Determination of the treatment and restoration needs of medieval frescos in Georgia

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Abstract

Diagnostic studies by an Italian/Georgian team of the wall-paintings in the Church of St. Nicholas in Kintsvisi and the Church of the Virgin in Timotesubani (from the 12th and 13th centuries) in southeast Georgia revealed the existence in both buildings of a strong pink coloration on the paint, of severe salt efflorescence and of dangerous flaking of the paint layer, all of which are problems common to many other monuments in the area. On-site inspection and laboratory analyses traced the salts as largely due to water infiltration caused by poor drainage and the use of inappropriate materials. The pink colour was traced to severe microbiological infestation. On the basis of these findings, the team drew up a preventive conservation emergency treatment, which was successfully implemented in collaboration between Italian and Georgian conservators and specialists. The treatment involved rectifying drainage problems, improving the microclimate, re-adhering the paint and treating the church with biocide.

Keywords

wall-paintings, water infiltration, salts, microbiological infestation, diagnostic study, preventive conservation

Introduction

Microbiological damages and microclimatic factors have become a critical problem in the conservation of Georgian mural paintings in recent years. Most paintings are in very poor condition and suffer from similar problems, the chief of which are the presence of a strong pink coloured layer on the paint surfaces, salt efflorescence and severe detachment of the paint layer. A research project to look into these problems at the churches at Kintsvisi and Timotesubani in Georgia was implemented by members of the Italian company CBC Conservazione Beni Culturali (Rome) and the GACC Georgian Arts & Culture Center, with the international collaboration of Italian and Georgian conservators and specialists and with funding by the World Bank/Italian Trust Fund, the Open Society Georgian Foundation and the World Monument Fund/S. Kress Foundation.

A project for an emergency treatment for the preventive conservation of the Kintsvisi paintings was drawn up by the Italian consultants and implemented by Georgian specialists and conservators from the Centre for the Research and Restoration of Old Georgian Wall Paintings and was funded by the Fund for the Preservation of Cultural Heritage of Georgia and the World Bank/Italian Trust Fund.

Two groups of paintings were chosen as pilot sites for diagnostic studies, determination of methodology and execution of emergency treatment; these were the paintings in St. Nicholas at Kintsvisi and in the Church of the Holy Virgin at Timotesubani. Both churches are located in southeast Georgia and dated to the end of the 12th century and beginning of the 13th century. The sites were chosen for four reasons. First, they have similar conservation problems (which they also share with many other churches in the area). Second, they are located in roughly the same area and exposed to comparable climatic conditions. Third, analogous artistic techniques were employed in both churches. And fourth, they are both of very great artistic importance.

General conservation background

Due to the politics of the Soviet era, many of the churches in Georgia, including those discussed here, were prevented from being used as places of worship and consequently suffered serious maintenance problems. From the 1960s to the 1980s, the State Department for the Protection of the Monuments tried various measures to remedy the perilous condition of the buildings and their paintings. But in the 1990s, the political and economic turmoil and collapse of infrastructure that followed the disintegration of the Soviet Union meant that conservation and preservation activities were halted due to lack of resources, leading as well to isolation from the international conservation profession.

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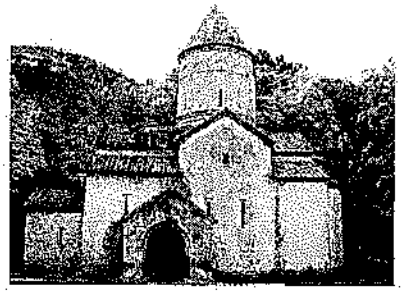

Figure 1. The Church of the Holy Virgin at Timotesubani, Georgia, 12th to 13th century. View from the south. (Photo: Nana Kuprashvili)

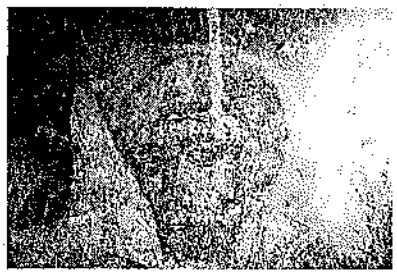

Figure 2. Detail of the wall-painting in the apse of St. Nicholas Church in Kintsvisi, Georgia, 12th to 13th centuries. The photo, taken in raking light, shows the extensive flaking of the paint layer. (Photo: Nana Kuprashvili)

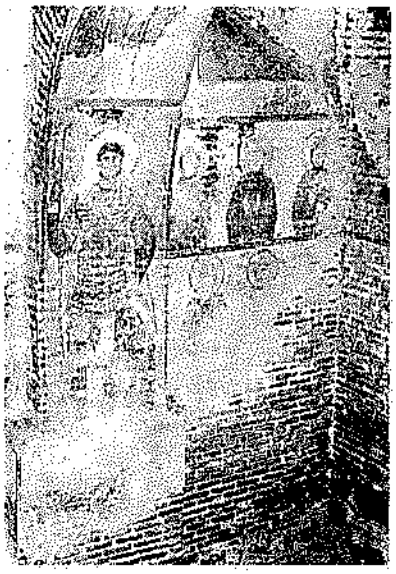

Figure 3. Wall-paintings on the west wall in the northwest bay in the church at Timotesubani. The pink discoloration is found on extensive areas of the plaster, paint and exposed wall. (Photo: Nana Kuprashvili)

Technical description

The two churches are large brick structures with stone slab roofs (Figure 1), although St. Nicholas at Kintsvisi was covered by galvanized iron in the 1960s. The interiors of both churches (well over 1000m^2) were originally almost entirely decorated with paintings executed in a combination of *buon fresco* with extensive secco work, probably with casein as a binder. The paint was applied to a lime/sand/straw *intonaco*, which, in turn was applied over a fairly thick lime/sand *arriccio*. The palette employed in both cases was fairly restricted but, especially notably in the case of the Kintsvisi paintings, was the prodigious use of lapis lazuli in the backgrounds.

Aims of the project

The objective of the international program was to provide a condition report and to draw up a treatment project aimed at stabilizing the condition of the paintings.

The project had four specific aims: identifying the types of damage; localizing the sources of deterioration; determining methods for remedying the worst of the damage; and establishing ways to eliminate as far as possible the sources of deterioration. This latter point was felt to be of the utmost importance, as all too often, and not by any means solely in countries such as Georgia, where resources are so limited, conservation is restricted to hasty remedial treatment of symptoms, rather than any serious attempt to deal with underlying causes.

Condition of the paintings

The paintings at Kintsvisi and Timotesubani were found to be in poor condition, with the most obvious symptoms being staining and detachment of the plaster, flaking and powdering of the paint (Figure 2), salt efflorescence and a pink coloration over extensive areas of the plaster, paint and exposed wall (Figure 3).

Causes identified

Water infiltration

The most obvious and immediate cause of damage was due to water infiltration. Although infiltration was not as severe as in the past, due to remedial work carried out in the 1960s and 1970s,[1] it was still a severe problem. Direct observation, core-sampling and mapping of salt efflorescence showed that the sources of damp were located both in the upper part of the church and in the ground. Further, the team determined that there was no underground water-table causing rising damp and that water was entering through the walls and rising from the foundations of the buildings due to the lack of gutters and drain-pipes (Figure 4). Rainwater flowed over external surfaces, infiltrating the walls, before being discharged on the narrow, cracked and broken pavements surrounding the buildings. Thus, water was allowed to enter the foundations, but was prevented from evaporating (Figure 5). The team also found that, as the buildings were both on sloping terrain, excess surface water from rainfall was flowing downhill, further saturating the foundations and adding to the rising damp (Figure 6).

Salts

Significant quantities of nitrates and, in several samples, sulfates, were found. The nitrates were probably due to a variety of organic materials (bird and bat excrement and decaying organic material from cavities within the walls). The sulfates were almost certainly due to cement and gypsum repairs from earlier interventions.

Microbiological infestation

One of the most pressing problems facing the team was the identification and treatment of the pink coloration, so prevalent not only in these churches, but also

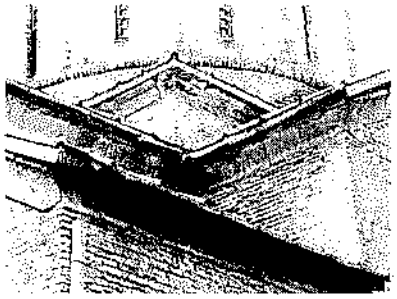

Figure 4. Twisted and broken gutters are seen at the northwest corner of the church at Kintsvisi. (Photo: Nana Kuprashvili)

Figure 5. The drainpipe discharges rain water directly onto the concrete pavement at the southwest corner of the narthex at the church in Kintsvisi. (Photo: Nana Kuprashvili)

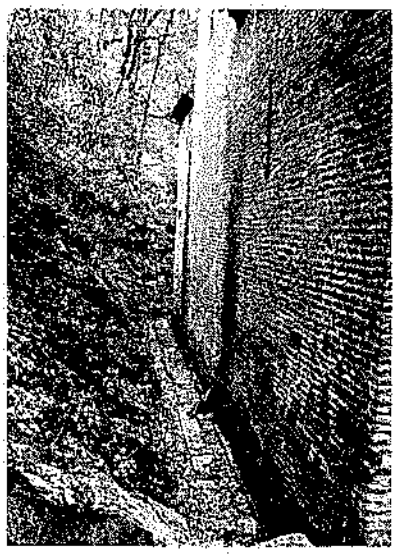

Figure 6. The sloping terrain along the north wall of the church at Timotesubani. (Photo: Nana Kuprashvili)

in many other sites throughout Georgia. Apart from being highly disturbing visually, many Georgian specialists feared that this unknown agent might be causing physical damage to the paintings. The coloration had been gradually increasing for a number of years, as confirmed by colour photographs of the paintings at Kintsvisi taken in the 1980s, which showed that the phenomenon had already been present at that time, though at a barely perceptible level.

In 1996, two Russian scientists had conducted a series of tests, including work on microflora in the church, but had not been able to draw any definitive conclusions (Dneprovskaya 1996). The recruiting of Italian specialists was a second attempt to resolve the problem. When the team started the investigation at Kintsvisi, it was felt that several factors contributed to the likelihood that the pink coloration was biological in nature. These were:

- high relative humidity (over 70%)
- the concentration of pink in the lower, damper areas of the churches
- the slow but steady increase of the phenomena
- the fact that the church was open at most for a few hours a day, thus limiting air movement
- the presence of possible nutrients in the binders of the paintings (casein), in materials used in previous restorations (casein and egg as fixatives, bread crumbs and wine as cleaning agents), and bat and bird excrement
- the habitual touching and kissing of the painted figures of saints by visitors to the church, which would provide an effective transmission mechanism for spores (an hypothesis supported by examination of the pink material under a magnifying glass, which showed it to be powdery in nature, as well as having a soft, slightly spongy consistency).

An unpainted area of plaster was experimentally tested with Metatin N58-10/101, a broad-spectrum biocide effective against algae, fungi and bacteria. The biocide was applied twice at a concentration of 4% in water, using a hand spray, with eight days between applications. Although no results were discernible at the end of the 15-day period, this was not surprising, as biological agents are often slow to show effect. Indeed, the follow-up investigation four months later found the test area to be completely free of pink.

During this experimental intervention, samples were taken of the contaminant and the underlying plaster, and these were subjected to intensive analysis to determine whether biological agents or some other factor was causing the coloration, and to identify the micro-organism if the cause proved to be biological. The procedure used in the analyses and the results may be summarized as follows.[2]

Four samples were examined for biological activity and proved to have an unusually high total bacterial load for wall-paintings. On the other hand, the total fungal load of the samples, while high, was generally within the normal parameters. None of the fungi and actinomycetes found in the cultures were red or pink and thus could not have accounted for the observed colour.

To test whether a non-biological agent in or on the plaster caused the pink, two samples were examined by XRD. However, none of the crystalline forms detected were red or pink. On the other hand, both whewellite and weddellite were found, indicating the possible presence of proteins.

Enzyme immune assays were then employed on the four samples to test whether suitable nutrients existed for bacterial activity. The samples were tested for a variety of protein binders, with positive results being obtained for cow-milk casein in all four cases and egg-yolk in one of the samples, proving that there existed suitable organic nutrients for bacteria.

SEM microimaging was then employed to examine the structure and composition of the pink material, with the aim of locating possible bacterial forms, revealing large numbers of spherical forms (Figure 7). Further analyses involving selective microbiological cultures and biochemical testing, together with the observed form of the bacteria, which led to the conclusion that the infestation was due to *Micrococcus roseus*, fairly commonly found in the soil and in water, and capable of producing a more or less intensive pink colour.[3] The results of these

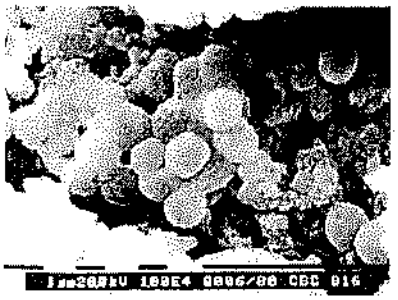

Figure 7. Unmounted sample, secondary electron SEM photomicrograph, 10,000'. Cluster of spherical bacteria with a diameter of about 2μ, within a fracture of pink layer.

Figure 8. View to the west wall in the church at Kintsvisi. (Photo: Nana Kuprashvili)

analyses, together with the positive result in the zone subjected to biocide treatment, confirmed the microbiological origin of the pink colouring.

The treatment program

Notwithstanding generous support from the international sponsors listed at the beginning of this paper, the treatment program was only fully implemented for the church of St. Nicholas at Kintsvisi, due to limitations in available resources. Priority in the treatment project was given to preventive conservation, aimed at stopping further deterioration in the paintings, rather than an aesthetic restoration.

Water infiltration and rising damp

The guttering and drainpipes were repaired and replaced, the pavement around the church was repaired and its drainage was improved, and a simple cement trench was dug uphill of the building to divert the flow of surface water away from the structure. Local volunteers and a small religious community nearby will ensure the drains remain free of vegetation and litter. The microclimate of both churches is currently being monitored with thermo hygrometers.

Flaking and powdering paint, serious detachments in the plaster

The paint layer in imminent danger of loss was consolidated with Primal AC 33. Severely detached plaster was re-adhered using hydraulic lime, where necessary.

Salts

Cement and gypsum fillings were removed and replaced with lime and sand fillings. It is believed the reduction of water infiltration and rising damp described above will limit, if not totally halt, the ongoing damage due to salts. It was decided to avoid more invasive interventions until the microclimate stabilizes.

Microbiological treatment

During the course of the treatment of the paint and plaster, all areas of the church were treated twice with Metatin N58 10/101. A further final application was carried out while the scaffolding was being removed.

It is important to note that that all biocide treatments should be repeated after an interval of time, as a single treatment may not eliminate the usually much more resistant spore forms of the organisms, which instead must be killed after they begin to germinate. It should also be noted that in heavily contaminated situations all tools used (brushes, scalpels, spatulas, etc.) for other tasks should be disinfected regularly.

By the time the work on the church was finished, the paintings were completely free of the colouring associated with the bacterial infestation (Figure 8). To help avoid further outbreaks, bird and bat excrement was removed and the aeration of the church has been increased slightly (increasing it too radically is likely to increase salt efflorescence). Moreover, local volunteers are monitoring the church's condition. The measures taken to reduce water infiltration and rising damp will also help to reduce the risk of further outbreaks.

Conclusion

The project can be considered a success for several reasons. First, it succeeded in identifying a series of problems that are creating risks, not just for the works examined, but for a large number of other highly significant works of art in the Republic of Georgia. Second, it also identified the causes of these problems and was able to provide solutions and a methodology of preventive conservation, which will we believe is transferable to many other monuments in the area. Finally, less tangibly but perhaps most importantly in the long run, it re-established fruitful contact between conservation experts in Georgia and the international conservation community at large.

Acknowledgements

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Notes

1 Areas that had suffered extensive damage in the past were quite dry, and the borders of salt efflorescence and water stains had moved quite significantly from previous positions.
2 For a detailed discussion of the step-by-step process of the analyses, see V. Meggiolaro, et al. (1998).
3 This bacteria, together with three other species of bacteria and 16 species of fungi and one of actinomycetes, had earlier been detected in samples taken from the paintings at Kintsvisi by two Russian biologists, but they had failed to connect these findings with the pink coloration found on the paintings (Dneprovskyaya and Lebedeva 1996).

Bibliography

Caneva, G, Nugari, M P and Salvadori, O, 1996, *Biology in the conservation of works of art*, Rome, ICCROM.

Dneprovskaya, M B and Lebedeva, B V, 1996, 'The reasons for the destruction of the dye layer of the Kintsvisi frescos – Technical report' Scientific research and Project Institute of Restoration 'Saqrestavracia', Tbilisi. Unpublished.

Gittins, M, Martellotti, G, Nerger, S and Paparatti, E, 2000, 'Poster: The Conservation of Roman wall decoration in Nero's Golden House, Rome', IIC Congress, Melbourne 2000, Summaries of the posters.

Massari, I, 1997, Report on the structural problems and moisture in the church of St. Nicholas at Kintsvisi, Unpublished report to the World Bank.

Massari, I, 2000, Report on the Church of the Mother of God, Timotesubani, Georgia, Unpublished report to the GACC.

Meggiolaro, V, Pressi, G and Vedovello, S, 1998, 'Degrado biologico delle pitture murali della chiesa di San Nicola a Kintsvisi Repubblica della Georgia' *Restauro & conservazione* 29, 81–86.

Sorlini, C, Monte Sila, M and Ranalli, G, 1996, 'Le indagini microbiologiche condotte sulle alterazione rosa degli affreschi' in G Testa (ed.) *La Cappella Nova o di S. Brizio nel duomo di Orvieto*, Milan, Rizzoli, 411–13.

Materials

Metatin N-58 10/101 (R) (a mixture of tributyl-tin naphtenate and benzyl ammonium chloride), Acima Chemical.
Primal AC 33 (R), Rohm & Haas