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Technological-Architectonic Studies on the Polychromy in the Grand Masters' Palace in Malbork

The construction of the residence of the Grand Masters in Malbork was inaugurated at the end of the 13th century. A hundred years later Mikołaj Fellenstein carried out a significant reconstruction very innovatory for his time. Particular decoration was used for the eastern elevation of the Grand Masters' Palace facing towards the court, which became the main façade of the Palace. It underlined the residential character of the building, and its architectonic divisions and sculpted details were different from other elevations. The rich and stormy history of the Malbork Castle is depicted here by vast damages either due to wars or to the adaptation to a royal residence or, last but not least, to numerous restoration activities undertaken in recent centuries.[1]

This is why certain difficulties arose concerning the explicit determination of the chronology of various fragments of architectonic decoration and in consequence the setting up of the order of the traces of paint layers. The determination of the colouring of the façade in different periods would not be possible without a thorough investigation of the palace's history. In recent years two authors, senior researchers of the Malbork Castle, have concentrated on this issue: Kazimierz Pospieszny and Bernard Jesionowski. Based on earlier sources, documentation, bibliography and every-day work at this monument, they elaborated the history of the building. As preparation for the future restoration of the palace elevation, K. Pospieszny published the "Documentation for the restoration of the façade of the Grand Masters' Palace".[2] This publication was a starting point for outlining a draft restoration programme. It did not, however, deal with the problem of polychromy that was inaccessible on higher storeys and fairly visible from the court level. Gothic polychromy was far better preserved indoors. In the grand rooms of the castle it was uncovered at the end of the 18th century. Restoration work began in 1983 in the High Vestibule and next continued in the Summer Refectory providing very interesting new material described in detail and interpreted by the author.[3]

An investigation of the polychromy of the interior is so important because it may help to interpret the chronology of the façade, as outdoor polychromy has hardly been preserved at all. The entire Palace has to be treated integrally. Both the indoor polychromy and the painted decoration of St. Catherine's Chapel may also be helpful.[4] Also a detailed examination of the chronology of walls and construction stages is important. The latest results of architectural research of the eastern part of the Palace were published by B. Jesionowski.[5]

It is worth listing in brief the dates significant for the stages of the construction and restoration of the Palace. First, the above mentioned works of M. Fellensteina from 1393-98, when Gothic pointed arch windows were replaced by rectangular windows and arcades were supported on granite columns with carved limestone capitals. In the 15th century after the war damages and abandonment of the residence of the Grand Masters in 1457, the Palace became a residence of the kings of Poland. For this reason further reconstruction was carried out. Later, in the 17th century new war damages were observed. The key date is 1782–86 when a textile factory was set up in the castle interior. This is when granite pillars were removed, stone windows deteriorated and spaces between pillars were bricked up. Also the crenels were demolished. The devastation of the Palace continued until 1804 when the Prussian king Frederic Wilhelm III prohibited further damage. In the following 200 years restoration work was carried out. As for the elevation, 1822 was an important date, when re-erections were removed and pillars and windows were reconstructed. Work continued until 1915 when Conrad Steinbrecht took over. World War II also left its trace on the Malbork Castle, including the eastern facade. During the renovation programme in 1947–49 deteriorated pillars were replaced by brick pillars (Fig. 1).

This short historical overview shows how complicated the interpretation of the architecture and the polychromy of the elevation is.

In November 1998 a complex restoration of the façade of the Grand Masters' Palace was undertaken, including construction work, reconstruction of granite columns in place of secondary brick pillars, cleaning the façade of deposits as well as consolidation and protection of the historical substance. A question arose concerning the colour and the final shape of the façade. Does the present knowledge permit to re-establish its historical appearance? Which of the historical periods would be the most appropriate for presentation? This complex problem was a subject of discussion on a wider forum. It was based on the results of historical, architectonic and physico-chemical investigation and restoration work, presented during a scientific session in Malbork in March 2001.[6] Scientific work was the foundations for a conservation programme regarding the final shape and colour of the palace façade.

The results of the physico-chemical investigation of the multilayer polychromy were presented with the aim to characterise the techniques and materials applied on the façade. Having done this, a chronology of the paintings on various fragments of the elevation was sought and their state of preservation was determined as well as the causes of deterioration.[7] Thanks to uncovered areas and a sample analysis, the original colouring of various stone elements of the façade (column capitals, cantilever beams, window frames, crenels and background) was determined.

Investigation of the polychromy on the façade of the Grand Masters' Palace

1. *Research material*

Free access to the façade from scaffolds allowed for a better evaluation of the state of preservation and the nature of the remaining polychromy. Traces of polychromy were found on all kinds of substrata on the architectural elements. It was best preserved on stone – in the area of the window framing, the column capitals and the cantilever beams. Some of these elements could

be part of the Gothic decoration of the façade. A multi-layer polychromy consisted of up to six chronological layers. In some areas it peeled off and delaminated (Plate VIII, 4, window frames) or changed its colour. As an example one can consider the blackened surface of capitals. The lack of a precise composition of the layers and the changes in their colours made it difficult to put this material in the right order.

Polychromy was also present as characteristic blue-green stains, as can be seen on certain Malbork portals repainted in the 19th century (e.g. Golden Gate, end of 13th c.)[8] and the portals of St. Anne's Chapel (1340)[9] (Plate VIII, 5 and 6). In the "chaos" of colours a trail was made to ascribe each to a particular period. By a comparison with the above-mentioned portals, the character and composition of the 19th-century paint layer was determined (dating probably from 1884; samples 7, 9 and 10 from window framing). Only 19th-century or later layers could be present on the crenels rebuilt in 1850 after they had been demolished in 1785 when the factory was set up in the palace.[10] Traces of peeling yellow paint were found there. The same type of paint was later found on the façade, where it was used as over-paint to cover the window frames (samples 8 and 11). This made it possible to date the layers from the lower storeys and to look for the earliest original layers.

Most important, however, were the traces of polychromy that were considered part of the genuine Gothic decoration of the façade. The samples were found in four areas uncovered in the course of earlier conservation work – from the side of St. Catherine's Chapel (sample 45), in the crack of the second southern buttress (sample 43), on the eastern wall[11]. Other remains of polychromy dating from this period were noticed under plaster on the southern wall and on the capital surface (sample 35) under a darkened over-paint layer (Plate VIII, 3). The samples were taken successively in the course of the restoration work in order to solve arising conservation problems. At this stage close co-operation of art historians, specialists of physical and chemical methods and restorers was indispensable.[12] 60 multi-layer samples were taken from the areas marked in Picture 1.[13] A probable area of the preserved Gothic structure of the elevation was marked in yellow.

2. *Methodology of research*

Thanks to exposure areas (outcrop) and observation in situ, appropriate sampling places were identified in the process of the restoration work. The investigation programme of the polychromy was completed according to the scheme presented in Plate VIII, 4 with the use of standard procedures.[14]

3. *Results and interpretation*

The results of the investigation of the remaining polychromy discovered on the eastern façade of the Grand Masters' Palace was presented in detail in the report of the technological restoration research,[15] including a description and interpretation of the scientific methods applied. The aim of this report was to find a correlation between the data obtained and the history of the façade and its changes in the course of time. It should be remembered that many factors can perturb the effects: e.g. the elevation could have been cleaned before successive over-painting in order to obtain a better adhesion and durability of the polychromy. Temporary painting intervention could also have been possible as well as repainting of only chosen fragments or colour unification of secondary wastage filling by means of heat-treated gypsum.

Polychromy on these fillings can also contribute to an identification of the earliest layers. In the course of the centuries the aspect of the façade was composed of a different colouring of its elements. Therefore, as a first step the results of the research methods will be presented for separate architectonic elements – wall background, window framing, supports, column capitals and 19th-century crenels. In the second step I will try to set up the chronology of paint layers and identify the genuine aspect of the façade.

3.1. *Interpretation of paint layers based on exposures and micro-chemical research*

In the samples tested, up to six paint layers were identified (Plate VIII, 2a–d). The material is chronologically diversified. Regularities were sought in the way various fragments of the elevation were painted. It was noticed that stone elements were painted similarly, e.g. window frames (sample 1) and cantilever beams (sample 19). Stone was first covered with lead white that could be a kind of substratum. Next, the elements were covered with iron red. This type of work with the use of lead white was often found in architectural polychromy dating from the 17th and 18th centuries, but it may also originate from conservation activities in 1817–25. The next layer – green-blue (sample 19) – originates probably from the second half of the 19th century. This type of over-paint is also present on the window frames (samples 7, 9 and 10).

On the artificial stone of the window frames (samples 5 and 11) and fillings (sample 6), first a grey layer is visible (chalk, gypsum, plant black), covered with ochre (yellow ferric clay). Window frames could originally have been painted in grey and then painted over with ochre (samples 6 and 11). They were filled in in certain areas and the fillings were unified by means of another yellow paint. This was oil paint, the presence of which was also stated on the crenels (sample 12). On the surface of the brick, in the background of the crenel tracery iron red is present (sample 16), in certain areas on a whitewash layer.

3.2. *X-ray fluorescence analysis*

The spectral analysis of polychromy samples[16] allowed for a detailed identification of chemical elements present in the paints of the same colour applied in different areas of the façade and for a comparison of layers dating from the same period. This is clear for the samples from crenels, stone blocks and polychromy on walls (joints, brick). The spectroscopic analysis confirmed the presence of lead yellow (PbO) on the crenels. Moreover, samples no 43 and 46 are distinguished by the contents of Ca, S and Fe. This is red on whitewash. The first sample was taken from a Gothic wall at the first buttress from the south. The latter comes from the exposure area near St. Catherine's Chapel. These areas were previously and independently identified as covered with early (original?) polychromy. A similar composition can only be found in the case of the red of samples 8 and 11 on stone elements.

Attention should be given to the contents of Zn ions (samples 27 and 28, cantilever beam) and Ba whose presence is also characteristic. It can be found in the overpaints of some window frames, capitals and cantilever beams. It has not been found on the crenels, bricks and joints and on original stone blocks.

Both artificial zinc white and barite white are pigments introduced to the palette in the first half of the 19th century (zinc white in 1834 and barite white in 1830).[17] Their presence allows for a more precise evaluation of the paint layers.

Tests were performed on an X-ray spectrometer PW 4025 Mini Pal, using Mini Pal software; analytical spectrum from sodium Na to uranium U.

3.3. *Initial analysis of media by gas chromatography GLC*
Gas chromatography was applied in order to identify fat acids in oil and tempera media. Two samples were analysed: a grey layer on a stone block behind a pillar (sample 32) and blue-green paint on a cantilever beam (sample 27). The grey layer contains glue, while the blue-grey contains linen oil.

Analyses were carried out on a chromatograph HF 6890 with a HP5 30m column; gas He – 2ml/min; detector FID, temp. 280° C. Research is continued.

The analysis of media in mortars was done micro-chemically.[18] The presence of oil was stated in all samples of yellow that had been used to paint over the crenel tracery.

Discussion

As a result of the investigation the type of materials was determined and the chronology of paint layers was set up for the façade of the Grand Masters' Palace in Malbork. Also the nature of the black layers was identified, which appeared not to be the patina typical of historical monuments. A resolution was also made concerning the question if apart from a different carving column capitals also differ in their material.

The results are the following:

1. Traces of probably the earliest paint layers were found on the surface of a wall near the first and the second buttresses from the south and near St. Catherine's Chapel. Spectroscopic analysis showed that they could also be present on the upper ledge of the second window from the south.
2. On column capitals numerous over-paints are present, containing white, red, green, yellow and black pigments.
   The darkened surface of capitals is due to the application of whitewash with lead white. In the course of time it turned into black lead sulphite.
   Among the capitals the first one from the south is particularly interesting. Executed in a different limestone it shows a characteristic punch. The earliest traces of painting are red.
3. Pigments present on various elements of the façade are:
   a) Yellow (two types) – ochre and massicot – found on crenels, window frames and cantilevers,
   b) Green (three types) – malachite, chrome and organic – traces on cantilevers, capitals and plaster,
   c) Red (three types) – minium, two iron reds – on capitals, cantilevers and crenels,
   d) Plant black – admixture to paint,
   e) White (four types) – chalk, lead, barite and zinc white.

The analysis of the layers' stratigraphy and their composition indicates the Gothic character of the colouring of the façade. As was characteristic for many constructions of that time, the walls of the Grand Masters' Palace were covered with red paint of natural ferric clay. Window frames and cantilever beams were painted with a lighter hue of red on chalk whitewash. Most probably the capitals were also worked in red.[19] This is testified by the traces of polychromy on the first capital from the south. K. Pospieszny reports on the domination of red on the façade, saying: „particularly astonishing is the red painting on elevations which was applied on brick walls immediately after the building had been finished, similarly as on the limestone white details, adding a darker or lighter joints network for a better exposure of the weft".[20]

In the next monograph more colours are reported, which is particularly clear in the case of the capitals. Stone window frames were again painted red. Unfortunately, the paint layers have only been preserved in traces and it is difficult to evaluate the character of the polychromy. Only 19th-century polychromy can be interpreted, especially on the crenels. The tracery was painted with grey casein paint composed of chalk, gypsum and plant black. The background of the tracery was covered with iron red on chalk whitewash. In overpaints lead yellow (PbO) in oil medium can be found. The same type of paint was applied to overpaint the fillings of artificial stone on window frames. This is a 19th-century over-painting with the use of paint applied also in other parts of the Malbork Castle.

Analyses carried out once again confirmed the necessity of integrated research. Conservation work on the elevation was completed in 1999 (Plate VIII, 1). Parallel investigation of the polychromy and supports to identify comparative parameters facilitate the interpretation of the chronology of paint layers. A comparison of the results with historical periods and the related changes may give an answer to the questions related to the architectural shape of the elevation. It allows to make conscious decisions concerning the final aspect of the façade.

Notes

1 Detailed documentation of the history and restoration work in the Malbork Castle can be found in the archives of the Castle Museum in Malbork. They also contain many sources and monographs in historiography.

2 Kazimierz Pospieszny, *Problematyka historyczno-architektoniczna elewacji Pałacu Wielkich Mistrzów w Malborku- rozpoznanie konserwatorskie,* mpis, Malbork 1988–1989, Archives of the Castle Museum in Malbork, Documentation Section.

3 Kazimierz Pospieszny, *Gotycki wystrój malarski głównego piętra Pałacu Wielkich Mistrzów Mistrzów Malborku w świetle ostatnich odkryć,* Acta Universitatis Nicolai Copernici, Zabytkoznawstwo i Konserwatorstwo XVII, z. 226, Toruń 1991, pp. 231–247.

4 This is reflected in more detailed work on the polychromy in the residence of the Teutonic Knights Order in Malbork: Kazimierz Pospieszny, Die Farbigkeit der Hochmeister-Residenz des Deutschen Ritterordens auf der Marienburg *[w:] Putz und Farbigkeit an mittelalterlichen Bauten,* edited by H. Hofrichter, Veröffentlichungen der Deutschen Burgenvereinigung e.V.,Reihe B: Schriften, Marksburg/Braubach 1993, pp. 78–84. Also O barwności rezydencji zakonu krzyżackiego w Malborku, [in:] *Sztuka około 1400,* Materiały Sesji Stowarzyszenia Historyków Sztuki, Poznań, November 1995, Warszawa 1996, pp. 251–269.

5 Bernard Jesionowski, Uwagi nt.wyników ostatnich badań we wschodniej części głównej kondygnacji Pałacu Wielkich Mistrzów Malborku [in:]. *Praeteria Posteriati. Studia z historii sztuki i kultury ofiarowane Maciejowi Kilarskiemu,* editor Mariusz Mierzwiński, Malbork 2001, pp. 383–400.

6 Maria Poksińska, Bernard Jesionowski, Małgorzata Musiela, *Konserwacja fasady Pałacu Wielkich Mistrzów Wielkich Malborku. Możliwości Wielkich granice kreacji,* Miedzynarodowa Konferencja Konserwatorska *Dziedzictwo Kulturowe Fundamentem Rozwoju Cywilizacji,*23–26 October 2000. Also: *Pałac Wielkich Mistrzów Malborku – wyniki badań architektoniczno-konserwatorskich,* Sesja naukowa w Muzeum Zamkowym w Malborku, 30–31 March 2001.

7 Collective work, *Badania technologiczno-chronologiczne fasady Pałacu Wielkich Mistrzów w Malborku,* mpis Toruń 2000, documentation in the Archive of the Castle Museum in Malbork. Analyses were performed by MACTE Toruń, on the commission of RESTAURO S.A, the executor of restoration works.

8 Bogna Jakubowska, *Złota Brama w Malborku,* Malbork 1989 pp.17–19.
9 Szczesny Skibiński, *Kaplica na Zamku Wysokim w Malborku,* Prace Uniwersytetu im. A. Mickiewicza w Poznaniu, seria Historia Sztuki, Nr 14 Poznań 1982. Also Ryszard Rząd, *Kaplica św.Anny na Zamku Wysokim w Malborku – zarys dziejów rekonstrukcji na przełomie XIX i XX wieku,* Ochrona Zabytków 2(1994) Warszawa, pp. 185–196.
10 K. Pospieszny, *Problematyka...* op.cit., p. 5.
11 The location was indicated by Bernard Jesionowski.
12 Physico-chemical analyses were performed by: Mrs Elżbieta Mirowska – microchemical analyses of pigments, Mr Adam Cupa – X-ray fluorescence spectroscopy XRF, dr Stanisław Gierlotka – X-Ray diffraction analysis XRD, Mr Marek Wróbel – X-Ray microprobe SEM-EDX, Mr Grzegorz Jaworski – gas chromatography GCL. Petrographic research of stone and mortar was carried out by dr hab. Andrzej Gąsiewicz in co-operation with a restoration group under the leadership of Ms Małgorzata Musiela.
13 Detailed description of samples in the files, see footnote 7. B. Jesionowski marked the probable fragments of the Gothic construction in yellow.
14 Hans Peter Schramm, Bernard Hering, *Historische Malmaterialien und ihre Identifizierung,* Berlin 1988; M. Matteini, A. Moles, *Naturwissenschaftliche Untersuchungsmethoden in der Restaurierung,* München 1990.
15 See footnote 5.
16 Adam Cupa, Maria Poksińska, *Spektrometr rentgenowski Mini Pal PW 4025 w badaniach warstw malarskich,* Rocznik Muzeum w Gliwicach, v.16, Gliwice 2001, pp. 315–325.
17 H.-P. Schramm, B. Hering, op. cit., p. 21.
18 Passim, pp. 192–214.
19 M. Poksińska, *Polichromia romańskiej i wczesnogotyckiej rzeźby architektonicznej.Zespół rzeźby trzebnickiej,* Toruń 1993.
20 K. Pospieszny, *O barwności...* op.cit., pp. 258–259. The author reports that traces of red were uncovered on elevations in 1990/1991.

Fig. 1. Facade of the Grand Masters' Palace before restoration in 1998. In the first arcades from the south fragments presented in colour plate VIII, 3 and 4 exist (Photo by A. Skowroński)