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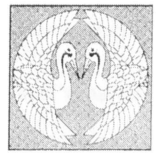

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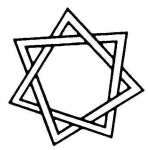

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CONSERVATION PROBLEMS

K. B. Kalinina, E. G. Shishkova

SOME ASPECTS OF INVESTIGATION AND CONSERVATION OF GLUE PAINTING ON PAPER FROM KHARA KHOTO

The Hermitage has at its disposal a large collection of Chinese Buddhist pieces of art of different painting schools and of different periods. In particular, the collection includes the unique items found during the 1908—1909 excavations of the famous *suburgan* near the dead city of Khara Khoto in Northwest China. These objects originate from the Tangut state Xi Xia (982—1227) which was destroyed by Mongolian troops of Genghis Khan. The excavations began on the initiative of the Russian Imperial Geographic Society and were carried out under the guidance of the outstanding explorer of Central Asia P. K. Kozlov [1].

The collection under consideration here consists of about 200 Buddhist icons painted on canvas, silk, and paper, as well as of a number of secular items. During several recent years, some icons of the collection have been restored. The restoration was accompanied by technological investigations which not only allowed the researchers to familiarise themselves with the old painting technique employed, but also helped them to solve some restoration problems of importance. For instance, it has been found that the paintings are mainly made by using a traditional technique with the use of animal glue as a binding medium for sizing and ground, the ground thickness varying within a certain range. Some objects appeared to be painted on a sized support without additional ground as became clear, for example, from investigating a number of icon fragments painted on paper and silk. The colour of the ground may be white, ochre or reddle.

Among the unique items under study here, there is a set of fragments of *mukut*-crowns. These are almost intact and consist of separate parts, or fragments. Each fragment is a multi-layered support which is made of text-bearing paper sheets glued together, the top one being painted in the glue painting technique. Some of the fragments have vestiges of strings employed to assemble the whole of a crown.

The investigation of pigments adhesive and of the binding medium of the paint film and ground, as well as the examination of the composition of adhesive for gluing together the multi-layered paper support were made. The painting technique was studied by using micro-chemical analysis and thin-layered chromatography. The analysis showed that the following pigments were employed: orpiment and yellow ochre for yellow, cinnabar and red ochre for red, azurite for blue, malachite and green ochre for green, and carbon black. The ground was made of chalk with a great amount of animal glue. Ochre in the colour ground is also present.

To analyse the binding media, we used domestically produced "Sorbfil" plates. In order to improve their selectivity, the plates were preliminarily impregnated with inorganic salts. Carbohydrate part of the binding medium hydrolyzate was analysed using plates impregnated with phosphate buffer having pH=8.0 in the system propanol-1 — chloroform — dimethyl phormamide — water. This system, which enables the researcher to separate neutral sugars and uronic acids, was developed by the authors of the current paper [2]. For visualisation of chromatographic zones, we suggested an original reagent allowing one to obtain spots of different colours for a number of monosaccharides [3]. All this can facilitate the binding medium identification. In order to analyse protein-bearing medium, plates impregnated with salts of alkaline-earth and transition metals were used. Chromatographic analysis was carried out in the system propanol-1 — acetone — NH_4OH. It has been already shown earlier that impregnation with sulphates of transition and alkaline-earth metals changes the separation ability of silica gel [4]. The best results were achieved for the plates impregnated with $CuSO_4$ solutions (0.01÷0.02M). The use of this impregnant allowed us not only to improve the selectivity of silica gel with respect to amino acids to be separated, but also to obtain, after treating with ninhydrin, spots of different colours for the major part of them. Thanks to this, the identification of the binding medium became much easier.

The analysis showed that animal glue was used as a binding medium. Besides animal glue, which was the basic component, the paint-layer binding medium includes a small amount of plant glue. To glue together the text-bearing paper sheets inside the crown, a mixture of plant glue and a small amount of animal glue was used.

It should be noted that the problems of restoring and conserving the *mukut*-crowns arise from the fact that they are archaeological items, which underwent a long-term storage in the ground in humid environment. As a result, the crowns' paper support partly lost their interior sizing, which led to the loosing of their structure too. In addition, some

Fig. 1

Fig. 2

Fig. 3

areas of the paper were so strongly destroyed that the support fell to separate fibres and fragments. The glue between the paper sheets has also lost its gluing effect. Therefore, we have mainly fragments of *mukut*-crowns split into separate sheets or blocks of sheets glued together. The paint layer, covered with sedimentations of soil and clay, was strongly deteriorated as a result of centuries-long storage in unfavourable conditions. Here and there it was detached from the support, covered with cracks, suffered peeling and dusting (see *figs. 1* and *2*).

Since these fragments are rare pieces of art and history and, on the other hand, the materials they are made of are very brittle and strongly deteriorated, our purpose was to prolong their life by employing most delicate conservation. The main task was to remove the surface soil precipitations to permissible extent, consolidate the paint film and support, and also to develop a procedure of storing the *mukut*-crown's fragments, bearing also in mind the necessity of research work.

The surface precipitation were removed from the areas where the paint layer was stable, i.e. where it lacked considerable damages such as peeling off, detaching from the support, or swelling. This was done in such a way as to avoid damaging the original paint layer. The soil and clay, forming an even thin film on the painting surface, were removed with a kolinsky or squirrel brush No. 0 by delicately touching in circular and straightforward direction. The soil dust, produced as a result of the contaminated areas treatment, was removed from the brush with a cotton swab slightly moisted with alcohol. The adhered nubbins of soil and clay were carefully reduced with a scalpel to tiny particles; the resulting dust was also gathered first with a squirrel brush and then with a cotton swab.

In order to consolidate the paint layer of the *mukut*-crown fragments, two techniques were used. The first was to bring, using a brush, 1.0—2.0% gelatine solution under separate areas of painting, while the second was to cover the surface of the paint layer areas, which were entirely crackled and liable to dusting, with strengthened 0.5% gelatine solution by using an air-brush and graphic suction table. The procedure demanded the following materials and tools: granulated gelatine, glycerin, rectified alcohol, distilled water, filter paper, hollitex, hostafan film, a vessel for gelatine sizing, an air-brush for gelatine size, a vessel with warm water for heating the gelatine size, and a kolinsky brush No. 0. The suction table was prepared for performing the following procedure: a sheet of blotter paper was placed on the wire netting of the table, then a sheet of hollitex was placed on the paper; over them a sheet of hostafan film with a special "window-hole" 0.2 cm smaller than the object which is placed under it. A crown fragment was placed in the "window-hole" on the hollitex. Before switching on the suction table, the paint layer was slightly sprayed with distilled water in order to prevent formation of stains in following operations. In 2—3 minutes after this the suction table was switched on, and the process of consolidating the paint layer started. If the paint layer was liable to peeling off or some areas were detached from the support, a method of local consolidation was used. Warm gelatine size in 1—2% concentration was applied with a brush to the cracks of the paint layer or brought under the paint layer areas which were peeled off or detached from the support. On applying gelatine size, the detached areas were slightly pressed to the support with a teflon spatula in order to ensure adhesion between the paint layer and support. If the paint layer was crackled all over the surface, being liable to dusting, swelling, or peeling off from the support, it was strengthened by spraying 0.5% gelatine size onto the surface of destroyed areas. It is important that in the process it was necessary to prevent excessive gelatine size to penetrate under the fragment and to form stains. For the most destroyed areas of painting the operation was performed up to three times with the 24-hour intervals. The gelatine size has been chosen to consolidate the painting because the binding medium of the paint film and ground is usually animal glue whose origin and properties are similar to those of gelatine size. On completing the consolidation of the paint film and drying, the fragments were placed between two layers of hollitex and blotter paper to be in this position 1 to 2 days. After that they were set between two sheets of calendered micalent and blotter paper [5].

Another matter of importance was to consolidate the multi-layered support. The majority of *mukut*-crowns are painted on papier-mâché, some of them — on silk pasted on papier-mâché. In both cases, the support was strengthened with Japanese paper. We repaired only those deteriorated fragments which were at risk of being considerably damaged with time or even lost. The tears' edges were glued together using wheat starch paste of about 2% concentration and thin Japanese paper Minogami (Kozo 100%) and Tengujo (Kozo 100%). The procedure of pasting together the tears of the paper support was as follows: strips of Japanese paper 0.3—0.5 cm wide, and of length equal to the tear's length, were put under the tear edges. One of the tear edges was lifted a little, and a strip of Japanese paper was put under it so that a half of the strip width was under the tear edge. Then the same was done for another edge of the tear after which the strip of Japanese paper was pasted and the tear edges were slightly pressed to the paper with a teflon spatula. It should be noted that only the top and bottom papier-mâché layers were glued (see *fig. 3*).

Large missing areas were filled with Japanese paper Sekishushi (Kozo 100%). In order to recreate a missing area of the paper support, first of all a patch should be prepared using Japanese paper. For this purpose, first a Melinex sheet and then a sheet of Japanese paper were placed, one after another, on a fragment of the crown. The silhouette of the missing area was drawn out with a wet brush, and then the excessive paper was removed from the blank patch. The fibrous edge of the completed patch was covered with paste and glued up to the edge of the missing area from above, or, if the layers of the paper support were detached from each other, under the top papier-mâché layer. The splice area was pressed by a kolinsky brush Nos. 10—12. However, the described procedure of filling up the missing areas of the fragments is not a reconstruction of the artistic object. The patches are spliced to the very edge of the object so that they can be removed if necessary without destroying the object (see *fig. 4*).

It was also important to choose conditions for storing and exhibiting the crowns. We were the first who used the mounting of separate fragments under mats of acid-free cardboard on strips of Japanese paper for this purpose [6].

A specially designed mat consists of two cardboard sheets with an "window-hole", by 0.5 cm larger than the object, and two protective covers. All parts of the mat were joint together along one of the edges with strips of cotton cloth tape or paper (see *fig. 5*).

Fig. 4

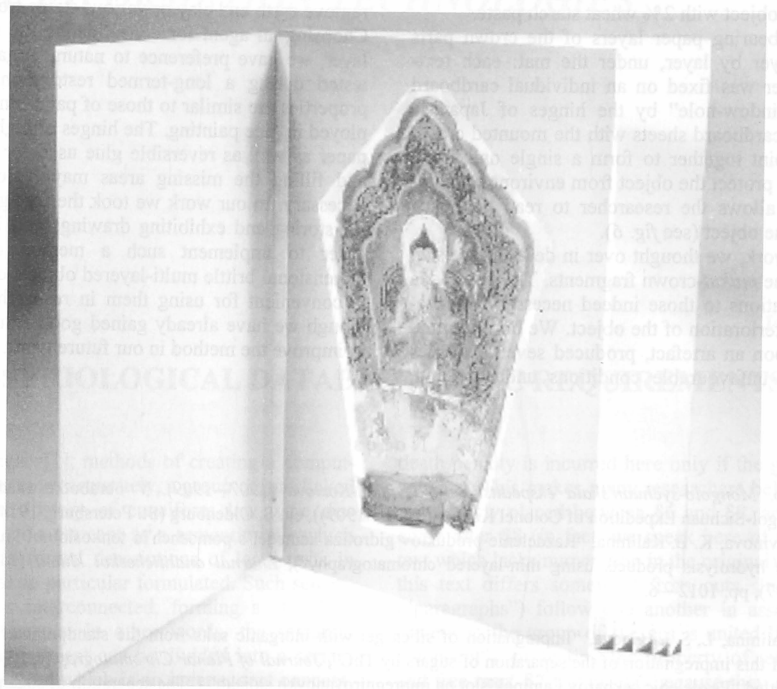

Fig. 5

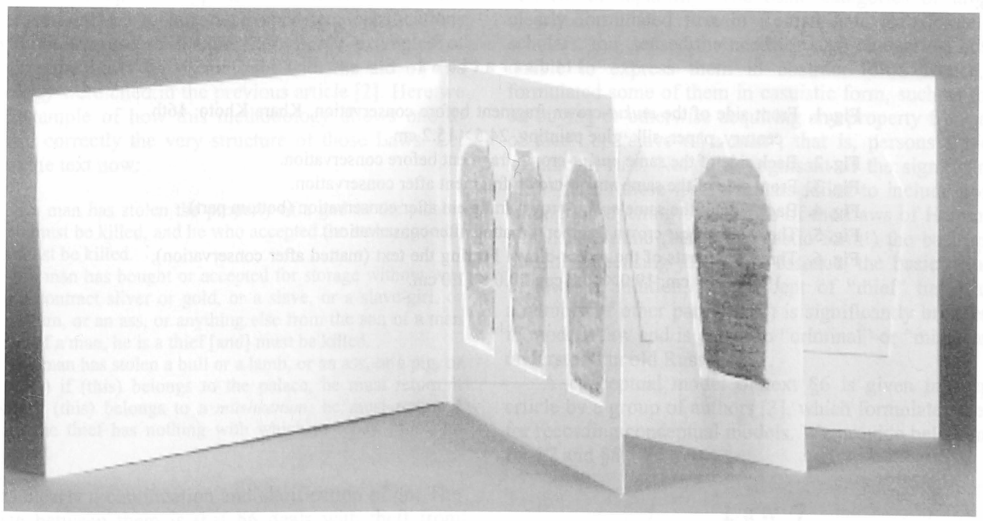

Fig. 6

The crown fragment was fixed between two cardboard sheets with an "window-hole", using hinges of Japanese paper 1.2—1.5 cm wide and 3—4 cm long, which were in turn spliced to the object with 2% wheat starch paste.

Separate text-bearing paper layers of the crown parts were mounted, layer by layer, under the mat: each text-bearing paper layer was fixed on an individual cardboard sheet with an "window-hole" by the hinges of Japanese paper. Individual cardboard sheets with the mounted crown fragments were joint together to form a single one. Such a mat not only can protect the object from environmental influence, but also allows the researcher to read the texts, which are inside the object (see *fig. 6*).

Starting our work, we thought over in detail every step of restoration of the *mukut*-crown fragments. The basic idea was to limit operations to those indeed necessary for preventing further deterioration of the object. We bore in mind that any action upon an artefact, produced seven centuries ago and suffered unfavourable conditions under ground, could provoke an additional stress leading to future deterioration of the object. In order to avoid water or chemical treatment of the objects, we did not make efforts to fully remove earth and clay or various stains from the paint layer. Choosing an agent for consolidating the deteriorated paint layer, we gave preference to natural organic polymer well tested during a long-termed restoration practice, whose properties are similar to those of paint binding medium employed in glue painting. The hinges of high-quality Japanese paper as well as reversible glue used for splicing the tears and filling the missing areas may be easily removed if necessary. In our work we took the foreign designs of mats for storing and exhibiting drawings and improved them in order to implement such a method of storing three-dimensional brittle multi-layered objects of Oriental art that is convenient for using them in research work. However, though we have already gained good results, we are going to improve the method in our future work.

Notes

1. *Khara-Khoto. Mongolo-sychuan'skaia ėkspeditsiia Polkovnika Kozlova (1907—1909).* V obrabotke akademika Ol'denburga (Khara-Khoto. Mongol-Sichuan Expedition of Colonel Kozlov (1907—1909)), ed. S. Oldenburg (St. Petersburg, 1914).

2. See L. S. Litvinova, K. B. Kalinina, "Razdelenie produktov gidroliza kamedeĭ s pomoshch'iu tonkosloĭnoĭ khromatorgafii" ("The separation of gums hydrolysis products using thin-layered chromatography"), *Zhurnal analiticheskoĭ khimii* (Journal of Analytical Chemistry), IX (1997), pp. 1012—6.

3. See *ibid.*

4. See K. B. Kalinina, L. S. Litvinova, "Impregnation of silica gel with inorganic salts from the standpoint of specific adsorption theory. The effect of this impregnation of the separation of sugars by ThC", *Journal of Planar Chromatography*, III (1999), pp. 190—5; also their report entitled "Pazdelenie sakharov i aminokislot na impregnirovannykh sloiakh" ("The separation of sugars and aminoacids on impregnated layers"). The paper was delivered at the all-Russian symposium "Surface Chemistry, Adsorption and Chromatography" (1999), p. 194.

5. *Restavratsiia proizvedeniĭ grafiki. Metodicheskie rekomendatsii* (Restoration of Graphic Arts Objects. Methodological Recommends), compiled by L. L. Metlitskaya and E. A. Kostikova (Moscow, 1995), p. 35. See also *Paper Conservation Catalog. AIC. Book and Paper Group, Third Edition, May, 1986*, chap. 40: "Matting and framing", pp. 19—21, 38—40.

6. *Paper Conservation Catalog. AIC. Book and Paper Group, Fifth Edition, 1998*, chap. 23: "Consolidation/Fixing/Facing", pp. 5—6.

Illustrations

Fig. 1. Front side of the *mukut*-crown fragment before conservation, Khara Khoto, 16th century, paper, silk, glue painting, 24.5×15.2 cm .

Fig. 2. Back side of the same *mukut*-crown fragment before conservation.

Fig. 3. Front side of the same *mukut*-crown fragment after conservation.

Fig. 4. Back side of the same *mukut*-crown fragment after conservation (bottom part).

Fig. 5. The same *mukut*-crown fragment (matted after conservation).

Fig. 6. Three fragments of the *mukut*-crown bearing the text (matted after conservation), 19.5×10.5 cm; 19.0×10.8 cm; 20.0×11.0 cm.