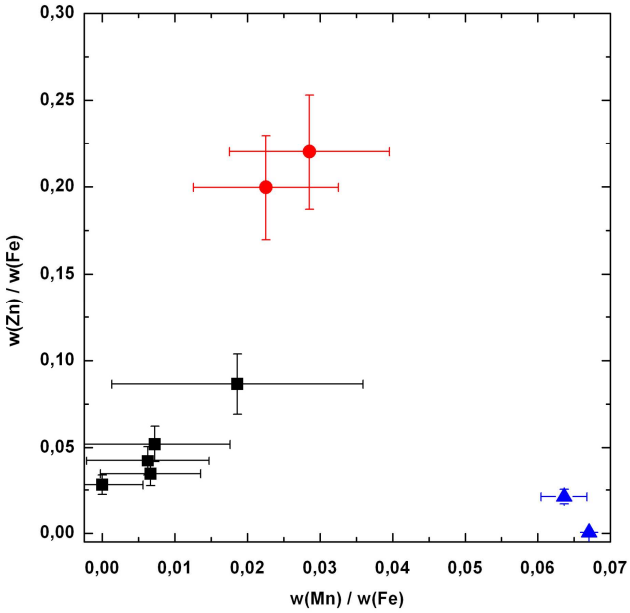

figure 4

Fingerprint values w(i) / w(Fe) obtained by XRF analyses: black squares correspond to the ink of the original drawing; blue triangles and red circles correspond to the inks from the supplements.

The analyses were carried out with the mobile energy dispersive micro-X-ray spectrometer ArtTAX® (Bruker Nano GmbH, formerly Röntec-GmbH, Berlin, Germany), which consists of an air-cooled low-power molybdenium tube, polycapillary X-ray optics (measuring spot size 100 µm diameter) [7], an electrothermally cooled Xflash detector, and a CCD camera for sample positioning. Furthermore, additional open helium purging in the excitation and detection paths enables the determination of light elements (11 < Z < 20) without vacuum. The silicon drift detector with high speed, low-noise electronics permits an energy resolution of 160 eV for Mn K_a radiation at a count rate of 10 kcps. It has an active area of 30 mm^2 and an 8 µm-thick Dura-beryllium window. The geometry between primary beam, sample, and detector is fixed at 0°/40° relative to the perpendicular of the sample surface. All measurements were conducted with a 30 W low-power Mo tube, excitation parameter were 45 kV and 600 µA. To minimize the risk of damage, every single measurement was performed with an acquisition time of 12 s (live time). For better statistics, at least ten single measurements were averaged for one data point, with 3σ representing the uncertainty (see Fig. 4). The detection limits for the elements measured in this work lie in the ppm range. Data evaluation was performed with finger print model that takes paper composition into account. It is important to note that we do not normalize the quantification results. Therefore the absolute values from the quantification are very sensitive to the spectrometer calibration and have large error bars. The ratios of the calculated mass fractions, however, are more robust and have lower uncertainties [8].

Results

Results of Art historical analysis

After the art historical analysis of all known Egmont-Master drawings, these drawings can

be divided into three subgroups:

Pen drawings
Previously, at least 18 pen drawings were attributed to the Egmont-Master. The Dresden Kupferstich-Kabinett expanded this group by additional 11 drawings (e.g. **fig.5**).

figure 5

Scene with ancient gods; (DE-KKDD-C1967-210)
Example of a 'pen drawing' ascribed recently to the Egmont Master.

Chalk drawings
Karel Boon was the first one to attribute two black chalk drawings to the Egmont-Master in the 1960s.[9] Meanwhile there are already eleven chalk drawings allegedly from his hand, two of them in red chalk. Most of these drawings belong to a ‚Life of Jesus'-series (e.g. **fig.6**).

figure 6

Adoration of the Shepherds; (DE-KKDD-C7064)
Example of a 'chalk drawing' ascribed recently to the Egmont Master.

Washed pen drawings

One of the first four known Egmont-Master drawings introduced by Pouncey in 1958 belonged to this type. In 1968, Konrad Oberhuber attributed another three washed pen drawings from the Dresden Kupferstich-Kabinett to the Egmont-Master (e.g. **fig.7**). Also this group has grown and includes further drawings from the Louvre-collections.

figure 7

The Mannah rain; (DE-KKDD-C1974-428)
Example of a washed pen drawing ascribed recently to the Egmont Master.

Results of paper analysis

Watermark analysis of the pen drawings

Even the collection of the attributed Egmont-Master pen drawings from Dresden has to be thematically and stylistically divided into several subgroups. Graphic design, formats, and watermarks of some of these drawings are broadly similar. Others show a difference or previously unknown watermark.

Three drawings from Dresden contain an identical watermark: a *post horn on a coat of arms above the letters NH*. Similar watermarks allow dating the paper to the mid-1590s (1594 / 95 + / - 2 years). Three further pen drawings from Dresden and Cologne display other watermarks that suggest, however, a paper usage in the same period (e.g. **fig.8**).

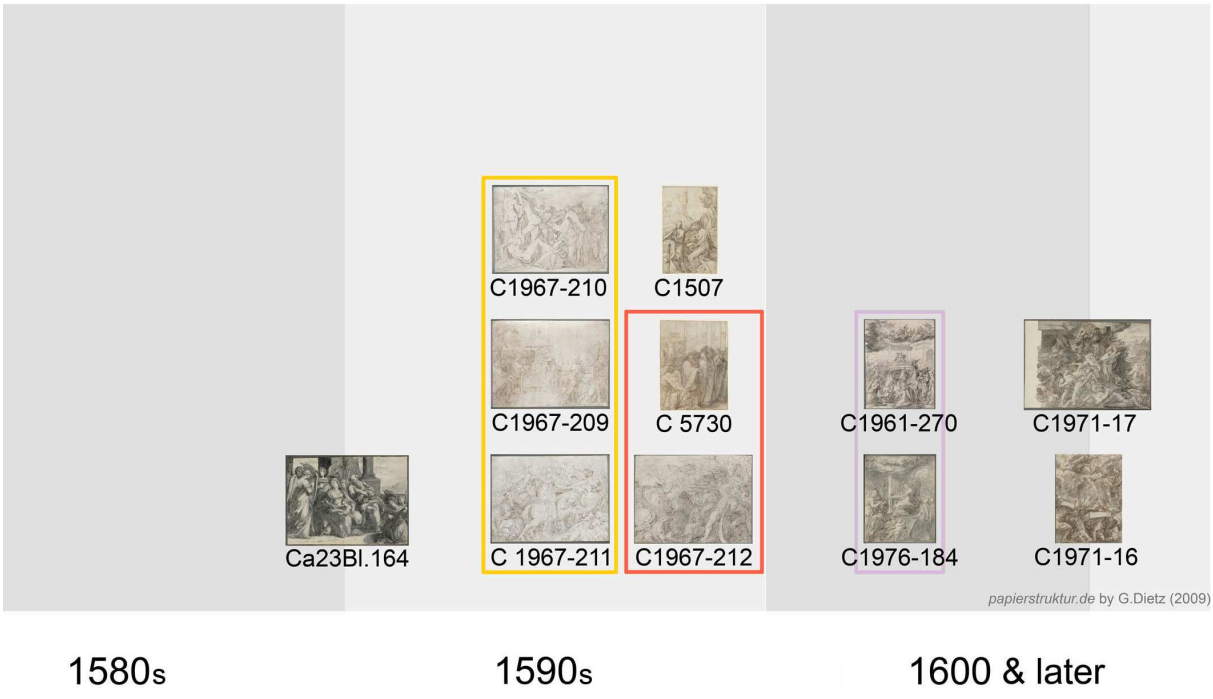

figure 8

Dating of the pen drawings from Dresden Kupferstich-Kabinett attributed to the Egmont-Master, based on the evaluations of the watermarks. The yellow border corresponds to the watermark "*post horn on a coat of arms above the letters NH*" (1594 +/-2 years) like the red framed drawings, although they show a different watermark. The violet borders outline paper whose watermarks indicate a usage in the 1600s and later, respectively.

watermark analysis of the chalk drawings

The entire group of chalk drawings of the Dresden Kupferstich-Kabinett does not display similar or identical watermarks. One drawing, though, could be tentatively connected with an Egmont-Master drawing in Berlin. We believe that at least the paper of two chalk drawings from Dresden was manufactured in the 1580s (**fig.9**). The "uniformity of the chalk drawings" postulated by various art historians – for instance Pouncey and Hans Mielke cited by van der Sman [10] – is not visible in the paper of the investigated drawings. In other words: we find no indications for the chalk group context assumed by the art historians. It differs completely from other artists whose similar thematic groups are commonly characterized by a limited number of different papers and watermarks.

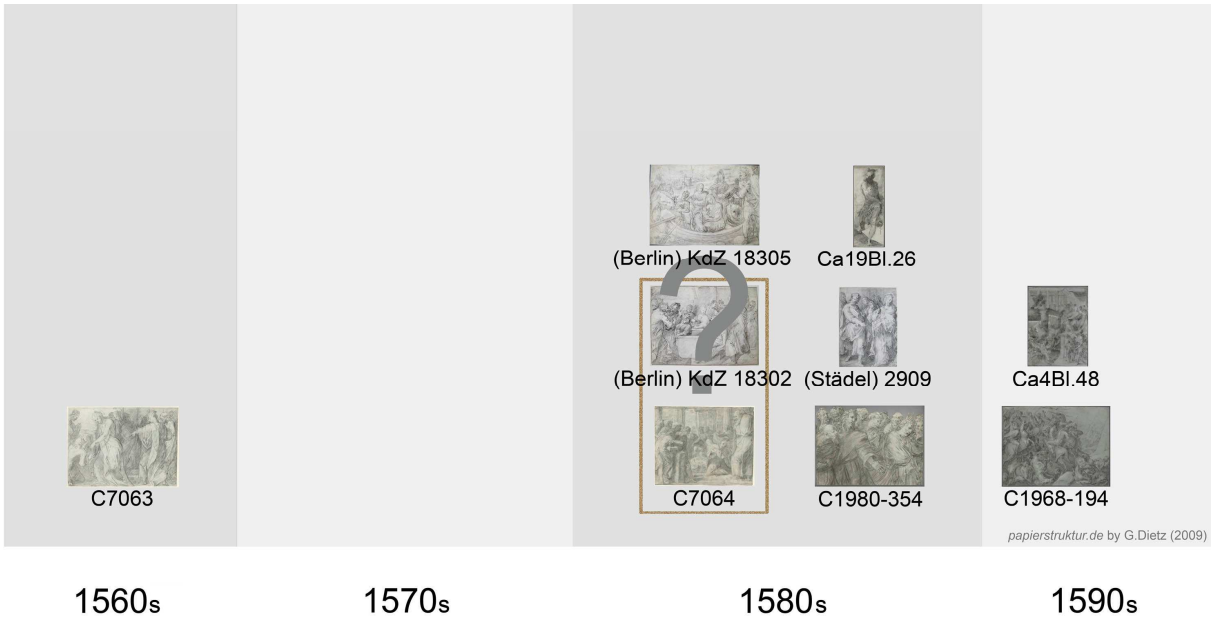

figure 9

Dating of the chalk drawings from Dresden Kupferstich-Kabinett attributed to the Egmont-Master, proposed on the basis of the watermark analysis. The drawings C7064 and DE-KDZ-18302 presumably have identical watermarks. Here the watermark evaluation of DE-KdZ-18302 is based on the results obtained from the illumination with raking light. The final assignment can be made only after re-assembling and a proper inspection of the drawing.

watermark analysis of washed ink drawings

On the basis of the watermark analysis washed ink drawings from the Dresden Kupferstich-Kabinett can be divided in two subgroups according to the paper usage: 1560s and late 1580s – late 1590s, respectively (**fig.10**). Such an assignment raised an interesting problem associated with a time gap 1570 and the end of the 1580s.

figure 10

Dating of the chalk drawings from Dresden Kupferstich-Kabinett attributed to the Egmont-Master, proposed on the basis of the watermark analysis. The green and the blue borders outline paper whose watermarks indicate the of usage 1560s, respectively The final position of KKDD DE-C1967-269 (marked with question marks) in this figure will follow after the re-assembling of the drawing.

Conclusion concerning the attributions to the Egmont-Master based on the dating of paper.
Attribution of 30 drawings from various collections excluding Dresden Kupferstich-Kabinett to the Egmont-Master allowed, van der Sman to suggest that the master was mainly active between 1585 and 1600.[10] In the Dresden collection we find a new group of washed ink drawings whose paper indicates his appearance on the scene about two decades earlier – in the 1560s. Hence the master had aquired his characteristic handwriting in the sixties, stopped working for a decade in the 1570s, then reappeared still using the same hand writing he had started with (**fig.11**). Note that his style had never changed until the end of his activity after 1600.

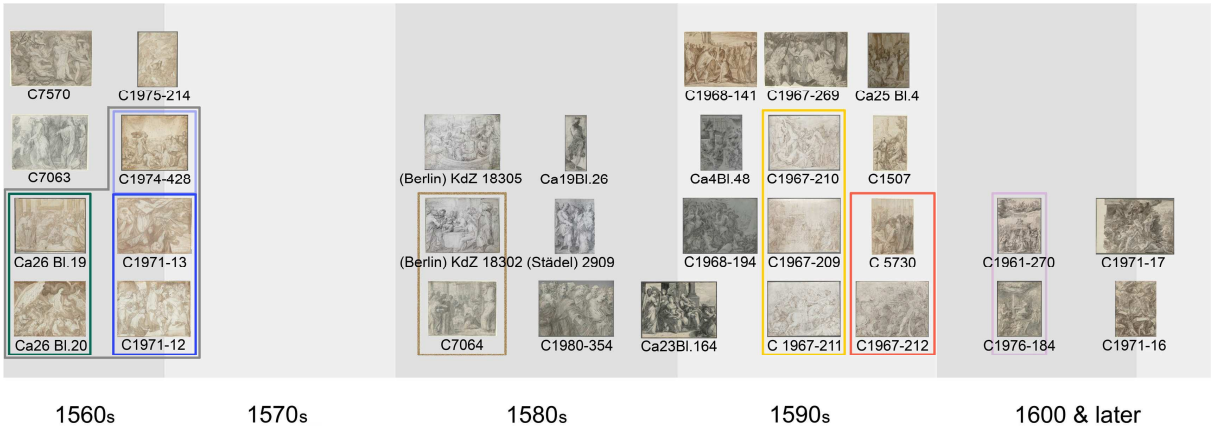

figure 11

Classification of all Egmont-Master drawings in the collection of Dresden Kupferstich-Kabinett based on their paper structures and watermarks.

Watermark analysis led to another important result for the art historical interpretation: not a single feature in the paper investigated would indicate a possible link between the different types of drawings – pen, chalk and washed ink drawings.
The findings described above lead to the following conclusion: our watermark analysis cannot confirm that the Egmont-Master actually existed. The evidence leads rather to the conclusion that we deal with a much broader 'Egmont phenomenon', which corresponds to a particular stylistic expression in chalk and pen drawings in the second half of the 16th century.

paper quality analysis

As a part of the typology project we investigated the quality of the paper used for drawing. Our aim was to study the individual drawings in context, their function, the type of paper, the relationship between the paper quality and the type of drawing on it.
For statistical analysis we have defined, seven characteristic categories to describe the quality of the paper: thickness, cloudiness, color, inclusions, structure of the paper mould, watermark imprint and production errors. The papers were then classified in terms of descending quality (**Scheme 1**).[11]

Paper quality	paper thickness	Pulp clouds	Paper color	inclusions	Mould structure	Imprint of the watermark	production errors
best quality	thin, uniform paper **(1)**	no pulp clouds **(1)**	pure white **(1)**	no inclusion **(1)**	fine and uniform mould structure, thin wires **(1)**	No water mark **(-)**	no production error **(1)**
medium quality	thicker paper **(2)**	small paper clouds **(2)**	Yellow-white or pure light blue **(2)**	small inclusions **(2)**	coarse sieve structure or irregular wire distances **(2)**	clearly visible, watermark without any error **(1)**	Small or a few production errors **(2)**
simple quality	thick paper **(3)**	large paper clouds **(3)**	brownish / bluish / grayish **(3)**	many and/or large inclusions **(3)**	coarse sieve structure **(3)**	poorly visible, improper watermark **(2)**	greater or more production errors **(3)**
worst quality	**(-)**	**(-)**	dark (brown, blue, gray) **(4)**	**(-)**	**(-)**	unreadable watermark **(3)**	**(-)**

Scheme 1

Table classifying the quality of the paper,

Paper quality scores calculated in such a way were converted into a 16-step paper quality index. The paper was then grouped according to the index classes so that paper of the best quality corresponded to the index classes 1-5, medium quality - to 6-10, simple quality - index 11-15 and finally poor quality to the index class 16.

Studies of the paper quality for drawings of the Dresden Egmont master showed ambiguous results **(fig.12)**. The pen drawings were made on paper of medium to simple quality. This suggests a certain inhomogeneity within this group of drawings concerning the date and point of origin, and the causes for the drawings. On the other hand, the quality of the paper for the group of chalk drawings is quite homogeneous. This supports the "uniformity of the chalk drawings"[10], in contrast with the previous watermark analysis. The washed pen drawings were also executed on very similar and mostly medium paper qualities.

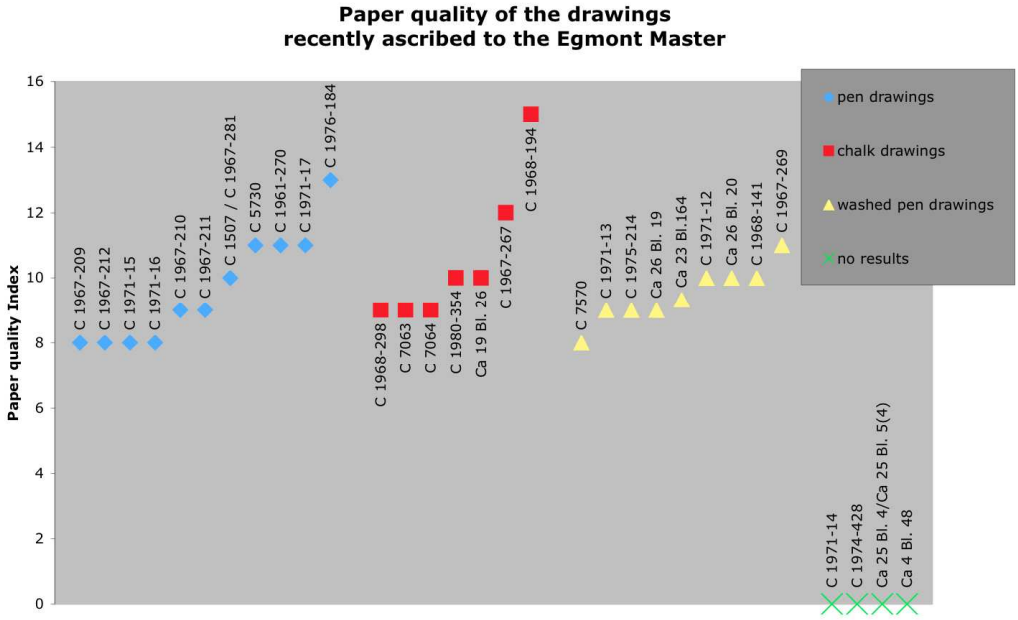

figure 12

Paper quality of the drawings attributed to the Egmont-Master in the Kupferstich-Kabinett Dresden

Conclusions based on the results of the paper quality analysis

Despite the fact that the most of the paper studied in this work roughly falls into a quality index between 8 and 10, the scatter found in the drawings ascribed to the Master Egmont is larger than that common for the paper quality used by other artists. This scatter is particularly aparent within the group of the pen drawings. We consider this result to be another indication against a direct group context.

Results of analysis with micro-XRF

18 iron gall ink drawings can be attributed to the Egmont-Master until now Iron gall inks are produced from four basic ingredients: galls, vitriol, gum arabic as a binding media and an aqueous medium such as wine, beer or vinegar. Vitriol, the main inorganic compound of iron gall inks, was obtained from different mines and by various techniques [12]. Therefore the iron sulfate is contaminated in varying degrees with many other metals like copper, aluminium, zinc and manganese, which do not contribute to colour formation in the ink solution but possibly change the elemental composition of the inks.

The different elemental compositions, which vary remarkably from one ink, is a characteristic property of these historical drawing materials. On the one hand, there are qualitative distinguishable components or impurities. On the other hand, they appear in different quantities [13]. The qualitative and quantitative investigations of the inorganic ingredients for instance lead to exact characterisations of the different materials, summarized by means of *fingerprints* [8,14].The iron gall inks were found to contain Fe, Cu, Zn and Mn in noticeable quantities; thus, the composition fingerprint is expressed by three relative amounts of

weight concentrations of Cu, Zn and Mn in relation to iron (see fig.13 / Egmont_XRF). The quantification procedure based on a Fundamental Parameter based approach is described elsewere [15]. **Fig.13** shows the XRF results for the whole set of drawings. Besides the elements Zn and Mn the element Cu was found as a representative ink impurity, which fact demands the three axes representation. It is obvious that the inks can be grouped allowing to establish chronology of the drawings studied here.

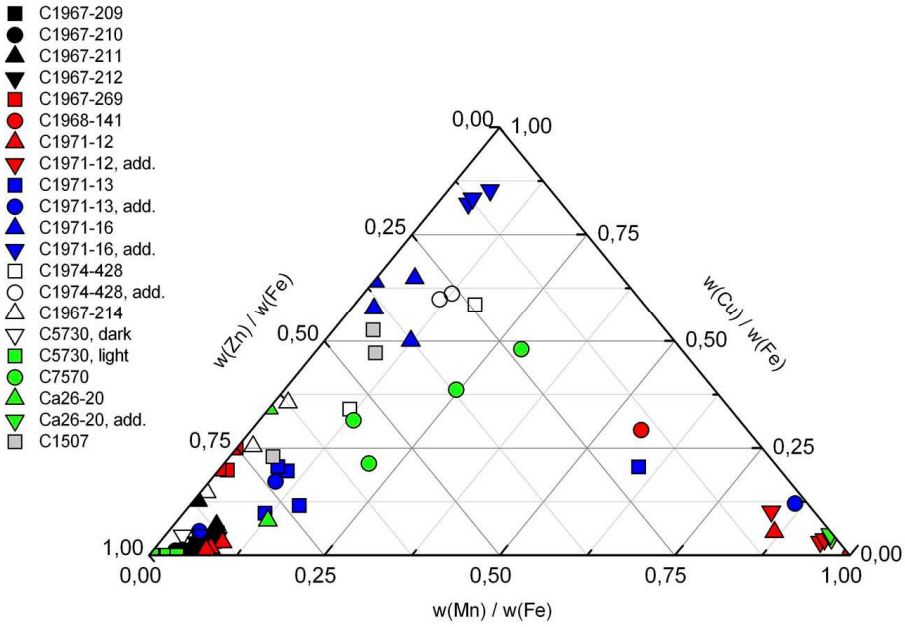

figure 13

Fingerprint values w(i) / w(Fe) obtained by XRF analyses (Note that the data was normalized to unity.)

The drawings with signatures: KdZ27736, C1967 209, C1967-210 C1967-211, C1967-212 (scene in the centre) and C5730 (dark ink), repectively, clearly build one group, the very group already established by watermark analysis. This result obtained by two independent techniques transforms a hypothesis into a proven fact.

figure 14

Classification of some selected Egmont-Master drawings from the collection of Dresden Kupferstich-Kabinett based on their ink composition.

For other drawings the results of the ink examination are less decisive. However, there are probably links between the three pairs of Egmont drawings (C1967-269 & C1971-13, C1507 & C1971-16, C7570 & C1974-428). Furthermore, it appears that the supplements of two drawings (C1947-428 & CA26-20) have been done in all likelihood with the same ink (**fig.14**).

Discussion

localization based on the paper analyses

To this day, the art-historical analysis has failed to connect the Egmont-Master to a known artist. A succession of artists, including Antonio Tempesta, Anthony Blocklandt or Hans von Aachen, have been named in this respect. All the attempts failed because no drawing of any other artist display features those make Egmont-Master's drawing recognizable. Generally he is described as a Dutch artist with strong Italian influence from the late 16th century.

Based on the watermarks of Dresden Egmont-drawings we tried to locate the areas of his activity using the Bernstein Portal [16]. The Bernstein Portal is a watermark database that at present gives access to around 120.000 watermarks including their metadata. The resulting geographical distributions are shown in **fig.15** and **16**.

figure 15 (left)

Geographic distribution of all detected watermarks identical and similar to DE-KKDD-C1967-209 / -210 / -211, with the motif *post horn in the coat of arms of the Monogram ‚NH'* (8 pieces dated 1590-1604). The watermark addition ‚NH' stands for the papermaker ‚Nicolas Heuser' from Basel. Comment to the inscriptions on the maps: the larger the font, the larger the number of the papers with the searched indications is known. [last update: summer 2009]

figure 16 (right)

Geographic distribution of all documents with a related watermark motif *Rod of Basel in the coat of arm and the Monogram ‚NH'* (48 pieces/documents dating between 1582 date and 1599). [last update: December 2009]

It is clear that the paper types for the Egmont-master drawings from Dresden were mainly

used in the settlements along the river Rhine, with usage peaks in the Upper Rhine valley and single centres in the North Rhine Westphalia region. This is in agreement with geographic origin of an additional Egmont-Master drawing currently in the Amsterdam collection. In 1999, van der Sman suggested that, in the last decades of the 16th century, the Egmont-Master was probably staying north of the Alps in the Rhineland or in the Netherlands. He based his argumentation on a comparison of a countermark [17] from a single drawing (*Flagellation*) in the collection of the Amsterdam print room with the one in Heawood (no. 3119, Duisburg, 1589).[10]
Given the geographical distribution of the corresponding watermarks, we see a probable connection between the Egmont-Master and engravers or publishers of the Rhineland, e.g. Johann Bussemacher from Cologne like proposed by van der Sman [10]. Furthermore, paper analysis does not offer an indication any of the Dresden Egmont-Master drawings were made in Antwerp, the Netherlands or in Italy, as has been proposed in the various art-historical debates in the last decennia.[10]

Conclusion

The results of watermark analysis date the Egmont Master activity to 1560s and after 1600 with a distinct time gap between 1570 and 1580, for which period no attributions exist so far. We consider 50-60 years to be too long for a lifetime of a single person. Furthermore, papers of the individual style and material groups (characteristic style and drawing techniques) have a marginal overlap and – in contrast to other artists – barely intermingle. From the point of view of the materials used we assume that a person “Egmont-Master” never existed. We believe, instead, that Egmont-phenomenon’ envelopes a certain stylistic movement of the second half of the 16th century, that was located in the Upper Rhine and Westphalia area.

Acknowledgements
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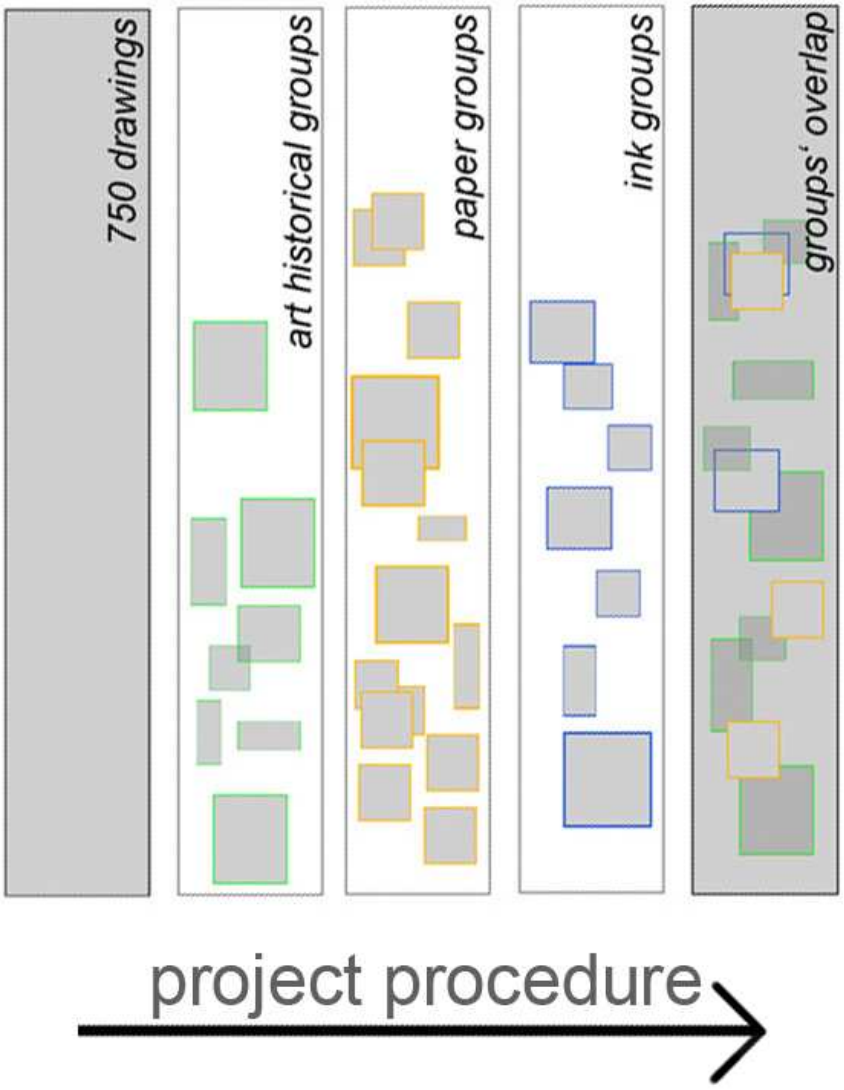
[17] Countermarks are logos of papermakers placed as second watermarks in the paper sheet. They are completely independent of the main watermark.



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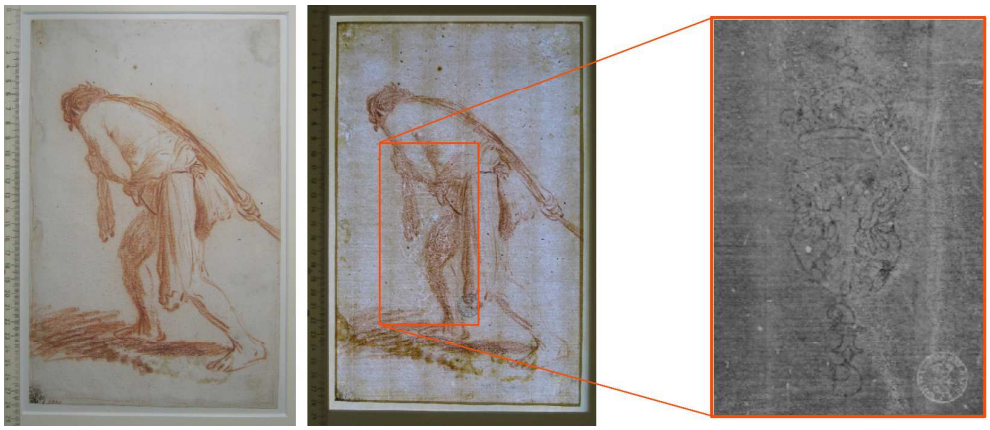

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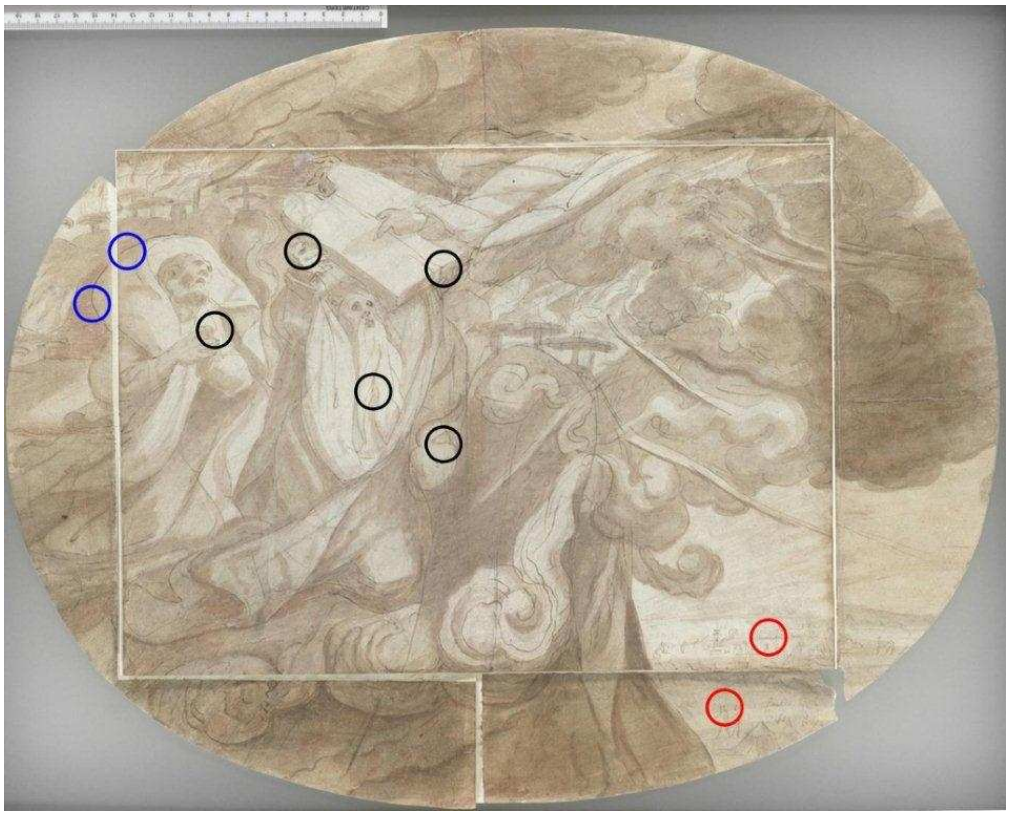

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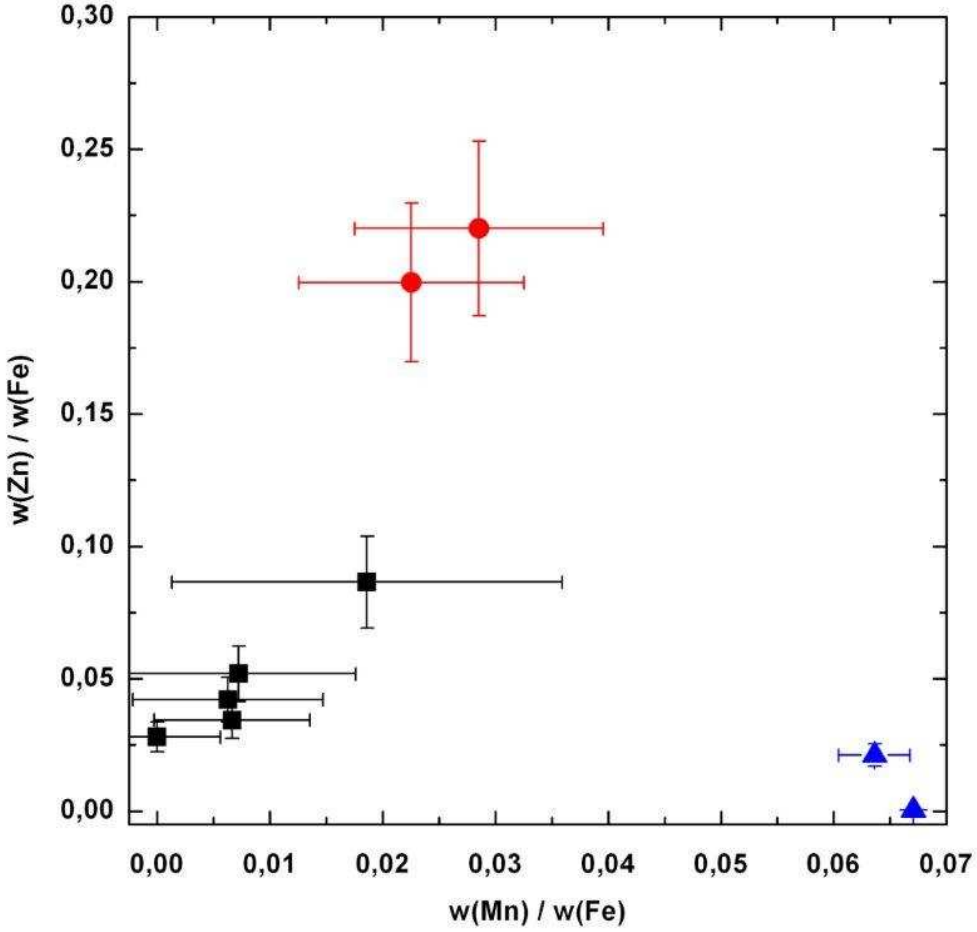
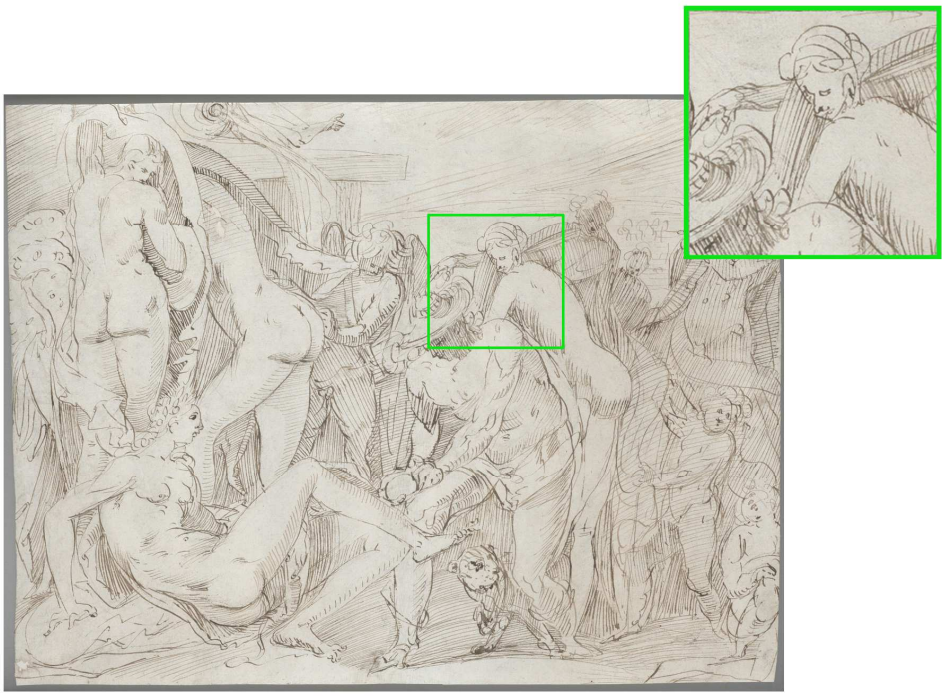
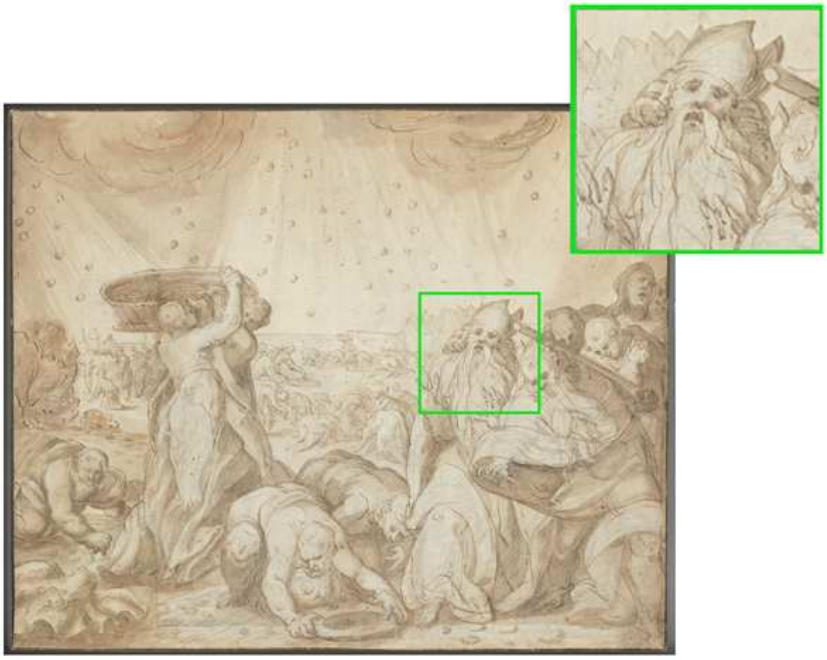


211x203mm (96 x 96 DPI)



666x499mm (72 x 72 DPI)

204x146mm (150 x 150 DPI)



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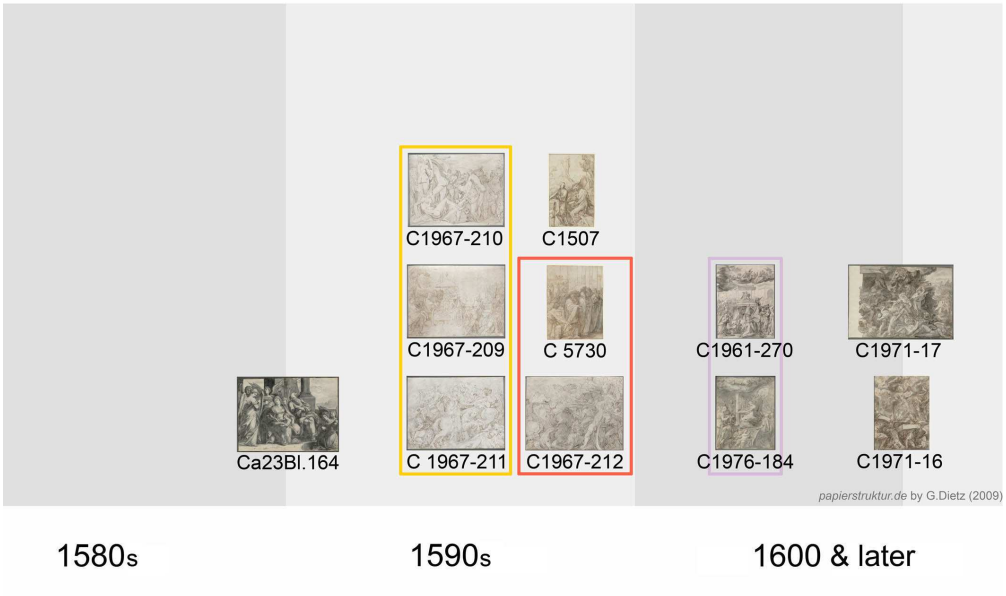

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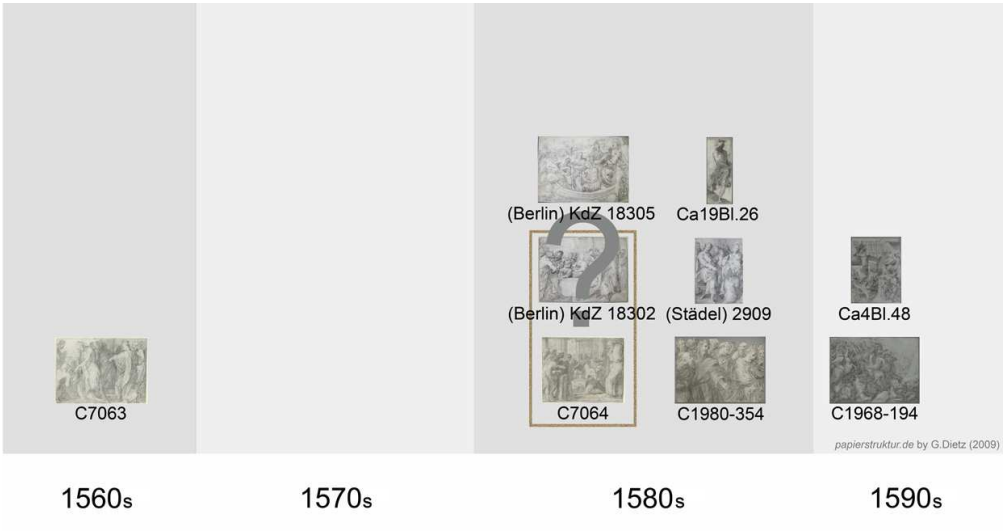
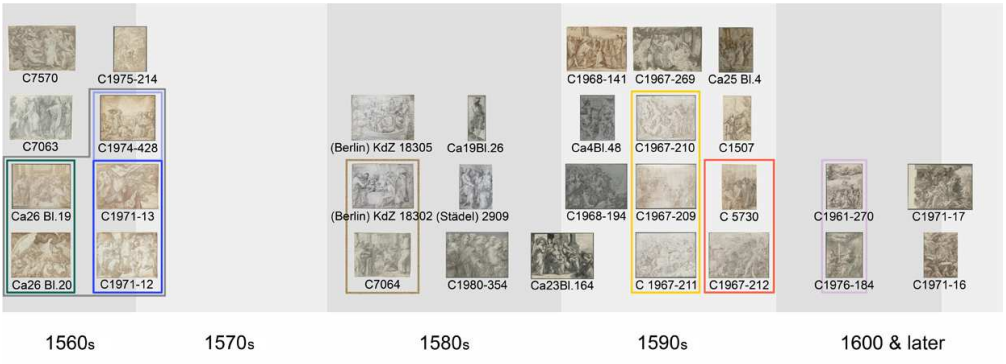


209x110mm (150 x 150 DPI)

209x77mm (150 x 150 DPI)



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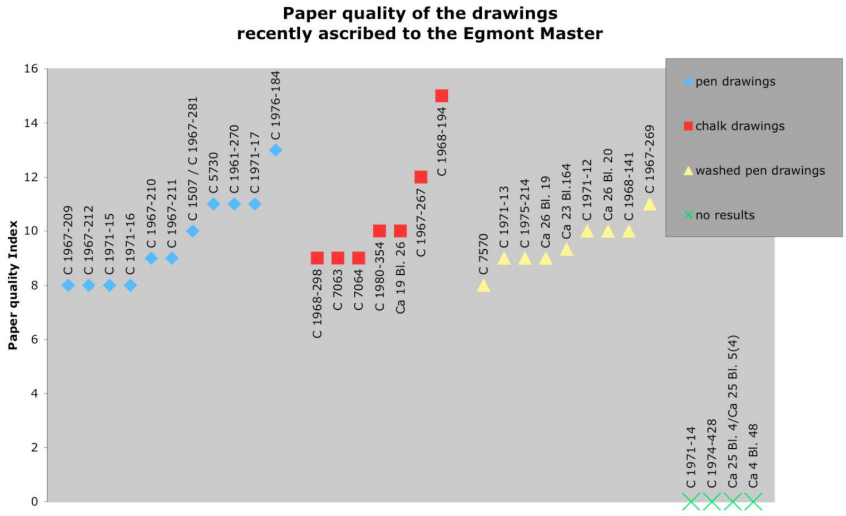

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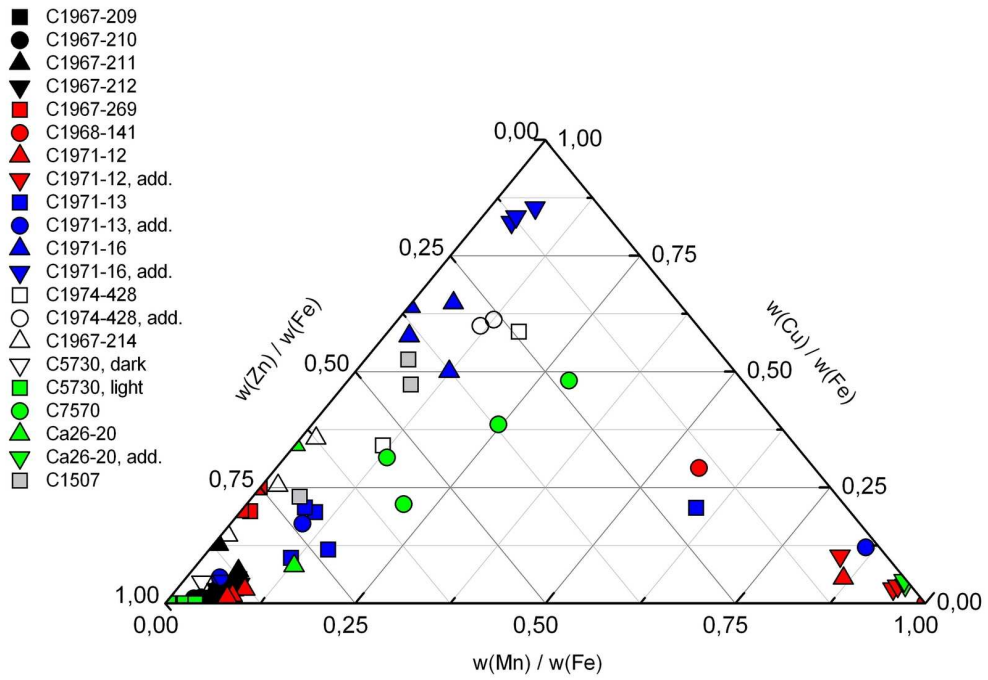

137x94mm (300 x 300 DPI)

209x86mm (150 x 150 DPI)


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Basel
Luzern


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