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# Conservation and restoration of two large cartoons for frescoes in Djakovo Cathedral

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## Abstract

Of the 37 cartoons (preliminary drawings) for frescoes in St Peter's Cathedral in Djakovo which Alexander Maximilian Seitz and Ludovico Seitz were commissioned to produce by Bishop Josip Juraj Strossmayer, only two have survived. These are *Jesus Cleanses the Temple* (ITT) and *The Great Flood* (OP). The surviving cartoons are historically and artistically important documents of sacred art from the late 19th century. The main problems with the two works are their remarkable size, unsuitable storage to date, and the poor quality of the materials used. This article gives a brief presentation of the circumstances in which the cartoons were created, their condition before intervention, scientific tests carried out on the works, the conservation-restoration intervention for each cartoon separately, and a proposal for the presentation of the restored cartoons to the public.

## Summary

The two surviving cartoons for the frescoes in Djakovo Cathedral are valuable examples of drawings in 19th-century Croatia. Because of their historical and artistic value, they were accepted for conservation-restoration treatment as part of the regular programme of the Croatian Restoration Institute (HRZ). The cartoons had been stored for several decades in unsuitable conditions in the attic of the Croatian Academy of Sciences and Arts in Zagreb. The aim of the project was to examine, conserve, restore and present to the public these historically and artistically valuable specimens of cartoons. At each phase of the project it

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1 The article is based on Andreja Dragojević's master's thesis (2010).

was necessary to overcome the same obstacle – their size. It is for this reason that the conservation-restoration work took several years. Presentation of the cartoons to the public has not yet been definitively resolved, since a sufficiently large space with suitable climatic conditions will need to be provided for their presentation. It is likely that the protection, storage and presentation of the works will bring new challenges in the future, and it is this that makes this project so special.

## Introduction

Within a year of the start of construction of the church, Bishop Strossmayer realised that the 77-year-old artist Johann Friedrich Overbeck<sup>2</sup> would not be able to create the cartoons for the frescoes in Djakovo Cathedral on his own. This raised the question of finding a 'suitable' artist for the cartoons (AHAZU, 1868). The artists chosen were Alexander Maximilian Seitz and his son Ludovico Seitz, Roman painters of German origin. The fact that they were painters from Overbeck's inner circle and fresco specialists played a decisive role in their selection. Since Overbeck's last letter to Strossmayer expressed his agreement with the choice of the Seitzes, father and son (Feuss, 1994–1995: 152),<sup>3</sup> whom he rated very highly as artists, the bishop met Alexander Maximilian and Ludovico while staying in Rome in April 1869 and immediately came to an initial agreement on the paintings for the cathedral (Schneider, 1935b). The Seitzes began drawing the cartoons in 1872 when construction of the cathedral was almost complete and it was finally possible to begin painting.

Alexander Maximilian Seitz completed the fresco *Jesus Cleanses the Temple (Isus tjera trgovce;* hereinafter: ITT) in 1874 (Cepelić, Pavić, 1900–1904: 340), in other words two years after completing the drawing for it. In terms of composition, the number and distribution of figures, the movements of the figures, the architecture in the background, and even the details, there are no major differences between the drawing and the fresco. It is clear that the painter consistently reproduced in Djakovo what he had prepared in Rome (his work was made considerably easier by the fact that the drawings were on a scale of 1 : 1).

Ludovico Seitz did not complete the fresco *Scene from the Great Flood* or, as it is more commonly known, *The Great Flood (Opći potop;* hereinafter: OP), until August 1881, nine years after completing the drawing for it (Cepelić, Pavić, 1900–1904: 340). Although in the meantime he had considerably changed his painting style, turning more towards academic realism and freeing himself of the aesthetics of the Nazarene movement, he nevertheless painted the fresco precisely according to the drawing, both in terms of composition and the number and distribution of the figures. His interest in the work in Djakovo had waned considerably: the city seemed insignificant to him and he worried that he was

2 The historical account of the origin of the cartoons is taken from a report of the same title prepared for the Croatian Restoration Institute (HRZ) by Dr Dragan Damjanović of the History of Art Department at the University of Zagreb's Faculty of Arts.

3 He does not mention them by name but he is clearly referring to the Seitzes when he talks about the artists who have been invited to paint the frescoes.

spending too much time painting and working there for no good purpose. He therefore certainly did not wish to invest much energy in creating new cartoons for frescoes.

Anxious for as many traces as possible of their original work to remain in Djakovo Cathedral, the Seitzes managed to ensure that the realisation of almost all of Overbeck's cartoons was abandoned, although this meant that they would have to make their own. Just as with Overbeck, Strossmayer insisted from the very beginning that he wanted all the drawings by the Seitzes for the frescoes in Djakovo Cathedral to remain in his possession once painting was complete, after which he intended to donate them to the Gallery of the Academy.<sup>4</sup> In the contract signed in April 1870, it was therefore expressly stated that all the cartoons made by the Seitzes for Djakovo Cathedral belonged to Strossmayer (Djakovo Diocesan Archives, 1870). The bishop therefore regularly paid the sum of 500 *scudi* for each completed drawing, in other words half the amount envisaged for each fresco on the walls of the cathedral (DDA, 1873). The Seitzes did not bring the completed drawings to Djakovo until the completion of painting. Strossmayer had not requested them to do so, since he assumed that they needed them for the purpose of harmonising the scale with the new drawings. Everything suggests that the Seitzes did not make cartoons as Overbeck did, but rather only simple drawings or complete watercolours.<sup>5</sup>

After completion of the cathedral and the removal of the bishop's gallery to the Academy building in Zagreb, Franjo Rački tried to get the Seitzes to hand over their drawings to this institution, as per the contract. His efforts, however, merely confirmed the earlier suspicions of Nikola Voršak (a canon at the Institute of St Jerome in Rome and for a long time the chief intermediary of Bishop Strossmayer in discussions with the Seitzes and other artists in Rome), namely that some of the drawings had been sold. Since it was almost certainly not worth taking the Seitzes to court, it was agreed that Strossmayer would only demand photographs of the cartoons from them (Šišić, 1931: 443). The Seitzes did eventually send two cartoons to Zagreb, probably at Strossmayer's request: **ITT** (*Jesus Cleanses the Temple*) and **OP** (*The Great Flood*).<sup>6</sup> The drawings are believed to have been

<sup>4</sup> In June 1869, i.e. immediately after the first conversations about employing the Seitzes in Djakovo, Strossmayer made the following point: »... es versteht sich von selbst daß alle Ihre Compositionen in Contouren mein Eigenthum bleiben. Sie wissen, daß ich dieß zum besten meiner Nation, die ich nach Gott und meinem Beruf im höchsten Grade liebe, zu verwerthen gedanke.« (DDA, 1869)

<sup>5</sup> 'My opinion or compromise with regard to Seitz's picture is: With this picture we could in combination obtain the cartoons. I hear that the Seitzes do not even have cartoons like Overbeck's but merely sketches or watercolours of the pictures which they completed in your Church, and even that they have already sold the watercolours. So: if we were to take them to court, which in Italy would require a great deal of money and time, and even if we were to win the case, we would only obtain a few drawings. This reason, you yourself could write to Seitz offering to pay him 1,000 or 1,500 *scudi* for the triptych, with the frame included of course, and at the same time release him from the obligation in the contract regarding the cartoons and drawings, in exchange for which he should send you photographs of all the pictures they made in Djakovo – otherwise the Academy will be compelled to demand the fulfilment of the agreement by legal means. Seitz could also agree to such a compromise. We would get the triptych and photographs of the pictures, while the Seitzes would be released from their obligation and the matter could be closed. I only ask that you yourself write some flattering words to Seitz. It would please his vanity were he to receive a letter from your hand.' (Šišić, 1931: 443)

<sup>6</sup> Both the cartoons by the Seitzes, the elder and the younger, (*Jesus Cleanses the Temple* and *The Great Flood*), are already in the Gallery. I have informed Ludovico of this, with the remark that he should send us the remaining drawings and photographs. If you write to him, you should also tell him this. The cartoons are wonderful, everyone likes them. *E pur si muove!* (Šišić, 1931: 3)

exhibited in the stairwell of Strossmayer's Gallery of Old Masters in Zagreb right up until the 1950s (Knoll, 1922: 148, 153).

Before 1882, when the Seitzes began painting in Djakovo Cathedral, they also made drawings for all the other frescoes, although to date we have not been able to determine where these are located today. Of their other preliminary works for the cathedral, all that survives is a small coloured drawing for the fresco *The Finding of Moses*, done in a combined technique, which is kept at the Strossmayer Museum in Djakovo. This was given to Milko Cepelić by Ludovico Seitz in 1882.<sup>7</sup> The two surviving cartoons for the frescoes in Djakovo Cathedral are therefore rare examples of cartoons from the 19th century in Croatia. Precisely because of their historical and artistic value, it was agreed that it was necessary to conserve and restore them and present them to the public.

None of the literature that we have examined contains records of conservation-restoration interventions on cartoons of such enormous dimensions and made of materials of such poor quality. For this reason we have had to reconsider every single phase of the conservation-restoration work and test it afresh. The restoration and conservation of these two cartoons has in many ways been a pioneering project, both for Croatia and for Europe as a whole.

## Condition of the cartoons before the intervention

### 1. ITT – *Jesus Cleanses the Temple* (Figs. 1 and 2)

*Title:* ITT – Jesus Cleanses the Temple (Croatian title: *Isus tjera trgovce*)

*Artist:* Alexander Maximilian Seitz

*Technique:* drawing with black chalk and charcoal (unfixed)

*Date:* 1872 to 1882 (the period in which the frescoes were painted)

*Dimensions:* 4.405 x 5.68 m

The drawing consists of 66 sheets of paper measuring 53.5 x 77.5 cm and glued together at the edges to form a surface measuring 4.405 x 5.68 m. The entire surface was lined with a layer of paper sheets of slightly larger dimensions than the top sheets; this layer supports the drawing (Fig. 3). In many places the adhesive has weakened, with the result that the two layers have separated. Two further layers were glued round the edges of the back of the cartoon: the first was blue paper and the second a strip of fabric. Since the drawing had been rolled up for a long time, creases were visible in the paper, distributed evenly across its width (Fig. 4). In some places silver-coloured stains had appeared on the front of the drawing, formed as a result of the rubbing of the decorative batten over the surface. Small black stains, and in places red stains, could be observed across the entire surface of the drawing. These were formed by the action of microorganisms. The concentration of small black stains was slightly greater around the edges of the back of the drawing. This is probably the result of the greater quantity of glue at these points, while the high relative humidity of the location in which the drawings were stored also increased the possibility of development of microorganisms. Photographs of some parts of the drawing lit from the side showed superficial mechanical damage (Dragojević, 2010: 38–39).

<sup>7</sup> Details about the legend of the drawing *The Finding of Moses* are in the Strossmayer Museum in Djakovo.

## 2. OP – *The Great Flood* (Figs. 5 and 6)

*Title:* OP – The Great Flood (Croatian title: *Opći potop*)

*Artist:* Ludovico Seitz (initials L.S. on the drawing)

*Technique:* charcoal drawing (unfixed)

*Date:* 1872–1882 (the period in which the frescoes were painted); date on the drawing: 1862

*Dimensions:* 4.115 x 5.15 m

The cartoon consists of sheets of paper glued together to form a surface measuring 4.115 x 5.15 m, lined on the back by a thin woven linen fabric covering the entire surface (Fig. 7).<sup>8</sup> It was immediately apparent that the paper used as the direct support of the drawing was of poorer quality (darker in colour and more weathered) than the paper used for the ITT cartoon. The sheets of paper are darker in the upper left quadrant of the drawing than elsewhere.

The drawing had been rolled up for a long time and creases were therefore visible in the paper, distributed evenly across its width. At these points tearing had occurred of the paper support and of the fabric lining (Fig. 8). A strip of blue paper (approximately 17 cm wide, 4 cm at the lower edge) and a fabric strip were attached to the lining fabric at the edges of the drawing. A test of the durability of the drawing technique showed that the drawing had not been fixed. It was therefore necessary to handle it carefully so as not to damage the layer containing the drawing. The signature in the bottom left-hand corner consists of the artist's initials and a date,<sup>9</sup> although the latter does not correspond to the dating of the creation of the drawing. For this reason the signature itself is also questionable and will need to be studied in more detail.

The OP cartoon required more careful treatment than the ITT cartoon. Because of the poor quality of both layers of paper and the vulnerability of the drawing, we opted in this case not to unglue the work into individual sheets.

## Scientific tests

The majority of testing methods used to examine paper-based examples of cultural heritage derive from industrial methods of analysis, where the quantity of the sample is not problematic. In the case of cultural heritage items we are, by contrast, extremely limited when it comes to taking samples for testing, which means that in most cases only non-destructive or micro-destructive testing methods are relevant here. When invasive non-destructive methods are used, researchers intervene on the material but its properties are not altered. There can, however, be a change to its appearance (for example pH measurement). In the case of micro-destructive methods, which fall into the category of destructive testing, we need a tiny sample (a few fibres) which is, however, destroyed during testing (e.g. using a scanning electron microscope, an optical microscope, etc.).

<sup>8</sup> Analyses of the fibres were carried out at the Department of Textile Chemistry of the Faculty of Textile Technology, University of Zagreb under the supervision of Dr Ružica Čunko.

<sup>9</sup> Research by Dr Dragan Damjanović has shown that the date 1862 on the drawing does not correspond to archive information referring to the creation of the drawing in 1872.

In our case the nature of the damage and the size of the work meant that there was a relative sufficiency of fragments on which we were able to carry out a relatively wide range of scientific tests in order to determine the following:

- basic structural characteristics of the paper: grammage (ISO 536), thickness and specific volume (ISO 534),<sup>10</sup>
- pH of the surface of the paper (TAPPI 529),
- water absorptiveness (ISO 535),
- quantitative analyses of fibres (ISO 9184-2),
- thermal decomposition of fibres (Metler FP 90),
- chemical composition of the paper using FTIR spectroscopy,
- presence of starch (qualitative identification of colour using aqueous iodine solution),
- qualitative microscopic analysis of paper fibres for their identification in polarised light at 100x magnification with an optical microscope (ICP – Wild stereo microscope).

We also carried out the following tests:

- microchemical qualitative analysis of fibres with NaOH, HCL and phloroglucinol,
- analysis of fibres with scanning electron microscope (SEM), Faculty of Natural Sciences and Technology, University of Ljubljana, JEOL JSM-6060LV,
- microscopic images of the surface of the paper, impression and painting – measurement with reflection of light (ICP method),
- XRF analysis of the drawing (Scientific Laboratory of the HRZ, Zagreb), and
- microbiological analysis of the paper.

## Analysis of the paper

We carried out micro-destructive analyses of the paper on detached fragments of the paper support. The results revealed the condition of the paper support of both drawings and provided guidelines for further methods of work.<sup>11</sup> Microscopic images of the cross section of the layers in the OP and ITT cartoons are shown in Figs. 9 and 10. Other results are given in Table 4 (Dragojević, 2010: 63–64).

We analysed samples of fibres from both cartoons (ITT and OP).<sup>12</sup> Both drawings are in a large format created by assembling individual sheets of paper into a single whole and backed by a second layer of paper for greater strength. We analysed all the layers of the paper support of the drawing. The purpose of the analyses was to identify the fibres and their origin and to gain the best possible insight into the condition of the fibres of the paper support, which had visibly degraded over time. This degradation is in fact closely connected to the state of the fibres and damage to them. On the basis of the results of the

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10 Grammage (ISO 536), thickness and specific volume (ISO 534) were only determined for the ITT cartoon.

11 Analyses of samples of the paper support of both drawings were carried out at the Pulp and Paper Institute in Ljubljana under the supervision of Dr Marjeta Černič Letnar.

12 The research took place in the laboratory of the Textiles Department of the Faculty of Natural Sciences and Technology, University of Ljubljana, and, in part, in the Scientific Laboratory of the Croatian Restoration Institute in Zagreb.

analyses, we determined the state of the drawings and in this way laid down guidelines for the continuation of conservation-restoration work. We carried out investigations using two microscope-based methods, using an optical microscope (Dragojević, 2010: 51) and an electron microscope<sup>13</sup> (Dragojević, 2010: 53–54). We further confirmed the origin of the fibres in the paper support by means of FTIR spectroscopy and analysis of the thermal decomposition of the fibres (Dragojević, 2010: 58–60).

## Analysis of the drawing

In order to identify the technique used in the drawings, it was also necessary to analyse the pigments. We subjected the image to non-destructive analysis using an XRF spectrometer for X-ray fluorescence analysis<sup>14</sup>. A significant quantity of calcium was detected in the analysed parts of the ITT drawing, while other elements (S, K, Fe, Zn and Cu) were only present as traces. This means that the drawing was done in black chalk. From the spectrum recorded on fragments of the OP drawing, all the detected elements, including calcium were present as traces (Ca, S, K, Fe, Mn and Zn). From this we can conclude that the black colour in the drawing is charcoal-based.

## Microbiological analysis of the paper support of the ITT cartoon

Smears for microbiological analysis were taken from the paper support to allow us to identify any microflora present.<sup>15</sup> We spread the smears on a growth medium and left them in Petri dishes for 48 hours exposed to a temperature of 37°C to allow bacteria to develop, and for a further 72 hours at a temperature of 28°C and a relative humidity of 92% so that mould could grow. We divided the resulting colonies of microorganisms several times in order to obtain a pure culture. The following pure mould cultures were isolated from the mixed cultures in the smear samples: two species of the *Polyporus* genus and one species each from the *Rhizopus*, *Cladosporium* and *Monascus* genera. All the isolated moulds are capable of decomposing cellulose. *Monascus* sp. moulds synthesise a red pigment during growth and release it into the support, so this is probably the origin of the red stains. Black stains in the background of a drawing most frequently appear as the result of growth of *Cladosporium* mould, which secretes a dark pigment as it ages.

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13 Optical microscope images of fibres taken in the laboratory of the Textiles Department of the Faculty of Natural Sciences and Technology, University of Ljubljana. The samples were photographed using a JEOL JSM-6060LV scanning electron microscope (SEM).

14 Taken in the Scientific Laboratory of the Croatian Restoration Institute using an Arttax  $\mu$ XRF spectrometer made by Bruker AXS.

15 Microbiological analyses were carried out in the microbiology laboratory of the Department of Industrial Ecology at the Faculty of Chemical Engineering and Technology, University of Zagreb, under the supervision of Dr Felicita Briški.

## Results and discussion

The results of analysis of the general characteristics of the paper support showed an acidic pH level in both samples. This probably derives from the products of decomposition identified in the lower layer of paper (wood fibres). We found that the ITT sample has a greater grammage and thickness than the OP sample. The OP sample has a lower absorption capacity than the ITT sample, which indicates a greater proportion of filler and glue in the paper, and also of products of decomposition. This is also shown by the photograph of the longitudinal section of the analysed samples.

In the case of the ITT drawing it was established that the auxiliary paper support, i.e. the lower layer, was attached with starch adhesive. This information is important for the choice of the subsequent conservation-restoration procedure. The development of microorganisms in this drawing also confirmed that the adhesive used was a natural adhesive without added preservatives. In a large part of the drawing, microorganisms have developed between the two layers of paper. As a result the adhesive has lost its strength in these places and the layers have separated easily.

In the other drawing, OP, we did not carry out all the basic structural investigations on all the layers because we did not have a sufficient sample at our disposal; what we had was only enough to give us basic information.

Analysis of fibres using an optical microscope showed that the fibres in the upper layer of the paper support in both cartoons are cotton. This is proved by the characteristic appearance of the longitudinal section of cotton fibre. Wood fibres were detected in the lower layer,<sup>16</sup> which explains the degradation and the acidic pH level, which speeds up the decomposition of the paper support.

Microchemical analyses of fibres from the upper layer of the paper support confirmed that the fibres are cotton. This could be ascertained from the characteristic reactions of the fibre samples in reagents (NaOH, HCL and phloroglucinol).

In the images of the paper samples taken with an electron microscope it is possible to observe the difference in damage to the fibres and the major difference in the proportion of glue and filler in the paper support with regard to fibres. The paper supports OP1 and OP2 have a larger share of additives in the paper than the ITT1 and ITT2 supports. This explains why the OP cartoon is extremely brittle.

FTIR spectra of all the samples of the upper and lower layers of both cartoons confirmed that in terms of structure all of them are of cellulose origin. We compared the spectra of the samples with the spectrum of a known cellulose sample, from which it is only possible to conclude that cellulose fibres are present in the samples. It is not, however, possible to identify the types of these fibres (cotton and wood fibres).

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<sup>16</sup> Owing to the presence of dirt at high relative humidity, wood fibres cause an acidic pH level and accelerate the degradation of cellulose.

We carried out analyses of the thermal decomposition of fibres on samples of fibres from the original paper supports of the ITT and OP drawings. We expected to find the same changes as in the cotton fibres. In the sample of ITT fibres the first change of colour is observed at 301°C and the second at 317°C. The sample took on a dark brown colour at 329°C and the fibres became completely black at 332°C.

Analysis of the drawing on a fragment of the ITT cartoon showed a larger quantity of calcium and the presence of other elements as traces. This shows that a chalk-drawing technique was used. In another fragment of the OP drawing, all the detected elements were present as traces. From this it may be concluded that the black colour only contains carbon, indicating a charcoal-drawing technique.

Microbiological analysis was carried out on the ITT cartoon using mixed cultures from smear samples (there were small black stains and smaller areas of red stains on the drawing). The following pure mould cultures were isolated: two species of the *Polyporus* genus and one species each from the *Rhizopus*, *Cladosporium* and *Monascus* genera. All the isolated moulds are capable of decomposing cellulose. *Monascus* sp. mould synthesises a red pigment during growth, which infiltrates the support, making this the probable cause of the red stains. Black stains like those on the back of the drawing most frequently form because of *Cladosporium* mould, which secretes a dark pigment as it ages.

## Conservation-restoration procedures

The cartoons are the property of the Bishop Josip Juraj Strossmayer Memorial Museum in Djakovo, but because of their dimensions they were kept at the Croatian Academy of Sciences and Arts in Zagreb. For the same reason it was not possible to restore them at the Paper and Leather Workshop of the Croatian Restoration Institute (HRZ) in Zagreb, and we therefore decided that the work would take place at the HRZ's Ludbreg Restoration Centre, located in Batthyány Castle, where there is room to work on large-format works of this kind. Work on the cartoons continued for five years, with a team of 14 people working a total of 3,360 hours.

For perhaps the first time since the cartoons were shown to Bishop Strossmayer, it was possible to see the whole of these two drawings. This actually occurred during the photographic documentation process, which took place at the HRZ in Zagreb in the 'large studio' at the Zmajevac location.<sup>17</sup> The procedure is similar to that used in the photographic documentation of large easel paintings. The method used for photographing large-scale works of art is well established. The camera is positioned on the studio ceiling at a height of seven metres, allowing the whole of the drawing to be captured (Fig. 11).

The first step after the elaboration of photographic documentation was the removal of the decorative battens that were nailed to the upper and lower edges of the drawings. These needed to be removed because they represented a load on the brittle paper and textile support.

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<sup>17</sup> The system for photographing large formats was constructed by Mario Braun.

The large format of the cartoons, which corresponds to the format of the frescoes, was a difficulty that had to be overcome time and again, at each successive phase of the conservation-restoration process.

Work on the cartoons took place in phases over a number of years, for financial and organisational reasons. Between phases, it was necessary to store the cartoons in such a way that they would not be damaged. To this end, a special cylinder was built and mounted on a stand. This cylinder can be rotated around its axis, allowing us to roll the cartoons onto it. The construction of the cylinder enables the insertion of a metal shaft around which the cylinder rotates.<sup>18</sup>

The two cartoons differ in terms of the type and extent of degradation of the paper support. For this reason the conservation-restoration procedure was different for each cartoon. Each cartoon is discussed separately below.

## 1. Conservation-restoration work on the ITT cartoon – *Jesus Cleanses the Temple*

The first aim of conservation-restoration work on the ITT cartoon was to stabilise the paper support of the drawing and in this way preserve the work of art. Using dry and wet cleaning methods, we removed dirt from the surface and in the structure of the paper. By removing the vestiges of glue that had lost its adhesive properties, we cleaned the surface of the paper support and in this way obtained a clean surface for the subsequent phases of the work. Severe mechanical damage was evident at the edges of the drawing and it was therefore necessary to consolidate it further by lining it with new layers of Japanese paper. The materials and tools used during conservation and restoration of the ITT cartoon are shown in Table 5 (Dragojević, 2010: 84).

### *Removal of the backing paper and fabric*

This procedure had to be carried out because the two layers of paper had partially separated before the intervention, and the second (lining) layer of paper was the cause of the acidic pH level of the whole cartoon, and therefore had to be removed (Fig. 12). This was also the only way to successfully carry out disinfection. In some places microorganisms had so dissolved the glue that the individual sheets had fallen away from the second layer of paper or had separated where they were joined together. The composition of the lower layer of paper, made of wood fibres, and the high moisture content of the air in which the two drawings were stored for a long time had caused the acidity of the entire cartoon. The measured pH of the paper support was 4.5, which is already an acidity capable of causing the degradation of cellulose.

Removal of the backing paper was relatively simple because the glue had lost its adhesive

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<sup>18</sup> The construction of the cylinder was entrusted to the master sheet metal workers of the Sebastijan sheet metal Workshop. When it was complete, transporting the cylinder and the metal shaft was quite a feat – because of their length it was difficult to carry them through the corridors of Baththyány Castle in Ludbreg.

properties and the layers themselves had separated. The textile strips had also separated. In some places, where the glue was stuck fast to the layers of paper and fabric, we activated the glue by wetting the layers and unstuck the layers while they were still damp. We carried out the procedure by spraying the layers of paper or fabric on the back of the cartoon with demineralised water. This caused the activated glue between the layers of paper to weaken, with the result that it was possible to separate the layers. This also led to separation of the individual sheets of paper making up the drawing, so in the stages that followed we dealt with the drawing by separate sheets. The drawing was divided into 66 sheets of similar dimensions (53.4 x 75.2 cm).

### *Dry cleaning*

The first phase of the procedure was dry cleaning of the cartoon. Removal of surface dirt is important since in this way we prevent the dirt from penetrating into the structure of the paper support. The choice of cleaning agents and tools depended on the type of dirt and on the cleaned surface. On the back of the cartoon, where a layer of dried adhesive was present, mechanical cleaning was necessary. On the front, the use of a drawing technique that could be easily erased made it necessary to choose a method that would not put the drawing at risk. The procedure took place in several phases: first we removed larger flakes of dust, and then smaller, finer dust particles.

The first cleaning used suction and involved the back of the drawing and those parts of the front of the drawing not covered by drawing, and areas where the drawing layer was fixed. We carried out the procedure at low power through a mesh, in this way avoiding further damage. We removed the dry remains of glue on the back of the drawing by dry cleaning parts of the drawing mechanically, using a scalpel. Dirt on the front of the drawing, and those parts where there was no drawing, was cleaned using an eraser. Dust was removed from the rest of the drawing using a soft brush (Fig. 13).

### *Disinfection*

The presence of microorganisms made disinfection necessary in order to prevent the further development of microorganisms. In view of the drawing technique employed, which, as we have said, made the drawing very easy to erase, it was not possible to immerse the parts of the drawing in a solution. Instead it was necessary to choose a procedure that would not put the drawing at risk. We opted for a procedure using 75% ethanol, since this does least damage to the paper support and to the drawing itself. We carried out a procedure in the following manner: using a sprinkler, we sprayed the 75% ethanol evenly across the back of the drawing. We then placed the individual sheets on a net stretched across a frame, and then into a sealed chamber, which prevented the alcohol from evaporating too quickly and thus allowed it to work for longer.

### *Neutralisation*

The procedure is carried out in the case of an acidic pH level in order to stop degradation of the paper and create an alkali reserve in the paper support which prevents the formation of further acid products. We chose a method which is very frequently used in conservation-restoration interventions on paper items.

We carried out the procedure using a solution of calcium hydroxide ( $\text{Ca}(\text{OH})_2$ )<sup>19</sup> (Kemika d.d., 1000 g), where the aqueous solution had a pH of 10. We placed the sections of the drawing on a net, which prevented the paper from sinking.<sup>20</sup> The procedure lasted approximately 30 minutes (Fig. 14). We neutralised the paper support gradually from the back, in order not to jeopardise the drawing on the front.

#### *Lining with a new layer of paper*

The cleaned and neutralised sheets of the drawing were prepared for the following phase, namely lining with a new, more solid auxiliary support in order to strengthen it.

Lining was urgently necessary because of the damage to the paper support and also because the original cartoon had also been reinforced by an additional layer of paper. The additional paper support served not only to strengthen the cartoon but also to connect the 66 individual sheets of paper into a whole.

The next phase of the work consisted of lining with Japanese paper and making the missing sections from toned Japanese paper (Kozu Shi 23 g/m<sup>2</sup>). The procedure was as follows: a cleaned, disinfected and neutralised sheet of the drawing was placed face down, moistened with spray and then covered by Japanese paper (Kozu Shi 23 g/m<sup>2</sup>) to which a layer of starch glue had already been applied (4% solution). To ensure a better fit, we pressed the Japanese paper lightly with a brush and roller. We then turned the drawing face up and inserted sections of toned Japanese paper (Kozu Shi 23 g/m<sup>2</sup>) into the missing sections (having previously cut the Japanese paper to shape). We placed the still-damp sheet of paper into a press between two sheets of blotting paper (600 g/m<sup>2</sup>), where it gradually dried and flattened. The sheets of blotting paper were changed twice during the drying and flattening process, until the sheet was completely dry and flat. Once all the sheets had been lined (Fig. 15), we assembled the drawing with all the sheets in the same place as in the original (Fig. 16). The reassembled drawing is now at the Ludbreg Restoration Centre awaiting the final phase of the work, namely mounting on a support for presentation to the public.

## 2. Conservation-restoration work on the OP cartoon – *The Great Flood*

Owing to the great fragility of the paper support, we carried out work on the OP cartoon without separating the individual sheets. In the places where the sheets were stuck together, the drawing was not damaged and therefore separation was not even necessary. Working on the full-size cartoon was a real challenge. The standard phases of the conservation-res-

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19 Preparation of the solution: we prepared the calcium hydroxide solution before beginning the procedure. Since calcium hydroxide is a powder, it was necessary to make a solution in demineralised water. 5 g of calcium hydroxide is added to 1 litre of demineralised water, shaken well and left to stand for one day. We then pour off the clear water, add new water, shake the solution again and leave to separate. When the water clears, the solution is ready for use.

20 It was again necessary to consider the vulnerability of the drawing technique, so we placed the drawings on the surface of the water.

toration procedure had to be carried out on a piece of paper measuring approximately 20 m<sup>2</sup>, without causing new damage. During the restoration process the cartoon was placed face down and we moved across the back of the work on sheets of polystyrene (thickness 5 cm). This enabled us to avoid damaging the cartoon and made further treatment of the drawing possible. The materials and tools used during conservation and restoration of the OP cartoon are shown in Table 6 (Dragojević, 2010: 96).

#### *Dry cleaning*

Owing to the fragility of the paper support and the vulnerability of the drawing itself, which could be erased very quickly, dry cleaning was limited to low-power suction on the back of the drawing through a mesh, in order to prevent further damage.

#### *Protection of the face of the drawing<sup>21</sup>*

A review of the condition of the cartoon showed that the drawing was not fixed and that any work would be difficult to carry out. We therefore decided to protect the face of the picture. This had several functions. We prevented the drawing from being rubbed out and lightly fixed this layer. We also prevented any further mechanical damage to the extremely fragile paper support and lightly cleaned the front of the drawing, which was not possible with standard methods. We carried out the procedure using a 1% Tylose adhesive (Tylose MH300P<sup>22</sup> methylcellulose adhesive).

Taking fresh sheets of Japanese paper (Bib Tengujo 11g/m<sup>2</sup>), we wet cut them to a size of 20 x 30 cm, applied adhesive, and left them to dry (Fig. 17). We then continued the conservation-restoration procedures.

#### *Removal of the backing paper and fabric*

The acidity of the paper support (pH = 4.4) meant that the fabric and paper from the back of the drawing need to be removed. In order to come to the paper backing it was necessary to remove the badly damaged linen fabric. Removal did not present any difficulties because the fabric was only held to the backing paper by individual fibres and mechanical removal was simple (Fig. 18). The backing paper was very thin and brittle and therefore difficult to remove, but its altered structure made its removal necessary. As it aged, this support had decomposed and become acidic, in this way causing deterioration of the original paper support of the drawing. We carried out the procedure by means of gradual scraping with a spatula, which resulted in the backing paper falling away in small pieces (Fig. 19). Owing to the size of the drawing and the time-consuming process of dealing with the whole surface, it took four experienced restorers 15 working days to remove the backing paper.

21 A protective layer of thin Japanese paper attached to the damaged face of the drawing (facing), the purpose of which is to prevent any loss of paint during or before the conservation-restoration procedure ([www.art-conservation.org/GLOSS\\_Paint.htm](http://www.art-conservation.org/GLOSS_Paint.htm), accessed February 2011).

22 Preparation: Tylose adhesive is prepared in a 1% concentration by dissolving 10 g of powdered adhesive in 1 litre of demineralised water. After a little time the adhesive swells up in the water, after which it is mixed well with a mixer. It is left to stand until all the bubbles formed during mixing have disappeared, in order to prevent the formation bubbles during the procedure.

### *Consolidation of tears*

Following removal of the backing paper and before the next phase it was necessary to consolidate tears in the drawing. We did this using strips of Japanese paper (Bib Tengujo 11 g/m<sup>2</sup>) approximately 2 cm wide and starch glue (4% solution<sup>23</sup>). We applied the glue to a strip of Japanese paper placed over the tear. The glue penetrated through the thin Japanese paper to the paper support and in this way consolidated the tear.

### *Neutralisation of the paper support*

Once the drawing was more stable, following consolidation of the tears, we were able to carry out the neutralisation procedure. This could only be done by a dry method using 'Bookkeeper'.<sup>24</sup> This was the only possibility because the large format of the drawing and the vulnerability of the drawing technique meant that a wet procedure using calcium hydroxide was not possible. The procedure was as follows: first we sprayed the entire back of the drawing with 50% ethanol (this was in order to enable better penetration of the content of the neutralising spray into the structure of the paper). We then immediately applied the neutralising spray, in two layers.

### *Lining with a new layer of paper*

The next phase was the lining of the damaged paper support with a more solid paper auxiliary support. It is not possible to line such a large drawing with a single sheet of paper, for several reasons. The first reason is that paper of such a large format simply does not exist. The second reason is that the difference in the expansion and contraction of such a large format could cause additional damage. We opted to line the drawing with smaller sheets (20 x 30 cm) of thin Japanese paper (Bib Tengujo 11 g/m<sup>2</sup>) in multiple layers with an overlap of around 1 cm. We placed two moistened sheets of Japanese paper with a 1 cm overlap on PET film, applied starch glue to them (4% solution<sup>25</sup>) and gradually placed them onto the back of the drawing (Fig. 20). With the pressure of a brush and a roller, the Japanese paper fitted more closely to the original paper support. In this way we gradually lined the cartoon until the entire surface was covered. We repeated the procedure with a second layer, being careful to ensure that the direction of the fibres of the Japanese paper was at right angles to the previous layer, since one layer of such thin paper cannot provide sufficient support to another layer of thin paper. We changed the direction of the fibres in order to reduce the possibility of greater expansion or contraction when re-moistening the paper.

Since the drawing was insufficiently solid even with two layers of thin Japanese paper, it became necessary to additionally strengthen it with paper of a greater weight. We did this

23 Preparation: starch glue in a ratio of 1 : 10 (50 g of starch in 500 ml of water) is obtained by boiling. The procedure takes place in 3 phases: 1. – swelling of the starch; 2. – heating the glue; 3. – gentle boiling. When the glue has cooled it is strained a few times and then diluted with water to the desired thickness.

24 Bookkeeper is a neutralising spray based on magnesium oxide which is used when wet neutralisation is not possible.

25 Preparation: starch glue in a ratio of 1 : 10 (50 g of starch in 500 ml of water) is obtained by boiling. The procedure takes place in 3 phases: – swelling of the starch; 2. – cooking the glue; 3. – gentle boiling. When the glue has cooled it is strained a few times and then diluted with water to the desired thickness.

with another kind of Japanese paper (Kozu Shi 23 g/m<sup>2</sup>) using the same method as for the previous layers, but with larger sheets (32 x 45 cm) (Fig. 21).

## Findings after completion of conservation-restoration procedures

Work on the ITT cartoon (*Jesus Cleanses the Temple*) was, despite the large format, simpler than we expected. The reason for this was the ungluing of the drawing into the individual sheets from which it was assembled. The entire conservation-restoration procedure took place according to the standardised method of conservation and restoration work on paper. Some phases were, of course, more demanding, among them disinfection of the paper support. It was necessary to choose a suitable disinfecting agent and a disinfection method that would not harm the paper support or the powdery drawing itself.

The next demanding phase of the work was the flattening and drying of the newly lined sheets of the drawing. When pressing them in the hydraulic press it was necessary to equalise the pressure so that the sheets were flattened evenly.

Every phase of work on the OP cartoon (*The Great Flood*), measuring approximately 20 m<sup>2</sup>, was a challenge, all the more so when it turned out that all the work would have to be done on the complete, full-size drawing.

Even manipulating the drawing – turning it, moving it and so on – required the coordinated effort of several people. During the course of the work it was necessary to move across the drawing, so we made use of polystyrene<sup>26</sup> sheets of a thickness of 5 cm. In this way we reduced pressure on the drawing as we moved across it.

Removing the backing paper, an operation that was necessary because of the acidity level and the risk to the original paper support, took a long time because, owing to its brittleness, the paper had to be removed in small pieces using scalpels and spatulas.

This phase was followed by lining with Japanese paper, which again required a well-trained team of restorers, who consolidated the entire drawing under identical conditions. Lining proceeded from one edge of the drawing across the middle to the other edge. Difficulties occurred when it came to lining the central section of the drawing, which was wet through following the laying of Japanese paper on the back. Since cellulose fibres swell in damp and water, the paper support in the middle of the drawing expanded, while the edges remained dry and stretched. By taking into account this ‘relief’ characteristic, we adapted the lining process to the uneven surface of the back of the drawing. With gradual drying, the paper support flattened out and returned to its original shape. Having thus been consolidated, the drawing is now waiting for the final phase of the work, namely mounting on a support for presentation to the public (Fig. 22).

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26 Styropor, or expanded polystyrene (EPS), is an insulating material that is used for thermal and acoustic insulation, most frequently in the construction industry.

## Plans for mounting on an additional support and for presentation of the cartoons to the public

The drawings are now conserved and restored and are stored rolled up on a large cylinder at the HRZ Restoration Centre in Ljubljana. In the future it is expected that both drawings will be lined with a new backing or auxiliary support (probably linen) which would allow them to be presented unrolled, in their full size. In this way, the public would be able to see the artists' skill as draughtsmen and their original idea before it was transferred to the frescoes. This idea will need to be carefully studied and tested. In principle the procedure should involve lining with art canvas that has been lined with two layers of Japanese paper (where we will need to be careful that the direction of the fibres crosses); the whole thing will have to be stretched onto a stretcher. The latter should be metal and must be sufficiently strong to hold the weight of the drawing, while at the same time it should have a system of springs to enable adaptation to the tension of the backing. On the basis of tests, we would combine methods used to mount wallpaper. This involves 'air pockets' that enable the support to react to any microclimatic changes independently of the backing. The method will need to be carefully considered with the help of colleagues from the easel painting department, who are experienced in dealing with large paintings, and all its advantages and disadvantages anticipated.

Another major problem, and one that for now appears to be insoluble, is that a large enough space with a suitable climate where the cartoons could be safely stored on a permanent basis and/or exhibited in their full size has not yet been prepared.

## Conclusion

By studying the creation of the cartoons and using the results of analyses, we established the level of damage to the works of art and in this way selected methods for the conservation-restoration procedure. Each individual phase of the work required consultation with colleagues and careful planning. The large format of the works made every standard phase of the conservation and restoration of works on paper more difficult, and it was therefore necessary to consider each step of the process in detail so as to avoid additional problems. Before beginning the conservation-restoration intervention, we posed ourselves an ethical question. By removing the paper and textile auxiliary supports, we intervened on the original layer that originally served as the support for the drawing. Because of their poor quality and the long period in which they were stored in unsuitable conditions, these layers were degraded and in this way represented a risk to the original paper support of the drawing. The decision regarding the removal of these degraded layers was not easy, and it was necessary to weigh up what was more important: preserving all the original layers (including those that were very badly degraded) or saving only the layer containing the drawing. We decided to document all the layers in detail, to remove all those layers that jeopardise the paper support containing the drawing, and to consolidate the support by means of new lining.

The restoration and conservation of paper works of this size, created on paper supports of poor quality, was a pioneering project both for Croatia and for Europe as a whole.

In view of all the work that has been carried out to date and the experience gained, it would make sense to present the originals to the public as soon as possible. The main obstacle to the realisation of this part of the project is space. At present there is no sufficiently large space with a suitable climate available in Croatia for the permanent and safe storage of such delicate items as drawings on paper of such enormous dimensions.

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