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ANALYSIS AND WAYS OF IMPROVING PRESERVATION CONDITIONS IN THE COLLECTION OF 16TH - 17TH CENTURY FOREIGN ATLASES IN THE NATIONAL LIBRARY OF RUSSIA

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Abstract: The collection of foreign 16-17th-century atlases in the National Library of Russia is unique, both in its size and the range of authors, as well as in the number of new editions. It gathers over 450 volumes of masterpieces of world cartography. The superior historical and artistic value of this collection makes the problem of its preservation a matter of extreme current importance. The paper contains the results of analytical examinations of the stock. The main types of damages and binding characteristics have been revealed and classified. The conclusion states that the paper destruction in the course of its natural deterioration (storage) is caused likewise by external environmental factors and the ink applied to the paper. The paper presents statistical information describing the degree of safety in various items of the collection. It also describes a programme for their conservation.

The collection of printed books and atlases held in the National Library of Russia is among the country's richest ones, numbering over 170 000 bibliographic units. Of world-wide importance, both in size and richness, is the collection of West European engraved atlases of the 16th-17th centuries, containing over 450 volumes.

The 16th-17th centuries period was the time of cartographic rise and flourishing, triggered by the great geographic discoveries providing material for new maps and opening extraordinary vistas for the geographic outlook of mankind. Map-making was also largely affected by the major event in the 15th century culture, the invention of the printing press, followed by the practice of map engraving and printing. To meet the demands of commerce and navigation, atlases were published, systematic sets of maps and multi-purpose repositories of accumulated knowledge.

The earliest dated edition in the Division of Maps of the National Library of Russia (NLR) is a set of maps made by Ptolemy to supplement his « Geography »

published in 1508. On the whole, the work reflects pre-Columbian ideas in geography, but it also contains one of the first maps showing the recently discovered America - the « Universal Map of the Known World according to Recent Discoveries » by I. Ruysch (Rome, 1508). An end to the mixture of old and new geography, characteristic for the 15th century science, was put by the works of Abraham Ortelius. The NRL's collection contains 30 different editions of his atlases - the world's first printed atlas in the strict sense of the word. There are also 25 editions of one of the founders of science-based cartography, Gerhard Mercator, including the rare preliminary life-edition of 1585, published 10 years before the better known basic volume.

The Library also holds the country's only world atlas by Cornelius de Yode, 1593, of which the publication was never repeated ; one of the first printed marine atlases by Lucas Wagenar, whose importance in navigation cartography can only be compared to that of Ortelius in general geography ; several editions of the atlas of world city plans by G. Braun and F. Hogenberg ; many volumes of works by the predecessors and followers of Ortelius and Mercator - the atlases by Blaeu, Hondius, Janssonius and some others. The collection also contains assembled atlases, with maps made by some of the best engravers of the time.

16th-17th century maps were generally copper-plated, often hand-illuminated. Traditionally, there were rich ornamentation in the prevailing artistic styles, which made them similar to works of art, and their makers, to genuine artists. Thus, for example, A. Ortelius was a member of the famous guild of Saint-Lucas, an association of painters and engravers.

The superior artistic, historic and scientific value of the collection makes the problem of its preservation a matter of extreme accurate importance. To cope with the problem, analysis was performed in the condition of 343 volumes of foreign 16th-17th century atlases, both black-and-white and illuminated.

In the course of our examinations, we found destructions either typical for many paper-supported data, or characteristic for only the atlas collection. The most significant among the latter was paper disintegration due to effects of green dyes.

The generally recognised phenomenon of green dye lies in the fact that paper exhibits a strong brown colouring on its reverse side where there is green dye on the right side. Frequently, the dye itself turns brown, with the underlying paper getting unusually brittle, which results in fragmentary paper deterioration. Moreover, where the dye retains its colour, dark brown contours appear on the reverse side, corresponding to the green dye segments.

The most frequently used in Europe green dye, mainly in the Netherlands, Germany and Italy from the 12th to the 17th centuries, was basic or neutral copper acetate, the verdigris.

In Russia, the dye is called « iar'-medianka ». Its main advantage is the clear green colour. Often copper acetate has been used with lead or tin additives, to give other tints to the colour. Examinations made in Germany in the green dye of illuminated manuscripts also indicated basic copper nitrate - gerhardit, basic copper carbonate - malachite, a copper acetate - neutral gruenspan. Of all green dyes, however, copper acetate is considered to be the most reactive and the least stable.

There have been various hypotheses to explain the chemical nature of the dye's turning brown and paper's deterioration due to effects of green dye. The most reasonable opinion seems that cellulose degradation cannot be explained by a reaction according to an acetic mechanism only, nor can be regarded as an exclusively oxidation process. The presence of copper causes cellulose degradation both in acidic and alkaline media.

In the 16th-17th centuries, before the invention of paper-making machines, paper was cast by hand, with cotton, flax or rags, depending on manufacturing country, used as initial cellulose material. The random microstructural analysis of paper fibre in various samples, made in the Conservation Unit, indicated cotton cellulose in atlas paper.

The high quality of the raw material will ensure the strength and long life of the paper manufactured. Analysis of binding agents with fine-layer chromatography indicated the presence of glucose and aminoacides, thus permitting the conclusion of the presence of honey and gelatine, widely applied by artists. Paper pH determination with contact method showed the index in the interval of 5.5 - 5.7 on edges and in the areas free of green dye or printed text, and between lines.

This holds true for paper in good condition. In sections covered with green dye paper, pH value is lower, equalling 4.0 - 4.8, which confirms the idea of paper deterioration due to the presence of acids, at least at the initial stage of destruction. As regards to atlas paper in general, one may describe it as uniform in composition, devoid of mineral filling, with animal glue used as a binding agent.

While examining paper as an information carrier, all the indicated destruction were categorised, with the degree of destruction evaluated in each individual volume in terms of destruction forms (Table 1). The index « degree of

destruction » was used conditionally, to evaluate contribution of each individual destruction form to the overall process of paper deterioration in the atlases. The preservation degree in each atlas was defined as the difference between 100% preservation standards and the overall degree of destruction. Examination data illustrated by 3 atlases are shown in Tables 2 and 3.

Table 1

Description of the collection of foreign atlases in terms of paper destruction forms

Forms of paper destruction	Degrees of destruction	Number of volumes
Mechanical :		
Ruptures :		
on paper edges	10 - 15	53
in centre	15 - 20	69
deformation	5	1
losses	90 - 100	9
Deterioration :		
due to effects of green dye	95 - 100	6
due to effects of black ink	20 - 30	4
due to effects of printing dyes	10 - 20	
Physico-chemical :		
Contamination :		
overall	10 - 15	154
soiling (grease spots)	5	11
traces of glue	20 - 30	6
finger marks	5 - 10	144
foxings	10	53
Changes in colour :		
turned brown on edges	15 - 20	21
turned brown on one side only	20 - 30	3
overall brown	50	142
pigmentation	20 - 25	21
Biological damages	50 - 100	52

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The main form of damage evident in all paper-supported data is the destruction related to natural material ageing. This is primarily manifested in changes in the paper colour, the paper turning brown, generally starting from edges, due to the absorption of air acidic components by exposed paper surfaces. The extension of brown spots over the page, evidently, occurs faster, since accumulation of the acidic products of cellulose deterioration catalyses further degradation.

This has a significant numerical support : in 9 volumes the paper deteriorates, 21 volumes exhibit edges turned brown, and 142 volumes overall turning brown. Changes in paper colour are often of a local nature, sometimes evident in irregular pigmentation, which is most likely related to the process of paper manufacture.

Trivial damages, resulting from frequent and careless use of the document, or inadequate storage condition are :

- ruptures in the centre or on edges (69 and 54 volumes respectively)
- general soiling (154 volumes).
- Frequent are the cases of foxing (53 volumes).

Regretfully, it must be maintained that periodic violation of storage regime are the causes of generating foci of biological damages. Generally, micromycetes appear on edges, where paper structure is often broken and the paper becomes loose. In 16 cases, micromycete growth in paper resulted in complete deterioration.

The relationship of deterioration processes to the appearance and condition of colour layer can be traced fairly well (Table 1). And, of the 342 volumes examined, only 6 exhibited paper in green-coloured sections as brown, brittle, cracking, ruptured or sometimes lost, and 3 more showed cracks and ruptures, in due time more illuminated atlases will certainly be destroyed, the green being the potential agent in the process.

In 86 cases, there was evidence of green dye turning brown and migrating to the reverse side, distinctly reproducing configuration of the dyed section, and also migrating to the right side of the next page (Table 4).

The picture of paper deterioration can be supplemented with losses on map margins where there are texts written in ferro-gallic ink. In three cases out of four, sections of lines have slipped out.

There have been also parallel ageing processes going on in the other data supporting medium, the printing dyes and, subsequently, in the text. First a red, and then a brownish stain appeared around the letters, the text became diffused, transferred to the reverse side and neighbouring pages, the paper colour changed.

In early printed books and newspapers drying oils were used as binding agents. Perforation of a page with printing dyes occurred during printing dye being applied to the page. In time, there have been only slight dye migration and changes with ageing - when a yellow or brown halo appeared along letter outlines. It is well known from the literature that early printers added to printing dyes copper or lead oxides to darken the black and quicken drying (1,6). Probably, the presence of copper oxides « contributed » to the process of dye (text) ageing. In 67 atlases, there is strong evidence of black printing dye migrating to the vacant area between the lines, which a brownish halo developing around the letters.

Analytical findings have permitted to distinguish between three conditional categories in the degree of preservation.

Table 4

Defects caused by changes in text (pictures) with natural ageing

Appearance and condition of data supporting material	Number of volumes
Green water-colour	
Migration to the reverse side	86
Migration to the neighbouring pages	8
Changes in colour	23
Red water-colour	
Migration to the reverse side	3
Migration to the neighbouring pages	2
Black printing dye	
Migration to the reverse side	9
Migration to the neighbouring pages	4
Migration between lines (halo around letters)	67
Changes in colour	12
Ferro-gallic ink	
Colour changes	3

1. Preservation degree 70 - 100% : the paper has changed colour due to natural ageing and effects of green dye, but retains its strength.
2. Preservation degree 50 - 70 %: the paper is brown and brittle.
3. Preservation degree under 50%: loss of paper, the remaining paper is brittle, crumbing when touched.

About 80% of the atlas collection can be referred to the first preservation degree, requiring stabilisation treatment to retard further deterioration. The remaining 20% belong to the second and third categories. They require repairment in combination with strengthening and stabilising operation.

In 1980-1981, the Conservation Unit of the National Library of Russia started investigations aiming to design a technology for the restoration and stabilisation of 16th-17th century atlases, deteriorating due to effects of green dye. Today, the technology has been designed and is being continuously applied and improved (2,9). It has been a success in repairing atlases and illuminated manuscripts in the National Library of Russia and in restoration units elsewhere. We have had ample opportunities to examine the restored material in depositories. The findings have been very convincing : the atlases repaired in 1983-1986 can now be referred to the first preservation degree. There have been no evident changes in the conditions of paper, colour layer or binding.

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