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Comments on the Gelati Monastery Wall Painting Report:

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This document was prepared by Lisa Shekede and Stephen Rickerby, wall painting conservators, for the Ministry of Culture, Sport and Youth of Georgia and the General Inspectorate for the Protection of Cultural Heritage, in response to the "*Report on the State of Conservation of the Gelati Monastery World Heritage Property, Georgia*" by the Associazione Giovanni Secco Suardo, Rome, July 1st 2021.

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1) Failure to address mission objectives

The mission objectives, paraphrased from those stated at the beginning of the report were:

- to investigate the problem of water penetration and salts damage in relation to the building structure and painting technology through investigations and analysis
- to provide a visual presentation of the problem through photographic and graphic documentation mapping of conditions in relation to the various painting phases
- to advise on managing the emergency to minimise further deterioration and loss following appropriate investigations and trials

The period of investigation was brief and the church is large and complex, with multiple phases of painting executed at different times, almost certainly using different materials and techniques, and almost certainly manifesting different responses to the salts and moisture problems which are currently the major cause of concern. The time allocated should have been devoted to deeper investigation and characterisation in the various parts of the church as a first stage in developing both emergency and longer-term strategies for their monitoring and stabilisation. Instead, the team concentrated on testing a range of remedial treatments such as salts extraction, consolidation and grouting. This was premature both in terms of investigation sequencing and the current state of knowledge, but also because the fabric may still retain a great deal of moisture and these types of intervention are inappropriate for this stage. Specifically, the mission did not:

- distinguish between past and current moisture-related damage
- undertake an adequate investigation of moisture ingress and distribution across and within the fabric
- undertake a structured investigation into the various technologies employed for the various phases of painting, or identify aspects of technology which may have an impact on the occurrence or severity of deterioration, or inform treatment options. Without consulting other analytical work on Georgian wall paintings which might indicate the need for caution, the report assumes that the paintings are largely executed in a technique based on fresco
- provide a coherent visual presentation of infiltration in relation to the condition phenomena and painting technology
- distinguish between interim emergency measures to secure the painting as the fabric dries out and longer-term measures to be taken when the problem is no longer ongoing
- base recommendations on standard conservation ethics and principles, the use of adequately tested conservation-grade materials, wide-ranging and verified conservation research, or even the findings of its own investigations and analysis
- provide suitable guidelines for intervention, further monitoring and investigation.

2) Failure to abide by established international conservation criteria

Many of the recommendations do not accord with established international conservation principles, such as those exemplified in the **ICOMOS principles for the Preservation and Conservation-Restoration of Wall Paintings (2003) article 5: Conservation-Restoration Treatments.** This stipulates that:

- *"All interventions, such as consolidation, cleaning and reintegration, should be kept at a necessary minimal level to avoid any reduction of material and pictorial authenticity."*

- *"All methods and materials used in conservation and restoration of wall paintings should take into account the possibility of future treatments."*

- *"The use of new materials and methods must be based on comprehensive scientific data and positive results of testing in laboratories as well as on sites. However, it must be kept in mind that the long-term effects of new materials and methods on wall paintings are unknown and could be harmful. Therefore, the use of traditional materials, if compatible with the components of the painting and the surrounding structure, should be encouraged."*

Beginning with the first point – *"All interventions, such as consolidation, cleaning and reintegration, should be kept at a necessary minimal level to avoid any reduction of material and pictorial authenticity."* – according to ethical conservation practice, recommendations are based on intervention options which are least likely to alter the nature and behaviour of the original. Materials are also applied in the lowest feasible concentrations. It is also important to exercise caution when doubts remain regarding aspects of the technology of the paintings, which might make them vulnerable to certain treatments. For example, in the case of Gelati the presence of gypsum-containing layers, organic paint layers and glazes cannot be excluded. One of many instances presented in the report which demonstrates a lack of adherence to this principle is advocating the application of consolidants in abnormally high concentrations as a temporary measure, to be removed subsequently with hot water. This is unacceptably interventive and risky for important, aged, deteriorated and sensitive paint layers. Generally, the report recommends large-scale, highly interventive procedures which do not accord with the principle of minimal intervention.

Next, taking the second point – *"All methods and materials used in conservation and restoration of wall paintings should take into account the possibility of future treatments."* – the report advocates the introduction of a range of materials including fluoroelastomers, ammonium oxalate and DAP, all of which have the capacity to permanently and significantly cause irreversible changes to the paintings.

Lastly, taking the third point – "The use of new materials and methods must be based on comprehensive scientific data and positive results of testing in laboratories as well as on sites. However, it must be kept in mind that the long-term effects of new materials and methods on wall paintings are unknown and could be harmful. Therefore, the use of traditional materials, if compatible with the components of the painting and the surrounding structure, should be encouraged." – the report recommendations showcase a narrow range of commercial products, often to the exclusion of compatible materials/established conservation-grade materials and techniques. The promotion of these products to the exclusion of any others gives a false impression of the diversity of options available. For example, cyclododecane is a much more appropriate, conservation-grade material for creating a temporary barrier during grouting that acrylic emulsions. As full disclosure of the content and properties of proprietary products is often not made, their suitability for use is difficult to establish. Therefore if they do not have a proven track-record of testing and application in the context of wall painting conservation they should be avoided. Products recommended for use in the report include:

Polval® acrylic emulsion: this is a proprietary product marketed as a general purpose adhesive. It's high-film-forming properties make it inappropriate for use in wall painting conservation.

Westox Cocoon®: this is a proprietary product marketed mainly for use on sandstone and other types of masonry. It has not to our knowledge been tested on or recommended for use on wall paintings. As building structures, materials, conditions, salts sources, types and distribution differ

radically from case to case, a 'one size fits all' should not be advocated in any situation, but especially not for wall painting conservation.

Fluoroelastomers are synthetic rubbers developed mainly for use in sealants of automotive fuel systems. A number of different fluoroelastomer-based preparations are currently marketed for use as stone consolidants (mainly for application externally as a protective measure against atmospheric pollution) but their study remains at the laboratory testing stage and their properties and long-term performance in situ has yet to be fully evaluated. Some authors report that application methods can either result in superficial film formation and reduction in water vapour permeability, or poor protective properties (Licchelli et al. 2013). It has also been reported that fluoroelastomers do not provide long-term protection and can actually accelerate salts damage in the longer term (Bugani 2007: 115-116). To our knowledge fluoroelastomers have not been either trialled or advocated for use on wall paintings.

Ammonium oxalate: ammonium oxalate should only be advocated as a consolidant following further in-depth salts investigations as the application methodology can result in the superficial salts enrichment, and can lead in some situations to the formation of new ammonium salts (Dreyfus 2019).

Diammonium hydrogen phosphate (DAP): this has been tested on unpainted plaster but not to our knowledge on wall paintings, and it should be considered unsuitable for this purpose since it has been shown to cause irreversible optical, physical and chemical alteration of some pigments (Ma et al., 2019)

To summarise, many of the materials recommended in the report are in the early stages of laboratory development and their long-term performance has not been sufficiently tested in situ. As formulations based on these materials are produced commercially, information provided by manufacturers is not always objective. It is therefore advisable to consult independent studies before adoption.

3) Inadequate linkage between technology and deterioration phenomena

The monastery of Gelati is a huge complex which has been expanded over the years and contains phases of painting executed at various times and in various locations from C12th to C17th. These almost certainly vary considerably in terms of fabric support, plaster types, pigments, binders etc. and their responses to the infiltration problems are likely to also vary. A brief chronology and graphic presentation of the structure, fabric and wall painting locations in relation to infiltration occurrence is a basic requirement not only for the reader to understand the nature and extent of the problem, but also to allow the conservators to formulate a systematic conservation plan.

The report exhibited considerable confusion in its reporting on the wall painting technologies used in the complex, and, importantly, failed to make any distinction between the materials and techniques employed in the different phases of painting. This is reflected in the sampling which was done area by area, not scheme by scheme. No attempt was made to consult other technical studies of Georgian paintings to inform and guide the conservators and lab analysts about the complexity and variety of wall painting technologies used in Georgia, which includes the use of gypsum plasters and grounds, and organic binders and glazes. As a consequence the report assumes that all the paintings were created in exactly the same way, and assumes that they are essentially frescoes. While paintings bound in fresco technique are generally durable and able to withstand much more drastic treatments than other paintings, it is a serious concern is that this assumption can lead to the

adoption of treatments which may cause harm to aspects of technology at Gelati which are not executed in fresco.

The important question of whether any areas of painting are bound in organic materials was not given sufficient weight in the investigation. Organic materials were not detected either in FTIR and in histochemical tests (although the nature and methodology of these tests was not reported) but this is not unusual in the case of aged organic materials, and a negative result does not necessarily mean that none are present. Nevertheless, the possibility of organically bound layers is largely ignored in the treatment proposals. There is also no variation of approach to take into account potential differences in technology, as this possibility was not investigated.

No attempt has been made to correlate the occurrence and severity of infiltration and the nature and extent of salts-related deterioration with differences of materials present in different painting phases (for example, the possibility that gypsum plasters and grounds may be present). The report fails to establish the causal link between these various technologies, deterioration phenomena, and moisture ingress (explored in more detail in **Section 4).**

The deficiencies highlighted here have serious implications for some recommended treatments, for example:

- **previous studies have established that Georgian wall painting technologies including those based on gypsum (calcium sulphate), and this possibility has not been adequately explored at Gelati. Therefore recommendations for deep salts extraction risk mobilising sulphate salts originating in plasters and grounds into the paint layers, causing damage to the painting on crystallisation as the fabric dries out.**
- **The temporary application of facings to the paint surface using high concentrations of acrylic emulsion followed by removal with hot water is very likely to result in damage to any organic paint layers and glazes present.**
- **The application of any film-forming material onto the surface of organic paint layers can result in flaking as the film expands and contracts in response to ambient environmental conditions.**

4) Weak investigations and data interpretation

The report displays extreme lack of understanding of the main mechanisms of deterioration at Gelati, namely moisture and salts, and their relation with each other and their environment.

Moisture investigations: establishing the topographic and stratigraphic distribution and concentration of water in the fabric – in this case liquid water from rainwater infiltration – is a top priority for developing an approach to the management of moisture-related deterioration. It also provides base-line data for measuring rates of water loss and establishing the point at which the fabric's moisture content stabilises. However the moisture investigations reported here were both poorly conceived and perfunctory, and were not capable of contributing significantly to the diagnosis of the problem.

Investigations were conducted using a 'masonry moisture meter' (presumably an electrical resistance metre) of unspecified model or sensitivity. The investigation was flawed because:

- these meters are unable to give any indication of the presence of moisture in depth
- they are calibrated for use on timber and cannot produce accurate results in masonry
- they cannot supply quantitative information, only providing readings on an arbitrary scale

- results are distorted by the presence of soluble salts, which are abundantly present on the vault. Results from the presence of moisture rather than salts can only be distinguished in conjunction with readings taken using a capacitance meter https://www.dryfix.net/blog/electronic-moisture-meters/.

The number, location and results of measurements were not mapped, tabulated or otherwise reported, and cannot be considered to constitute a moisture survey. This aspect of the investigation was therefore not able to advance understanding of salts and moisture related damage.

The report also describes an attempt to establish whether moisture is ongoing by observing whether salts formed on top of a small square of paper pasted onto the surface of the painting after leaving it for a few days. This is not an effective way to establish whether the fabric is dry, and reliance on such rudimentary empirical methods risks generating false and dangerous conclusions.

The authors seem not to be aware of more appropriate approaches to this type of investigation:

- A good-quality IR thermal camera is more usually used in modern conservation, as it provides visual information on the location and distribution of moisture and can be used to monitor drying (it is important to establish when the fabric is dry as interventions such as consolidation should not be done while the fabric still contains excess moisture).
- Although invasive, core sampling is unrivalled as a method for obtaining direct, accurate data on moisture and salts at various depths within the stratigraphy.

Salts: as with moisture, establishing the topographic and stratigraphic distribution of salts in the fabric is a top priority for managing deterioration, and this must be accompanied by the acquisition of quantitative data on salts ions and species present since different salts deliquesce and crystallise at different RH equilibria, and exhibit different morphological habits. These factors have an impact on how readily they move through porous systems, how frequently they move in and out of solution in relation to ambient environmental conditions, how damaging they are when they crystallise, etc.

On-site salts tests are mentioned in the text and there is a photograph of aqueous ion test strips being used, but we are not told how many of them were done, the locations where testing took place, what ions were tested, what methodology was used, or what results were obtained. As with the moisture assessment, no systematic survey was undertaken. No attempt seems to have been made to establish the distribution of salts at depth. The authors merely state that 'the tests carried out on site, confirmed by laboratory analyses, although they contain soluble salts in the form of sulphates and carbonates (based on magnesium), the vast majority of them are nitrates'. This is simply not true. Contrary to what is stated in the text, the FTIR results show that superficial efflorescences and salts present in the upper strata of the paint stratigraphies are dominated by calcium and magnesium sulphates – highly damaging slightly soluble salts.

The authors conclude that salts problems at Gelati are due to nitrates resulting from bird guano but the main agents or deterioration are clearly sulphates from entirely other sources, which may include cement repairs, original construction materials, and possibly plaster and ground layers, requiring an entirely different approach to mitigation. The poor diagnostic ability displayed in the report has resulted in the recommendation of measures which risk exacerbating, not ameliorating the problem.

To summarise, salts and moisture are the most significant contributor to current condition at Gelati and should have been the main focus of the study. However in neither case were adequate methods used for data gathering, and in neither case were systematic stratigraphic and topographic surveys conducted. The report therefore failed to

- **establish the locations/extent of wet fabric (or even whether any of the fabric is still wet)**
- **determine salts activity superficially and at depth**
- **establish the main causes and origins of salts-related damage**
- **correlate water ingress, salts activity and technology**
- **establish a method for monitoring rates of drying**

5) Flawed emphases in proposed measures

As conservation is concerned with stabilising paintings in their current state and emphasises the importance of adopting approaches which ensure the preservation of their significance and authenticity, it is therefore important to explore all options, starting with those which have the lowest risk of compromising these values and are most able to achieve long-term effectiveness. While remedial treatments may be necessary, it is important to give first consideration to measures which indirectly limit deterioration before exploring options which require physically intervention on the painting directly. This is because

- all remedial interventions have the potential to cause harm
- some outcomes of interventions are unpredictable, despite best precautions
- negative effects of remedial interventions are not always visible. Sometimes they are intangible or delayed, only becoming evident later, sometimes after many years

At Gelati there are areas of deterioration which are clearly currently at risk, but there is still likely to be a moisture problem and salts may still be moving towards the evaporation zone (ie. the surface of the painting). If this is the case, many remedial treatments proposed in the report, such as grouting, consolidation and salts extraction, are premature and could make the problem worse. Conservation measures should be applied in an appropriate sequence and be selected and adapted to address the specific problems present. Currently, if the fabric is still drying at Gelati, it is more appropriate to advocate measures which support dangerously compromised areas until it is safe to undertake full-scale remedial treatment.

Because there is always some level of risk in the application of remedial treatment it is important to ensure that it is both safe and effective by:

- undertaking adequate investigations to establish the causes of deterioration
- ensuring that the causes of deterioration are not ongoing
- obtaining knowledge of the original wall painting materials
- understanding the treatment limits imposed by condition
- understanding the nature of materials used, and their potential short-term and long-term effects on the painting
- gaining knowledge of treatment materials and procedures, and their long-term interactive effects (including non-visible) with original materials
- understanding future risks to the painting after treatment (will treatment make the painting vulnerable to new deterioration/damage?)

There is little evidence that the remedial interventions proposed were in informed by the investigative process or modified for the specific situations found at Gelati. Trials were mostly of a single material and technique, so there was no comparative assessment prior to selection. There is no evidence that materials and techniques were selected with due consideration of the need to minimise the impact of treatment on the painting. Other measures were proposed without trials and without demonstrating a clear rationale for their selection, or a clear understanding of the nature of these materials or the potential risks to their use.

6) Lack of clarity regarding interim, emergency measures vs longer-term measures

There is a complete lack of clarity over whether the measures recommended are to be applied as emergency measures while the fabric is still wet, or whether they are intended for application when the fabric is dry. There are no recommendations at all for supporting the deteriorating areas during the process of drying, and no adequate proposals for monitoring drying. However, most of the procedures recommended are completely unsuitable for implementation while the fabric is damp, if this is still the case.

For example, the application of impermeable barriers to the paint surface is recommended (such as high concentrations of PVA and even fluoroelastomers). If film-forming materials are applied to the surface of the painting while the fabric is still damp it will inevitably cause salts crystallisation and disruption within the underlying paint layers, eventually resulting in more severe flaking and paint loss. Even advocates for the use of ethyl silicate as a consolidant acknowledge that it cannot be used effectively in moist environments.

7) Recommendation of inappropriate and potentially damaging interventions

Aside from the many inappropriate methods and materials described in **Section 2,** The report also contains several other potentially highly damaging procedures, including:

Deep salts extraction: this is a complex undertaking, carrying a number of risks: preferential extraction of more readily soluble salts may occur, leaving behind less soluble and potentially more damaging salts; harmful redistribution of salts is also possible, including superficial enrichment of vulnerable paint layers. A salts-reduction strategy therefore needs to be based on appropriate quantitive and qualitative knowledge of the soluble ions types present, and of their distribution patterns (topographically and in-depth). It is also important to establish the need for such an intervention before embarking on such a potentially risky treatment. Instead the approach was justified not by investigations carried out, but by a statement, paraphrased here, that lowering the salt content of a wall to <0.2% will make a wall 'healthy' and will remain so unless more salts enter. It is unclear where this idea comes from – the authors may be attributing it to UNI 11087 2003, a standard which was cancelled in 2016 – but in reality, almost all walls contain soluble salts, many of which are intrinsic to the construction materials themselves. Whether they cause any harm is largely determined by ambient environmental conditions, their location within the structure, and the ions and species present. Advocating extraction to achieve salts reduction based on this arbitrary number is not a supportable aim.

Rapid reduction of the internal relative humidity: rapid changes in temperature and humidity exacerbate rather than ameliorate salts-related problems. Crystallisation of salts occurs not only on the surface of paintings, but also within the pores, cavities and layer interfaces within the stratigraphy, and rapid change can lead to rapid crystallisation, expansion, powdering and loss within the structure of the paint and supporting layers. There is also no set 'ideal' environmental situation because all the different salts species present differ significantly in terms of their RH equilibria (that is, the temperature and relative humidity at which a salt will deliquesce or crystallise). Accelerated reduction of internal relative humidity will preferentially catalyse the crystallisation of salts with high RH equilibria (including sulphates). These salts are more likely to crystallise within the structure rather than on the surface if the RH is reduced drastically, and this can have a devastating effect on the painting (Arnold & Zehnder 1989: 117).

Conclusions

It is very difficult to accept that it may only be possible to manage, rather than reverse or put right a problem, particularly when the problem is occurring to one of Georgia's most ancient, most significant, and most revered monuments. However, if the under-investigated and highly interventive recommendations puts forward in this report are followed, the result will be to turn the current disaster into an infinitely greater one.

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