CONSERVATION WORK AND STUDIES

Rajmund Witold Gazda

STONE BUILDING MATERIAL STUDIES

Following rainfall in the late eighties and early nineties, of an intensity unrecorded in the past 30 years, the mission was faced with having to find a method for the conservation of the limestone building material used in the temple.[1] The problem was outstanding all the more because work was nearing completion on a project to reconstruct the Upper Courtyard, which included some 1500 attributed stone blocks and fragments of blocks.

A characteristic of the Theban limestone formation is known and comparative research has confirmed that the limestone building material used in the Temple of Hatshepsut originated from the quarries at the entrance to the Valley of the Kings.[2] Studies and observations in situ in 1991 indicated a considerable difference in the state of preservation of the stone with distinct zones or particular blocks revealing a changed condition. Laboratory research was designed to reconstruct the process of destruction. The samples, studied in 1992 by Dr. M. Kęsy-Lewandowska, were classified as marl. Further research on the site showed a varying degree of damages regardless of a similar set of external factors and even the same exposition. This led to the assumption that loamy components were responsible for the swelling of the rock in humid conditions. A similar problem had been observed in the British Museum with regard to some of the limestone objects, which were stored in stable conditions.[3]

Consequently, samples were taken for study from two groups of stone material differing in their condition. The objective was to identify the petrographic factor that is responsible for the damages. As a result of examinations carried out in 1998 by J. Magiera, two kinds of limestone were distinguished:

1. A compact stone with laminated or cloddish structure, compact-tight texture, formed by alternating laminae of fine-grained micrite and a coarse-grained organodetritic limestone. The principal mass is made up of limestone micrite of 0.005 mm in diameter. It contains concentrations of iron oxides and hydrates. Numerous and usually small pores from 0.1 to 0.4 mm, mostly void.

[1] The present author was responsible for this task. See also R. Gazda, Analiza problemów konserwatorskich i estetycznego odbioru świątyni królowej Hatszepsut w Deir el-Bahari (1992), typescript; id., Technologische Probleme der Konservierung der Dekorierten Steine des Temples von Hatschepsut in Deir el-Bahari, Ägypten. IBB-Forum auf der Denkmal'98. Acts of the conference (Leipzig 1998), 11-16 and 17-23.

[2] R. and D. Klemm, Steine und Steinbrücke im Alten Ägypten (Berlin, Heidelberg, New York 1992), 120.

[3] S.M. Bradley, A.P. Middleton, A Study of the Deterioration of Egyptian Limestone Sculpture (London 1988).

2. A marl stone which is friable, heavily cracked, with a tendency to form clods. Composed of algae and micritic binder with loamy additions. The pores are irregular in shape. Numerous cracks are present running in different directions independently of the structural directions. Part of the cracks are filled with gypsum and anhydrite.[4)]

The laboratory research also indicated that there is no link between external factors and limestone texture. The reason for the damages are entirely physical: thermal changes caused by insolation. The damages run parallel to dressing surfaces. On the exposed blocks a spherical erosion phenomenon is observed. The structural features of the stone, laminae and the cloddish structure, are not revealed. This conclusion concerns both groups of limestone.

Further research (by R. Kozłowski in 1998) concentrated on the swelling of the loamy compounds present in both kinds of limestone. A correlation was observed between the loam content, the swelling/

Fig. 1. An example of exfoliation. Block without polychromy from the northern wall of the Upper Courtyard (Photo R. Gazda)

[4)] The author is preparing a study of the causes of damages and the most suitable methods for the conservation of decorated stone blocks and their display in the walls of the temple. For the findings of laboratory research on samples taken by the author in 1992-1998, see the typescript reports: M. Kęsy-Lewandowska, S. Krażewski, G. Jaworski, Badania próbek ze świątyni Hatszepsut w Deir el-Bahari (UMK, Toruń 1992); J. Magiera, Analiza petrograficzna próbek materiału kamiennego ze świątyni królowej Hatszepsut w Deir el-Bahari (AGH, Cracow 1998); R. Kozłowski, Analiza pozymetryczna próbek materiału kamiennego ze świątyni królowej Hatszepsut w Deir el-Bahari (Cracow 1998).

shrinking processes and the extent of damages. In consequence of these processes, concentrations of loamy substances packed parallel to the face of the stone immediately under it were created (exfoliation phenomenon (*Fig. 1*).

Detailed posimetric studies helped to characterize the differences in porosity. As the differences turned out to be insignificant, porosity cannot be considered as a tool for diagnosing the resistivity of the tested rock. Both kinds of limestone belong to the swelling sort. The degree of swelling is bigger in saline samples. More research should be carried out to check for fluctuations of water vapor.

CONSERVATION CONCLUSIONS

The research findings have helped in a more precise choice of conservation preparations used in the restoration. Blocks belonging to the marl group were first treated with a preparation neutralizing loams: Funcosil Antihigro by Remmers, followed by the stabilization method that reinforces the stone with silico-organic preparations of the Funcosil series: 100, 300 or 510 by Remmers.

Due to considerable fluctuations of relative humidity in the air (Rh = 20-70 % over the course of the season, it proved necessary to carry out a preliminary hydrolysis of the above mentioned silico-organic preparations with a 5% alcohol solution 24 hours before use (first applied in the 1997/1998 season).

Trials in local conditions also favored the use of Remmer's newest generation of silico-organic products with elastic properties: Funcosil VM 861, which is a reinforcing preparation, and Funcosil VM 859, which is a binder for putties used to fill in the cracks.

CONSERVATION AND AESTHETIC WORK

The restoration of the temple reflects the changes that have occurred in the field of conservation theory and technological development in the past hundred years or so. As a result of the long process, the restored temple parts have become aesthetically differentiated. Plaster, stone blocks and slabs were used to fill the spaces left by the lost elements of the decoration. In the nineties especially, more attention was directed at displaying details of the exposition: wall decoration and sculpture. The task was undertaken to uniformize the aesthetic reception in the parts of the temple being prepared for the tourists to visit. The assumed criterion for this work was to preserve the historical value and authenticity of the remains. The objective was to make the preserved decoration intelligible to viewers by eliminating disharmonious elements, like cracks in the stone, holes and faulty plaster. More extensive surface losses were filled with a tinted mineral plaster. The required differentiation of the restored and original parts was achieved by retreating the new plaster 2 mm below the face of the wall. The next problem, which had to be addressed, was the merging of slabs used in the restoration of the seventies and eighties with the new renovation-aesthetizing plaster. Furthermore, some of the representations, the more important and better preserved ones, required a plastic clarification of the restored parts. The first to undergo this treatment was the scene representing the symbolic union of Upper and Lower Egypt found in the Hall of the Bark; it was executed in bas relief in

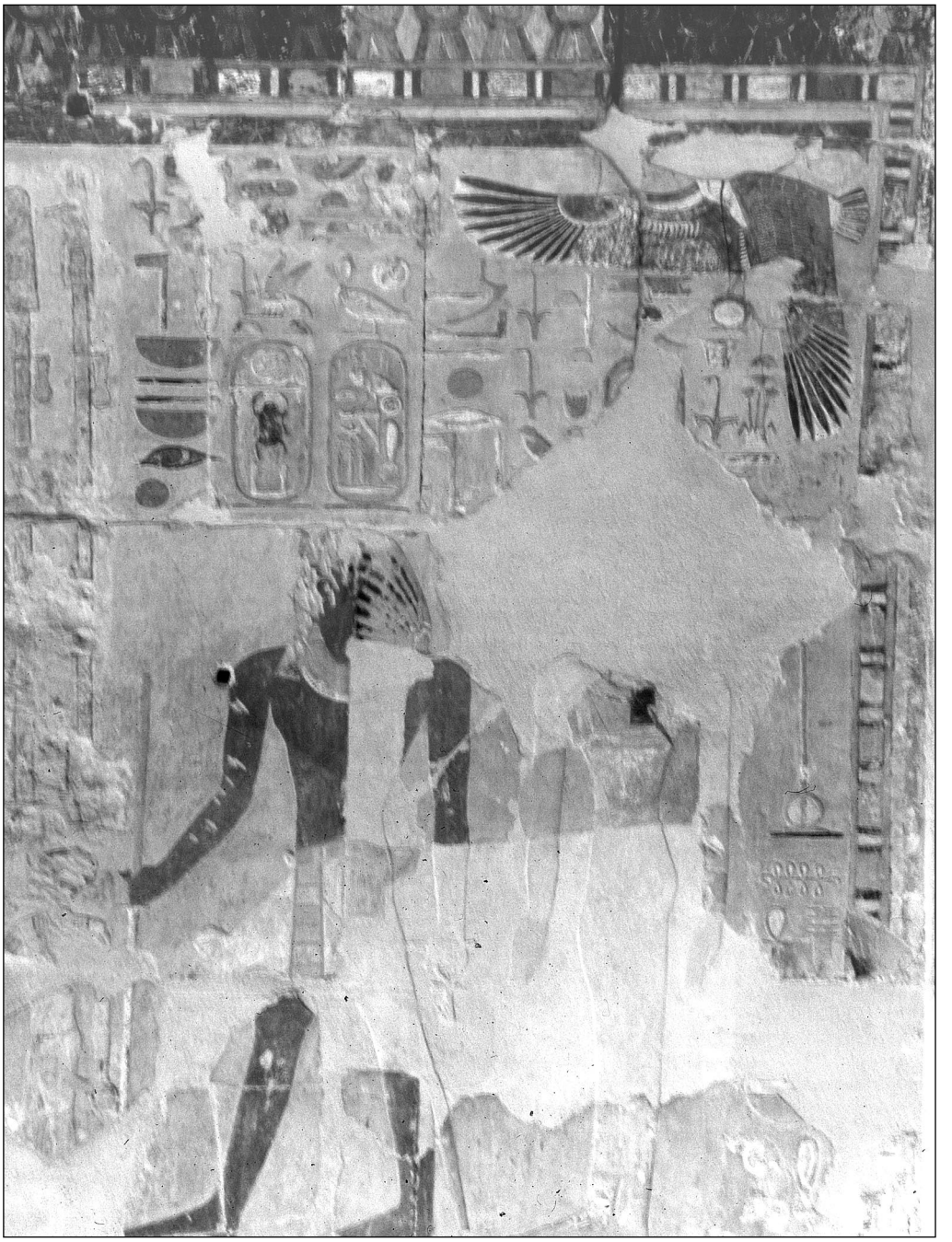

Fig. 2. Representation of King Tuthmosis I with Ahmes and Neferure, Hall of the Bark. Conservation of polychromy: A. Bogusz-Gazda, M. Lulkiewicz-Podkowińska, K. Rachuta-Wierniewska; reconstruction: R. Gazda (Photo R. Gazda)

the wet plaster technique.[5] Further work of this kind was done on representations of the north and east walls of the Upper Courtyard (*Fig. 2*). The final aesthetic effect on the north wall of the Upper Courtyard was achieved applying a silico-organic binder-based renovation paint for historic monuments, Pulverfarbe by Remmers.[6] The paint was used to cover plaster and the artificial stone slabs mentioned above.[7] The color merging of the new stone used in the restoration was achieved with the help of a transparent paint, Funcosil LA by Remmers.

[5] F. Pawlicki, *Pam X, Reports 1998* (1999), 123 and fig. 3.

[6] I am indebted especially to Messrs. Tadeusz Wrzos and Roman Kozłowski, representatives of Remmers in Poland, for sponsoring the paint.

[7] The team engaged in this task specifically included: Mr. Rajmund Gazda, Mrs. Aleksandra Kann, Mrs. Maria Lulkiewicz-Podkowińska, Mrs. Katarzyna Rachuta-Wierniewska, Ms Izabela Uchman.