Arts & Humanities Research Council

Science and Heritage Post Doctoral Fellowships Scheme

ACCESSIBLE HERITAGE - Remote trans-continental heritage support system **Dr T Agbota,** University College London
Amount Awarded: £241,433.00

This project aims to develop and deploy on heritage sites a wireless network of long-life and remote environmental monitoring devices and to develop an associated policy framework promoting local data ownership.

In line with the hybrid nature of the project, innovation is on several levels: from a technical point of view, the project will ensure the durability of sensor arrays and their sensitivity to principal ambient pollutants, which has not been achieved before in heritage monitoring. From the point of view of heritage management, one of the principal innovations of the project will be the way in which data are owned, accessed, and fed into heritage site management plans.

The selected sites are in UK, Africa and Asia in collaboration with English Heritage and UNESCO. The availability of such data will enable us to monitor and analyse the heritage climate and to implement the findings in view of the threats imposed by climate change. There is a real potential for the network to grow beyond the lifetime of the project thus maximising its impact and legacy of the programme.

From Structural Change to Perceived Damage: Appropriate Environmental Conditions for Parchment
Mr L Gonzalez, The National Archives
Amount awarded: £234,438.00

This fellowship will help understand how the storage conditions contribute to the decay of part of our heritage - historic documents. The fellowship proposed aims to carry out interdisciplinary research to measure the structural changes that can occur in parchment at different temperatures and relative humidities. Its sole purpose is to develop an understanding of how different levels of damage - that make up a historic parchment- are intrinsic to the rate of decay of the document. Appropriate guidelines can then be established on how best to preserve and store historic parchments.

The hosting institute- The National Archives- will allow access to historic parchments housed in their archives. This will give an unprecedented review of the range of damage found in historic parchments. The partner institute - Cardiff Imaging Institute- will provide the facilities needed to measure the structural changes that occur within historic parchments at a range of temperature and relative humidities.

The fellowship will include in its activities a series of seminars and workshops that are aimed at engaging conservators to become interested in the findings of the project, and, analysing the practical ways of researching how preservation techniques can contribute to the rate of decay of a historic parchment. The project intends to disseminate the findings as a manual that has the potential to inform archives and institutions worldwide.

Advancing and Communicating Synchrotron Techniques for Heritage Metals Conservation **Mr G K C Jones,** University of Warwick
Amount Awarded: £254,162.00

The patina or corrosion layer on a heritage metal may be a stable part of the object's beauty, and characteristic of its artistic and historical context, or it may be a dangerous source of degradation which can lead to the destruction of the artefact.

We wish to use synchrotron techniques to study problems in the conservation of heritage metals, both to understand the surface chemistry of stable and unstable patinas, and to investigate protective measures. A synchrotron is an exceptionally powerful source of "light" (from X-rays to infra-red). Its intensity leads to fast, sensitive experiments, the tunability (of colour) makes possible a wide range of analytical techniques, and the penetration allows measurements to be made on objects in their natural environment, or in a controlled one.

The scope of the project is quite wide, but based on four main objectives:

- The development of new instrumentation for non-invasive chemical imaging of static and dynamic processes
- The clarification of existing methods, especially in the area of data interpretation for museum professionals
- The exploration of the complementary aspects of three major methods in a heritage metals context
- The production of written guidelines in the form of a book suitable for individuals focussed on artefact conservation

The new instrumentation will be initially synchrotron based, but has excellent potential for evolution into a portable device for surface chemical mapping in other contexts. It is considerably more powerful than existing methods in that it identifies chemicals as well as elements, and could be applied to studies of such surfaces as paint and stone in addition to its demonstration role here in metal patinas.

Change or Damage? Effect of Climate on Decorative Furniture Surfaces in Historic Properties **Miss N Luxford,** University College London
Amount Awarded: £235,531.00

Within historic houses furniture surfaces are often richly decorated which can lead to an increased risk of damage due to the different environmental responses of materials. These composite objects are extremely difficult to study and a systematic work assessing the damage caused by changing humidity and by exposure to light still needs to be performed and is the focus of this proposal. With wood having been assessed as the second most damaged material in English Heritage collections, a number of curatorial questions arise, which need to be answered in an interdisciplinary context. The management of furniture collections, particularly decorative surfaces which are extremely costly to perform conservation interventions on, could become even more difficult due to climate change.

Experimental, as well as in situ research will be carried out in order to understand the effect of the display environment. After the sensitivity of objects to the environment is modelled, the integration of these models with environmental

modelling will be attempted. This will allow for examination of various scenarios, informed by climate change predictions.

Studies will be performed on how to integrate the new knowledge on the sensitivity of decorated surfaces into heritage management practices, standards and guidelines.

Cultural Objects worked in Skeletal Hard Tissues

Dr S O'Connor, University of Bradford

Amount Awarded: £244,324.00

From earliest times, people have used the hard skeletal parts of other animals as a source of raw material, from simple bone tools to subtle and evocative works of art. Worldwide, and throughout the human past, skeletal tissues have been valued for their range of material properties, their appearance and their versatility. Some, such as bone, antler and ivory, are hard, resilient tissues. Others, such as horn, tortoiseshell and baleen, are natural plastics that could be re-shaped by heat and pressure. These materials, and others such as feathers and hoof, were worked into everyday objects, tools and artworks, or symbols of power and affinity.

Today these materials have been replaced by alloys and synthetic plastics, and animal conservation concerns have made some (ivory, tortoiseshell) unavailable and unacceptable. With the passing of the raw materials, familiarity with their characteristics and properties has been lost, posing a challenge for those who work with historic and prehistoric artefacts made from them.

This research programme aims to advance our knowledge of the use of skeletal hard tissues as raw materials, showing how materials were harvested, selected and worked, by enhancing and validating our confidence in their identification. Although some materials survive burial in a greatly altered state, if at all, items made in skeletal tissues make up a significant proportion of archaeological finds and cultural objects in all kinds of museum collections. Correct and confident identification of raw materials is crucial. The choice of raw materials will have been informed by their physical properties and their availability, but will also reflect cultural tradition and social identity, belief systems, status, wealth or power, and changes through time can indicate social changes.

Salts and synthetic coatings on wall paintings: characterising their transformation, interaction and contribution to deterioration

Mr S Pandey, Courtauld Institute of Art

Amount Awarded: £240,135.00

Salts and degraded coatings - typically inherited from failed conservation interventions - are ubiquitous problems in cultural heritage conservation. In wall paintings, salt deterioration leads to powdering and flaking of the support and paint layer, causing serious loss. Synthetic coatings often discolour or become opaque, and may contract and pull off the painting; they may also become insoluble, making their removal impossible. When salts and coatings occur in combination, the problems are compounded, but there is a dearth of understanding on the mechanisms of deterioration and how these complex and heterogeneous phenomena may be addressed. To date, investigation of these issues has largely been limited to empirical treatment-oriented trials and to experimental research in controlled laboratory conditions. For a more informed

approach to actual conservation problems in the field, research is urgently needed that combines experimental study with rigorous in situ analysis.

The proposed research will examine the problem of salts and degraded coatings through in situ characterisation of the deterioration phenomena (singly and in combination), and of the impact of the prevailing environmental conditions. Two wall painting sites have been selected for study where salts and coatings are causing widespread damage: Hardham Church, with one of the finest and earliest schemes of medieval painting in the UK, and Nagaur Fort (India) with exceptionally important 18th-century Rajput-Mughal paintings.

The aim of this project will be to apply, evaluate and further develop non-invasive, non-contact, cost-effective characterisation and analytical techniques for in-situ analysis, and to evaluate and calibrate these methods against more sophisticated laboratory-based techniques. Although the research will focus on two sites, its methodological approach and findings will be applicable to many other sites and works of art.

Advancing heritage science with spectroscopic imaging

Dr S Tanimoto, Imperial College London

Amount Awarded: £269,978.00

Microsamples from paintings and objects are often prepared as cross-sections to examine their highly revealing microstructure and stratigraphy. The distribution of materials within the layer structure, or even within an individual layer, reflects the working practices of the artist/maker, the changes that have been initiated by environmental conditions, pollutants or the passage of time, as well as the use and conservation history, including interventions by restorers. The distribution helps to differentiate between original materials and later restorations or additions, as well as deterioration products, which is crucial when undertaking conservation treatments and interpreting the original appearance of the object. It is also important in understanding the causes of decay, informing decisions on storage and display of objects. Although analysis of inorganic components in a cross-section is reasonably straightforward, this is not the case for organic materials, which are very difficult to characterise with the techniques currently available to heritage scientists.

The project will develop the application of micro-ATR-FTIR spectroscopic imaging combined with data processing using multivariate methods to the analysis of cross-sections from cultural heritage paintings and objects. Other conventional IR spectroscopic techniques are of proven value in the field but this emerging technique is the only one that has the potential to become a routine and rapid method to simultaneously characterise both organic and inorganic materials directly (at a molecular level) on cross-sections, at the same time as determining their distribution with the necessary high spatial resolution. This would greatly improve analysis of organic surface coatings or components, understanding of which is crucial for solubility behaviour during cleaning of objects. It will ensure that advice from heritage scientists on the care and conservation of collections is based on the best possible data, improving conservation practice and our ability to preserve our national collections for future generations.

Seeing Through Walls: Discovering Europe's Hidden Mural Paintings

Dr GC Walker, University of Reading

Amount awarded: £281,055.00

The aim of this research proposal is to visualise wall paintings which have been obscured under layers of plaster and paint using a portable pulsed terahertz imaging system. Unlike other technologies used to study wall paintings, terahertz radiation is able to penetrate millimetres of plaster and still detect the obscured picture, while also providing spectral information which can be used to identify the shade and in some cases the age of the wall painting pigment and the covering plaster. Terahertz radiation is non-ionising and non-destructive and will in no way affect the integrity of the artefact under investigation.

Uncovering obscured paintings will be of huge cultural significance to the communities in which they lie dormant. They provide key information about the host building's evolution and influence on the wider community as well as art heritage.

An output of this work would be a multifunction, user orientated, software package to generate numerous 2D and 3D terahertz images, based on properties of the reflected radiation, the physical properties of the pigments used to paint the image, the physical properties of the covering plaster, and thickness of the constituent layers of the wall painting. This software will be aimed at non-specialist terahertz users and it is hoped it will be key to integrating the technology with the art heritage community. Commercial aspects of the software will be exploited. Work will begin using mock wall paintings and will be developed to culminate in testing on actual artefacts.

Interpreting the surface: the application of surface science to artists' acrylic emulsion paint films **Ms EA WILLNEFF,** University of Manchester
Amount Awarded: £274,584.00

Artists' acrylic emulsion paints gained popularity in the early 1960s, after production began in the mid 1950s. Today, acrylic paints sell equally to oil paints and acrylic emulsion-based works of art continue to form significant proportions of modern and contemporary art collections. Well-known users include David Hockney, Andy Warhol, Roy Lichtenstein, Bridget Riley, Patrick Caulfield and John Hoyland. Some of the oldest acrylic emulsion paintings are beginning to require conservation treatment as distracting marks, deposited soiling, loss of surface gloss and decreased colour saturation become increasingly apparent.

It is therefore proposed to carry out systematic investigations of the surfaces of acrylic emulsion paint films, as this is where the cumulative effects of exposure to light, soiling, pollutants, accidents, environment, conservation treatments and migrated materials become concentrated. As yet the variety of materials present on the surfaces of these paints have not been fully characterised and the nature of the interactions between migrated surfactant and deposited soiling have not been explored. The mechanisms and consequences of the degradation of surfactants with light exposure (display) have also to be determined, including whether degradation is dependent on pigment type, and whether there are any consequences of the removal of surfactant (through conservation treatment and/or display) on the underlying paint surfaces.

The proposal combines the expertise and knowledge available at the scientific departments at both Tate and the Getty Conservation Institute with the instrumentation and surface analysis expertise available at the Department of Chemical Engineering and Analytical Science (CEAS) at The University of Manchester University.