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Relocation of Iconographic Collections as a disaster response to water activity in 17th century palace

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Abstract:

The paper presents response to water activity damage that occurred on the wall of one of the storage rooms with the Iconographic Collections of the National Library of Poland in the Krasiński Palace:

1. *wall and room damage evaluation*
2. *microbiological sampling of air and objects*
3. *decision on relocation of the entire Iconographic Collections of approx. 500000 objects*
4. *preparation of the new storage rooms*
5. *decision on mass disinfection of the relocated objects*
6. *analysis of available disinfection systems*
7. *logistics of transportation*
8. *legal aspects of use of external disinfection system on premises of National Library*
9. *repackaging of large format objects for the disinfection system of National Library*
10. *introducing the evaluation of microbiological condition for individual large format objects instead of disinfection*

The entire operation took over 2 years and was executed by Department for Iconographic Collections and Department-Laboratory for Conservation of Library Collections with great help of many other units of National Library. In effect the storage conditions of Iconographic Collections were significantly improved. The experience gained during the relocation became the material for further research (including the microbiological evaluation of entire collections), procedures and training.

The Department-Laboratory is now the part of the Institute for Conservation of Library Collections of the National Library of Poland.

Introduction

The Department for Iconographic Collections of the National Library is one of the four departments that collect, preserve and provide access to the most precious of so called special collections (other three are the departments for early prints, manuscripts and cartographic collections). Similarly to the departments of early prints and manuscripts the Department for Iconographic Collections was located the Krasiński Palace (known also as Palace of the Commonwealth). This 17th century building has a long history of damage including three days long fire in 1782 and almost complete destruction during Warsaw Uprising in 1944. It was rebuilt in years 1948-1961 and became the main building of the National Library until 1980's. Since 1965 it is in the register of objects of

cultural heritage and every repair or modification has to be approved by the Office for Preservation of Objects of Cultural Heritage. There are no active systems of climate control like air-conditioning, but relatively thick walls provide stable climate with the average temperatures in summer that exceed these recommended by the ISO-11799 standard (up to peak of 27ºC while it was above 35ºC outside (measured by the sensor placed above the roof). On the other hand – in winter ("heating season") the relative humidity of the air drops below 40% which is not optimal for parchment objects and leather bindings of the early prints.

There are over 500 000 items in the iconographic collections of the National Library including: 68 000 of prints, 20 000 of drawings, 46 000 of ex libris, 115 000 of photographs, 100 000 of post-cards, so called *varia* (woodcut blocks, chalcography plates, coins, medals, orders of merits, melee weapons), 7000 of albums and folders (with photographs, ex libris and reproductions) as well as experimental and artistic books of different form (scrolls, leporellos) and materials (fabrics, wood, stone, handmade paper, beads, ribbons, feathers, pieces of plants).

The main five storage rooms (numbers 218, 217, 216, 215, 214) of the Department for Iconographic Collections were located on the second floor of the Palace, the last floor below the attic and the roof.

Water activity on the wall and ceiling of the storage room 218

The first information on water activity came on Monday, 22nd February 2010. Immediate action was taken: local vision of about $2m^2$ already drying wet spots and plaster coming off the wall, dry swab microbiological sampling of the walls and ceiling, impact sampling (MAS-100*Eco)* of the indoor air as well as background (atmospheric (outside) air).

Table 1. The results of first microbiological sampling of the air in the storage rooms of the Department for the Iconographic Collections on 22nd February 2010. Values in CFUs/m^3, both indoor and outdoor samples were 50dm^3. The following hyphaceous fungi were isolated in the indoor air: *Penicillium* sp., *Clasporium* sp. and hyhpaceous fungi without morphological characteristics enabling identification. The same fungi were isolated from the outdoor air with extra 3 colonies of *Aspergillus* sp.

lp.	storage room	T of the air	RH of the air	n. of samples	range of values	moulds (hyphaceous)	yeasts / bacteria	microorganisms (total)
1.	215	16,8 ºC	41,9%	6	0 - 60	3	20	23
2.	218	17,9 ºC	45,2%	6	20 - 200	7	73	80
3.	217	18,9 ºC	41,1%	6	0 - 200	0	57	57
4.	214	18,4 ºC	33,4 %	6	0 - 40	0	10	10
	Average background	-2 ºC	92%	6	0 - 140	50	3	53

As we can see from Table 1. in two storage rooms (218 and 217) the values for the indoor air were higher than those of the background. It could be worrying since one of the best (in my opinion) regulations on that subject recommends that the value for the indoor air should be always lower [1]. On the other hand: 53 CFUs/m^3 is exceptionally low for the outdoor air (it was February) and even 80 CFUs/m^3 is a usual for the storage rooms of the Palace (based on regular sampling of the storage rooms). The consecutive sampling in room 218 on April 15th (even when mould appeared on the wet spots on the wall) gave the following result: 120 CFUs/m^3 (background:461 CFUs/m^3). The mould was rubbed off with paper towels moistened with medical disinfectant (Aerodesin 2000: water solution of 32,5% propanol, 18% denatured ethanol and 0,1% glutaraldehyde) used in our microbiological laboratory and never reappeared as the wall dried and the relative humidity of the indoor air did not exceeded 60%.

The contact sampling of the surfaces did not showed any CFUs from the wet spots in room 218 (although few days later colour changes and mould appeared), the results are presented in Table 2. For detailed description of the sampling methods see my book on microbiological controls [2.]. Along with the wet spots in 218 we sampled any suspected (new and old) spots on the walls of other storage rooms and the results show that even "clean" parts of the walls have enough dust to "be positive" in sampling (rooms 221 and 223) but in case of wet spots the values should be higher (rooms 221 and 223). On the other hand – as we know today (please see my 2015 IADA presentation, paper to be published) the dry swab sampling procedures shows between 10^{-1} to 10^{-3} of the CFUs present on paper surface. Basing on these results of the air and walls sampling by the end of April we already knew that water activity in the rooms did not have effect on the microbiological condition of the air (that may influence the levels of presence of CFUs on uncovered surfaces by sedimentation). It must be stressed here that such an obvious and simple prophylactic action (described in chapter *6.8 Furniture and equipment* of the ISO-11799 standard [3.]) as keeping the furniture at least 200mm from the wall prevented from the damage to the objects (in my practice I have already seen books covered with mould only because they touched the humid wall of the cellar).

Table 2. Results of the dry swab sampling of the walls and ceilings of the storage rooms in Krasiński Palace . Sampling February 22nd, inoculation 25th-26th February, counting and identification of colonies: 8th March. For each room with suspected spots "clean" ones (without evidence of water activity) were sampled as control for reference values. NN - hyhpaceous fungi without morphological characteristics enabling identification. b/y – bacteria or yeast-like microorgnisms (not hyphaceous)

sampled spot (room, spot)	no dilution	dilution 1/10	dilution 1/100
215 clean (control)	0	1 x *Penicillium sp.*	0
215 wet spot	1 x *Penicillium sp.*	1 x *Penicillium sp.*	0
	3 x *Penicillium sp.*, 2 x *Cladosporium sp.*, 1 x b/y		
217 clean (control) 1	0	0	0
217 clean (control) 2	0	0	0
217 wet spot high	0	0	0
217 wet spot low	3 x *Penicillium sp.*	0	1 x *Penicillium sp.*
			1 x *Penicillium sp.*
218 clean (control) 1	0	0	0
218 clean (control) 2	0	0	0
218 wet spot - window	0	0	0
218 wet spot – above the bookcase	0	b/d	0
221 clean (control)1	1 x *Penicillium sp.*	0	0
221 clean (control) 2	0	0	0
221 wet spot 1	1 x NN, 1x b/y	0	0
221 wet spot 2	2 x *Cladosporium sp.* 3 x b/y	1 x NN	1 x NN
	1 x b/y		
223 clean (control) 1	2 x *Penicillium sp.*	0	0
223 clean (control) 2	1 x *Penicillium sp.*	1 x *Penicillium sp.*	0
223 wet spot 1	4 x *Penicillium sp.*, 3 x b/y	0	1 x *Penicillium sp.*
	4 x *Penicillium sp.*, 1 x b/y		
223 wet spot 2	1 x *Cladosporium sp.*	2 x *Cladosporium sp.*	1 x b/y
	3 x *Cladosporium sp.*, 4 x *Penicillium sp.*, 2 x b/y		

The immediate analysis of the data from the TESTO loggers proved that the water activity on the walls did not have impact on the climate of the storage rooms. Below an excerpt from original Laboratory summary (prepared by Joanna Wasil) on climate conditions:

Temperature [˚C] in storage rooms 215, 217, 218
In January the average month temperature was 16,9 ˚C
- the lowest temperature values were measured in storage room 215: 13,2 ˚C
- the highest temperature values were measured in storage room 217: 19,4 ˚C
In February until the water activity the temperature was fluctuating from approx.14,0 ˚C (storage room 215) to approx. 18,7 ˚C (storage room 217)
Between 17th and 22th February the temperature was fluctuating from approx. 15,4 ˚C (storage room 215) to approx. 18,6 ˚C (storage room 217)

Date	*Temperature [˚C]*		
	storage room 215	*storage room 217*	*storage room 218*
17.02 (Wednesday)	*15,4*	*17,9*	*17,5*
19.02 (Friday)	*16,3*	*17,3*	*17,0*
22.02 (Monday)	*16,4*	*17,5*	*17,3*

Relative air humidity[%] in storage rooms 215, 217, 218
In January the average month relative air humidity 32,2 %
- the lowest relative air humidity values were measured in storage room 217: 26,1 %
- the highest relative air humidity values were measured in storage room: 40,2 %
- the average water content was 4,0 – 4,2 g/kg of the air
1.1 In February until the water activity the relative air humidity was fluctuating from approx.26,2 % (storage room 217) to approx. 36,6 % (storage room 215)
1.2 Between 17th and 22th February the relative air humidity was fluctuating from approx. 30,5 % (storage room 217) to approx. 37,4 % (storage room 215)

Date	*Relative humidity [%]*		
	storage room 215	*storage room 217*	*storage room 218*
17.02 (Wednesday)	*35,8*	*31,0*	*32,0*
19.02 (Friday)	*35,8*	*32,0*	*33,8*
22.02 (Monday)	*35,7*	*32,2*	*34,0*

Conclusions: *Water activity in the storage rooms of Department for Iconographic Collections did not influence the temperature in the rooms. The relative humidity was increased but difference was low enough not to be dangerous (e.g. to cause the growth of fungi), especially when the objects in winter are usually overdried in the Palace. The only possible threat to the objects in this situation would be direct water activity on objects.*

The most probable reason of the water activity were leaks in the copper covering of the roof of Palace combined with excess of snow thawing upon it. It was controlled and repaired quickly, but the flooded walls and ceiling in storage rooms required repair. Because the room 218 is the last one in a row, it is accessible only through the storage rooms 214 (with reference collection) or 217 (with regular iconographic collections) and therefore no repairs could be executed without securing or removing collections of at least two rooms. In this particular case and considering the value of the collections as well as its vulnerability to dust (exceptionally photographic post-cards in the room 218) repairs in the rooms with objects of heritage was not an options. Since at least part of the collections had to be removed we came to idea of relocating all of them to the main building with full climate control (air-conditioning). This solution brought some extra advantages for the objects: new furniture (steel one instead of old wooden one), possibility of immediate conservation actions (without transportation of objects between the Palace and the main building), better access for the readers.

The relocation

Within a week from decision a two new rooms for the iconographic collections were found: 0408 in specially protected area and 1129, the former storage rooms for microfilms. The greatest concern was the climate in the new storage rooms, since 1129 is located on the first floor just below the flat roof which may cause the temperature to increase beyond recommended limits and capability of air-conditioning systems in summer months (a common issue in the neighbouring storage rooms 1120A and 1108D of the cartographic collection). We took that risk into consideration but the advantages of the relocations were greater. The rooms were refurbished following the already mentioned ISO-11799 standard. Series of air sampling (both microbiological and chemical after painting) were made, new infrastructure was introduced (most important changes for the collections were: new large format steel chests of drawers and repackaging of the photographs into polyester L-envelopes and new boxes following the PAT attest.) Since we already knew that the microbiological conditions of the air in the Palace are worse than in the main building and the new storage room is connected to the same branch of the air-condition system as the other storage rooms we decided to sample random 200 object of the iconographic collections (both objects and their protective boxes, envelopes and folders) to determine their microbiological conditions. The detailed results and procedures are described in my book and were also partially presented at IFLA congress in Goteborg [4.].

The final conclusion was the decision on disinfection with ethylene oxide (gas "S": 10% of ethylene oxide and 90% of carbon dioxide) of all objects that were made with technology allowing such a conservation treatment (ethylene oxide is safe for paper, but my cause damage to protein component of the objects like: albumin, gelatine, parchment, leather, silk, wool). The problem was that the disinfection chamber of the National Library with internal dimensions 0,65m x 065m x 1,9m has a working capacity of approx. 0,7m^3 and the top performance is two 48 hours long cycles per week. Another problems were size of some folders of graphics and posters exceeding 100 x 70 cm. Packages of that size would not fin in the chamber even when placed slanted; furthermore: a single package would be the whole batch then. We considered three options of disinfection of iconographic collections in external chambers, but none of them was safe enough or effective enough (the chamber of the National Library is unique in Poland because it is a pressure-vacuum chamber i.e. the disinfection takes place in up to 2atm pressure and aeration (air rinsing) between 0,5atm vacuum and normal pressure; the high pressure of the process means that the concentration of ethylene oxide may reach 522mg/dm^3, while disinfection in normal pressure (1atm) means 170mg/dm^3). Other problem was transportation of the collections to the external contractor. One of the options was the chamber of the State Archives in Milanówek (half an hour drive from the centre of Warsaw). It had capacity of approx. 10,6m^3 (dimensions: 1,5 x 3,5, 2m). It would mean ten convoys with the Library's half-truck and the Library Guards to fill a single batch. Because of labour required to prepare such a single transport it could be only one per day. That means 2 weeks before the first batch and for over ten days the objects would be in the storage rooms of another institution with no guarantee for the conditions of the storage. Another option was order a mobile chamber, but we did not overcome the safety aspects of introducing such an installation of external contractor on premises of the National Library. The potential contractor stated that there will be only one operator which was unacceptable; please imagine the following situation: the operator passes out or is found unconscious by the chamber that is hissing. What should we do then? Call the director of the company that is 350km away and evacuate 800 people of library personnel plus another hundred readers and call the Chemical Section of the Fire Department while waiting for him?

Another very important problem was the value of the transported objects. The maximum value of items of cultural heritage that can be moved without the police escort is defined by proper state regulations. It is very easy to exceed this value (expressed as a multiple average salary) and fall into official police convoy procedure. Especially with folders of prints by famous artist. That is why the volume of 0,7 cubic metre or 8 standard library steel boxes was the one transport limit.

The repackaging and evaluation

Since we did not find a solution how to disinfect large format objects (although a project of procedure of loading and reloading of the mobile chamber was ready, including use of crates and laboratory tables and working in the ducking position with gas-masks on the faces of the staff), we were forced to create a bypass path. All extra-large packages that did not fit into the chamber were opened, repacked into smaller ones (and disinfected) or evaluated (single objects one by one) and classify as microbiologically stable and forwarded to the new storage room. Altogether 30 objects from 24 packages (about 2000 items) were disinfected or microbiologically sampled before entering the new storage room. In most cases we succeeded (together with the staff of the Department for Iconographic Collections) to repack the folders and fit into our chambers for preventive disinfection. Some may question the term of "preventive disinfection" but as a mater of fact it may be widely used, e.g. in case of suspected mail, please see [5].

Summary

The most important aspect of the case was that the National Library had a conservation oriented laboratory unit with experience of field sampling and a clear vision what had to be achieved. From the very beginning the question was not "what" but "how". We did knew exactly what we are aiming for, it was just the matter of time and resources. We knew the standards to follow, our lacks and possible variants of fixing them. We had experience of years of silent and mostly "grey" work of monitoring the conditions and collecting data day by day. Therefore we knew exactly where we are going to come back, when situation turned to critical. It was just the matter of time, but the first thing a conservator has to learn is patience, also when communicating with the finance and administration department. These people are great support but do not think "in ages" (the expected "guarantee" for conservation treatments is about 100 years, they usually work within a "budget (or tax) year"). The whole operation of relocation of the iconographic collections took almost two years (first transport reached the disinfection chamber in September 2010, the last one left the Laboratory in July 2016). That was only 5 storage rooms out of over 20 in the Krasinski Palace. Within the next two years we are going to relocate over 170 000 of the early prints from the Palace to the main building. The estimated time frame is 2 years. Look forward to the next paper.

Figure 1. The bookcase in the storage room 218 is already removed and walls and ceiling does not look like heavily damaged. But any repair would require introducing the repair team and a lot of dust while removing the damaged layers of the wall probably down to the bricks.

Figure 2. After few days greenish shades appeared. It is an evidence of mould growth, probably of

Penicillium genus. Immediate counter-action stopped the growth, but the key is to eliminate the cause (humidity of the wall), not only the symptom.

Figure 3. Another example of damage: the plaster layer is peeling off in blisters and flakes, emitting dirt and probably CFUs (again the green shades). The wall and ceiling should be explored till firm layers undamaged by water. Difficult to perform with collections remaining in the room; this problem however was solved couple of years later.

Figure 4. Collecting a dry swab from the window area. Note the evidence of humidity by the window frame and the *ad hoc* counter action - towel between outer and inner window. Today we have already new windows.

Figure 5. View of the Palace from the Krasinski Square. The two right windows above the second level of arcades just left to the tympanum are the windows of the storage room 218. The water activity appeared on the wall that separates room 218 from the Wilanowska Hall (five

windows below the tympanum) also containing early prints.

Figure 6. View of the Palace from the Krasinski Garden. The top four windows right to the tympanum are the windows of the previous storage rooms 214 and 215, now the regular work rooms of the Department for Manuscripts.

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