Protecting Cultural Heritage: Reflections on the Position of Science in Multidisciplinary Approaches*

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Introduction

Over the past 40 years, scientific research activities in support of the conservation and restoration of objects and monuments belonging to the world's cultural heritage have grown in number and quality. Many institutes specifically dedicated to the study and conservation of cultural heritage have emerged. Small dedicated laboratories have been installed in museums, libraries, and archives, and, more recently, university laboratories are showing increased interest in this field.

However, no definition has been formulated so far to identify the specific tasks, responsibilities, and skills of a conservation scientist or of conservation science. This is contradictory to the availability of a clear *Definition of the Profession of a Conservator-Restorer*, published by the Conservation Committee of the International Council of Museums (ICOM-CC) in 1984.[1] Conservation-restoration is also described as an academic discipline in the *Clarification of Conservation-Restoration Education at University level or equivalent*, published in the Clarification Document of the European Network for Conservation-Restoration Education (EnCoRE) in 2000.[2] At present, definitions on conservation and restoration, but not on conservation science, are under discussion in workgroup 1 of Technical Committee 346 of the European Committee for Standardization.

Hopefully, multidisciplinary research consortiums, *e.g.* executing research projects within European framework programmes, will promote the synergy between the cultural heritage field and the natural sciences, and will generate elements for defining conservation science. Important players in this field, which readily address interactivity and networking, are the recently started 'Episcon project' in the European Community's Marie Curie programme[3] and the five-year-old EU-Artech project.[4] The goal of Episcon is to develop the first generation of actively formed conservation scientists at the PhD level in Europe. EU-Artech provides access, research, and technology for the conservation of the European cultural heritage, including networking among thirteen European infrastructures operating in the field of artwork conservation.

The present absence of a recognised, knowledge-based identity for conservation science or conservation scientists may lead to philosophical and even linguistic misunderstandings within multidisciplinary consortiums created to execute conservation projects. This paper discusses sources of misunderstandings, a suggestion for more transparent language when dealing with the scientific term *analysis*, elements to help define conservation science, and the benefits for conservation scientists of becoming connected to worldwide professional networks.

Disputable Terminology Around *Analysis*

Modern analytical protocols involve ever-increasing sophistication of sample preparation procedures, instrumentation, and post-run data treatment. This, together with the frequent absence of explanatory terms around *analysis*, may create an alienating effect on those professionals who are not familiar with the inherent terminology and evaluation processes, yet are closely involved in the multi- or interdisciplinary approach that must lead to the preservation of cultural heritage. There is no doubt that this may generate reservations when analysis of art is at discussion, even when such analysis is considered essential to reveal an object's conservation condition or to establish a conservation treatment. Among the most notable of such explanatory terms are *destructiveness*, *invasiveness*, *representativeness* and *resolution*. Such terms tend to create a polarization between non-invasive/non-destructive interventions and destructive analytical approaches.

Inevitably, the withdrawal of a sample from an object of art or culture implies some kind of mutilation - even when executed in an inconspicuous area or when dealing with minute samples. Such handling is therefore called destructive to the object. On the other hand, there are analytical techniques available that may be applied directly to the object, without the removal of a sample being required. These techniques are often referred to as non-destructive and they are mostly applied to inorganic materials in art.[5] However, from a scientific point of view, any interaction between a material and an energy-bearing analytical vehicle is unlikely to leave that material, or an accompanying-one, totally unaltered after the interaction.

The key feature in this discussion is the way one interprets damage. Obviously, the least critical position may be expected from evaluations of damage by the naked eye: there is no damage if it cannot be *seen*. The most critical evaluation is from data generated at the molecular level by relevant

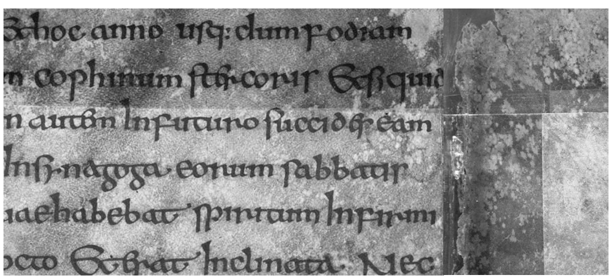

Fig. 1. Dyes in Preolumbian Peruvian textiles (reproduced with permission from the Royal Institute for Cultural Heritage, Brussels): A combination of medium destructiveness and high resolving power allowed for the identification of biological sources used for dyeing, and revealed changes in use as a function of cultural periods - see ref. 12.

spectroscopic techniques: There is no damage if the molecular compositional array at the spot of measurement has not changed beyond experimental deviations or beyond a preset level of tolerance. Sometimes, techniques applied directly to the object are called non-invasive. Although the term is correct since it is a non-sampling technique, the qualification may be misleading in terms of destructiveness for the reasons outlined above.

The complexity of the composition of artifacts such as paintings is expressed by their multi-layer architecture, by the high level of heterogeneity of each individual layer, and by the further contribution to that heterogeneity by natural ageing processes and human interventions. Having to reveal production technology or damage patterns of an object by observing analytical data produced from a microsample or a microspot may come into conflict with the low representativeness of such a sample or spot. Obviously, the only ways to increase representativeness are multiple sampling or increased spot size.

Multiple sampling increases damage to the object, but highly detailed results may be obtained by launching high-resolution mapping and imaging techniques to a set of microsamples.[6] Alternatively, non-invasive approaches may be applied, often with larger beam diameters than those used in high-resolution mapping and imaging. Such larger diameters are advantageous in terms of averaging and, hence, increased representativeness. But, due to the inherent lack of analytical resolution - both in the plane and in the depth of the artifact - they may miss phenomena vital to explain technology and/or damage that would require conservation measures.

It may be clear from this discussion that invasiveness/destructiveness alone is not a good criterion to select an approach for analysing artwork. One or more other parameters should be considered for evaluating the level and detail of information obtained.

Towards New Terminologies

So, should we stop using the often confusing terms that accompany *analysis* when discussing ageing, damage, and manufacturing technology of artifacts? The answer extends beyond the suspected yes![7]

Destructiveness could be replaced by ***degree of intervention***, which may be described at three levels: molecular (low change), microscopic (medium change), or visual (high change). This would imply, for instance, that the withdrawal of a microsample or the generation of a permanently discoloured microspot (as a consequence of prolonged remote radiation) reflect exactly the same degree of intervention. Using the older terms, micro-sampling would be called invasive, radiation non-invasive, but apparently destructive. However, the degree of intervention and its discussion should be time-related. Indeed, discolouration caused by radiation in a focused beam may be either permanent or limited in time, which means that the degree of intervention could be further classified as medium or low intervention, respectively.

However, the degree of intervention does not explain at all why analysis is proposed, requested, or executed, and by what party. More information is needed about the expectations of the requestor in terms of how analytical results will

Fig. 2. High-level destructiveness analysis of synthetic membranes without touching the 8th century parchment of the Codex Eyckensis (reproduced with permission from the Royal Institute for Cultural Heritage, Brussels). This revealed a polyvinylchloride polymer with 30 % (w/w) monomeric plasticizer; after removal of the membranes, the Codex could be conserved by the application of an innovative parchment leafcasting technique – see ref. 13.

be used. It is suggested here that the terms ***usefulness*** and ***innovation*** can provide such information.

The assessment of the ***usefulness*** of the intervention should consider whether the intervention can establish what production technology was used, provide a damage assessment, and determine the best conservation practice to use. ***Innovation*** may be formulated in terms of progress beyond the state of the art. Eventually, innovation could be assessed according to the degreee of intervention[8] or usefulness[9] of analysis executed according to the newly developed approach. Hopefully, a high level of innovation shall create data, insights, and experience which, inr turn, would improve usefulness and probably even lower the degree of intervention in the longer term.

The terms intervention, usefulness, and innovation may be rightfully used and combined to estimate the balance between the degree or level of intervention and the analytical outcome. And it will be exactly this balance that must be discussed by all parties involved when selecting the most appropriate analytical approach. Transparency will be increased specifying the degree of intervention, usefulness, and innovation when discussing scientific analysis in a multidisciplinary environment. Use of these terms also may improve the source's credibility, the receiver's attention, and the quality of the decision.[10]

Towards a Definition of Conservation Science

The linguistic and philosophical issues discussed in the two preceding paragraphs illustrate how a natural scientist (chemist, physicist, biologist), working in the field of cultural heritage, must critically define pathways for proposing, executing, interpreting, and explaining analyses of art within a multidisciplinary and responsibility-sharing environment. To this must be added more specific research-related issues, including old manufacturing technologies, ageing phenomena, and social, cultural and political pressures to preserve the past for the future. All of these elements constitute criteria for improving the understanding of the specific requirements of conservation science.

The major objectives of conservation science should be to study all aspects (chemical, biological, physical) of the manufacture, decay and preservation of objects of art and culture. Such studies require the following:

- reading and understanding the data present in historic literature (revealing the choice of sources, the preparation of products, and the combination of those products in the manufacturing technology of the final object), and the extrapolation of these data into a present day scientific framework (to prepare mock-ups or to develop an analytical strategy);
- recognition of phenomena, at any level of observation (visual, microscopic, molecular), related to manufacture and decay;
- creation of reference collections and databases of analytical results and standards;
- development of analytical approaches to enhance the ratio of information to destructiveness and taking into account levels of usefulness and innovation;
- understanding of usefulness;
- consideration and understanding of historical, geographical, and archaeological aspects of collections;
- appropriate applications of statistics;
- dedicated fundamental research and high-level interactivity with professionals from other disciplines.

A Multidisciplinary Research Forum in Cultural Heritage

Obviously, conservation scientists should have a strong interest in seeking and promoting interactions with other actors in their field. Such interactions will be more established within the framework of relevant professional organisations. A prominent player in this field is the *Conservation Committee of the International Council of Museums* (ICOM-CC).[11] This committee is the largest of 30 international committees of ICOM and is composed of 23 multidisciplinary working groups, covering all aspects of the investigation and conservation of museum collections. In this way, ICOM-CC helps to achieve ICOM's objectives, which are to exchange scientific information at an international level, to develop professional standards, and to adopt rules and recommendations. ICOM-CC membership, which is spread over 79 countries and has grown by 50 % over the last 7 years, is now more than 1500.

ICOM-CC organizes triennial conferences, where all working groups meet in dedicated sessions and where plenary sessions are organised on topics of general interest. At these conferences, working group members elect a coordinator and discuss a working programme for the next three years.

Conclusion

Multi- and interdisciplinary consortia established to preserve cultural heritage will benefit from a better integration of conservation science. This may be achieved through establishing a definition of conservation science and through the formulation of end-terms – formed at the Masters level at least – for conservation scientists. The terminology used nowadays to describe the potential damage to objects caused by analysis should be refined beyond the destructiveness/non-invasiveness polarisation. A terminology should include at least *degree level intervention* (low, medium, high), *usefulness*, and *innovation*. The further development and integration of conservation scientists will improve with their participation in international networks that encourage multidisciplinary approaches.

References and Notes

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NZ Science Scene Continued....

Secondary School DVD Competition

The Royal Society of New Zealand is celebrating the 150th anniversary of Darwin's *On the Origin of Species* this year.

As part of the celebration the 2008 Freemasons Big Science Adventures, nationwide DVD competition has the topic of Darwin and the theory of evolution.

The competition is open to Year 11-13 students and has a two-week trip to the United Kingdom as a major prize as well as a trip to a remote offshore location.

Teams need to comprise of three students and one teacher to act as guide and facilitator.

Entries need to be in by 9 May. For more details see the website. *www.rsnz.org/events/bigsci/2008/*

In Science the credit goes to the man who convinces the world, not to the man to whom the idea first occurred.

Sir William Osler (1849-1919) Canadian physician.