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NATIONAL GALLERY OF ART

RESEARCH PROJECT

on

ARTISTS' AND CONSERVATORS' MATERIALS

1950-1971

**Mellon Institute
Carnegie-Mellon University
Pittsburgh, Pennsylvania**

NATIONAL GALLERY OF ART RESEARCH PROJECT

ON ARTISTS' MATERIALS

Mellon Institute of Science
Pittsburgh, Pennsylvania

1950-1971

The principal objectives of the National Gallery of Art Research Project has been to engage in research on the causes of deterioration of pigments, dyes, paints, and varnishes and, through this research, to develop improved methods and materials for the artist and conservator. The results have been shared both nationally and internationally through more than 40 research papers, 20 didactic publications, and hundreds of lectures and consultations on individual subjects.

I. RESEARCH ON CAUSES OF DETERIORATION; DEVELOPMENT OF NEW MATERIALS

The Research Project has devoted major attention to the deteriorating effects of light on museum collections. The result has been the development of final and retouching varnishes that accelerated aging tests indicated will remain stable and colorless for more than 100 years under normal gallery conditions. Protective heat and ultraviolet filters have been tested and introduced in the National Gallery of Art as well as in other American Museums. New pigments and dyes are being introduced, and fugitive colorants rejected, in close cooperation with the American Artists' Professional League.

II. SERVICE TO NATIONAL GALLERY OF ART IN CONSERVATION

In its capacity as scientific advisor to the National Gallery of Art, the Research Project introduced ultraviolet filters over all the day-lighted galleries and continues to monitor the levels of illumination throughout the Gallery. A special container was designed and tested for the transportation of Leonardo's Ginevra de' Benci from Lichtenstein in the height of winter. Reports and inspections regarding the conditions of storage and exhibition of prints, photographs, lead and bronze medals and tapestries have been prepared at the Director's request.

III. SERVICE TO NATIONAL GALLERY OF ART IN THE ANALYSIS AND STUDY OF OBJECTS IN THE COLLECTIONS

Prior to purchase, the Degas sculptures were inspected at the Director's request. Financial and professional support was given to Dr. Herman Kuhn's internationally significant investigation of 30 of 35 recognized

paintings by Vermeer, while the Research Project itself has begun extensive investigations of sculpture in the collections, being able to provide conclusive evidence that several doubtful pieces were properly classified, and providing analysis of wood, marble, bronze and alabaster to assist in the preparation of a major catalogue of the Kress Collection.

IV. SERVICE TO PUBLIC AND TO THE CONSERVATION PROFESSION

The Senior Fellow has served as editor of the Bulletin of the American Group-IIC and assistant editor to IIC-Abstracts for more than ten years, as well as serving on the advisory boards of about 8 national or international organizations. Besides numerous lectures, formal leaves of absence were granted in the spring term of 1961 to allow him to serve as visiting scientist in the newly created Conservation Center at New York University and again, for two months in 1967, to assist in the restoration of flood-damaged frescos in Florence, Italy, at the request of the Committee to Rescue Italian Art (CRIA).

V. NEW METHODS OF ANALYSIS

Besides the study of pigments and varnishes by traditional scientific methods, the National Gallery of Art broke new ground in 1964 by initiating studies in the characterization of artists' materials by techniques of nuclear science. A summary of these activities follows.

NEW METHODS IN ART IDENTIFICATION

I. "DATING" LEAD IN LEAD WHITE

A method of roughly dating the ubiquitous pigment, lead white has been developed which has proven useful in distinguishing between 20th-century forgeries and works produced before the 19th century. The method relies on the natural radioactive series that begins with uranium and involves the measurement of small residual levels of natural radioactivity in samples of lead white. The dating of the "time when the lead ore was smelted" is approximate.

II. "DATING" LEAD-BEARING METALS

The above method was adapted and extended to lead-bearing metals such as brass or bronze. It is generally successful in proving the modernity of such metals.

III. NEUTRON ACTIVATION ANALYSIS FOR TRACE ELEMENT DETERMINATION

Patterns of accidental trace element contamination act as a crude "fingerprint" for batches of pigment derived from the same source. Statistical analysis of the composition of pigments has shown that one can distinguish the lead white used by different artists and the ultramarine blue produced by two modern manufacturers. Various identification problems may be solved through the accumulation of a large amount of similar data.

IV. THE DETECTION OF RECENT FORGERIES THROUGH CARBON-14 DETERMINATION

Since the early 1950's, there have been very large increases in the carbon-14 content of the atmosphere due to the testing of nuclear weapons. This has been shown to be useful in detecting recently produced linseed oil, canvas, and paper in techniques adapted to the small quantities of sample usually available from artistic works.

V. X-RAY DIFFRACTION OF LEAD WHITE

The use of x-ray diffraction to distinguish four different types of compounds in lead white suggests that relative proportions of these will provide a rough indication of the manufacturing process (and hence the period) of its production.

VI. MASS SPECTROMETRY - LEAD ISOTOPES

Samples of lead white prepared prior to the early 19th century have been found to exhibit a relatively restricted isotope ratio in comparison with more modern samples. This is an indication of the modern usage of lead from newer geographical sources such as the Western Hemisphere and Australia, etc. Also, a possible "fingerprint" technique was indicated since a group of samples from one forger was quite similar to one another.

VII. MASS SPECTROMETRY - SULFUR ISOTOPES

It was shown that sulfur isotope ratios varied significantly in samples of ultramarine. It was found that one could distinguish: (a) sources of natural ultramarine, (b) dates of production of synthetic ultramarine, and (c) synthetic and natural material. Other sulfur bearing pigments can be treated by this analytical method as well.

VIII. MOSSBAUER EFFECT IN IRON-BEARING PIGMENTS

A new technique is under development in which the large family of iron-bearing pigments (ochres, siennas, umbers, etc.) may be classified by the chemical state of the iron therein. This can be done completely non-destructively with no harm to a painting undergoing analysis. It is believed that one may distinguish between natural and synthetic iron oxides in this way and perhaps to pin-point their geographical source.

APPENDIX ISUMMARY OF SPECIFIC CONTRIBUTIONS OF THE RESEARCH PROJECT

I. Research

a. Processes of deterioration

Effects of light

- Crosslinking of polymers (4)*
- Chalking of paints and varnishes (2)
- Heating effects (1)
- Fading and discoloration of pigments (3)

- Oxidation and antioxidants (1)
- Oxidation of damar varnish (2)

b. New materials and methods of conservation

Materials

- Non-aromatic petroleum (2)
- Acryloid B-72, B-67; Rhoplex (Acrylics) (1)
- Poly(vinyl acetate) AYAB and solvent (for retouching) (2)
- Light-fast dyes (1)
- Regal chrome yellow (1)
- Non-chalking titanium white (1)
- Ultraviolet absorbers (2)
- Oxidation inhibitors
- Heat-seal relining adhesive
- Infrared reflecting glass and lamps (1)

c. New methods of analysis

- Tests for crosslinking in coatings (2)
- Analytical uses of color measurement (3)
- Standards of lightfastness (2)
- Characterization of spirit varnishes (2)
- Nuclear methods of analysis (Keisch)
 - Lead white "dating" (4)
 - Isotope ratios in lead white, vermilion, and ultramarine (2)
 - Carbon-14 content of vehicles (1)
 - Neutron activation analysis of pigments

d. Investigation of artists' materials

- Damar varnish and Picture Varnishes (8)
- Study of Vermeer's pigments (Kühn) (1)

* parentheses show the number of publications on the subject

d. Investigation of artists' materials (cont'd)

Specific Pigments:

Lead white (Keisch 2)
 Ultramarine (Keisch 1)
 Vermilion (2)
 Alizarin (1)
 Van Dyke brown

II. Conservation Services to NGA

Ultraviolet filters placed over all galleries
 Consultation on heating effects of lamps (T.V., Degas statues,
 Ginevra display)
 Compilation of library of technical books at NGA
 Design and construction of the shipping case for Ginevra portrait
 Advice to F. Sullivan, M. Modestini on solvents, pigments, varnishes
 Advice on storage of photographs 1965, corrosion of bronze, removal
 of paint
 Consultation on whitening of retouches
 Consultation of illumination of Kress tapestries at Philadelphia
 and preservation of silk in Art Treasures of Japan exhibition
 Elimination of the use of shellac (French Varnish) as an isolating
 coat in restoration practice

III. Training

a. Publication of journals, information bulletins

Bulletin of American Group-IIC (10 years)
 Assistant Editor IIC-Abstracts (7 years)
 Didactic publications (15, incl. book)

b. Advisory Boards (Winterthur, N.Y.U., American Artists' Professional League, ICOM, Museum of Primitive Art)

c. Direct teaching assignments

Visiting scientist, N.Y.U., spring 1961
 CRIA assistance to Florence, Feb-Mar, 1967
 N.Y.U. Intern at MI, spring 1969
 Oberlin conference on varnishes 1957
 NGA meeting on damage by light 1962
 Lecture series at Museum of Modern Art 1960

IV. Examination Services to NGA

Study of whitened retouches (1)
 Examination of Degas sculpture collection, 1956
 Study of Vermeers
 Benin Brass Cock
 Examination of seven terracottas
 Study of half-dozen individual paintings at various times
 Examination of corroded medals

APPENDIX IIPUBLICATIONS ON VARNISHES, RESINS, AND
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Book Review: "Recent Advances in Conservation" Washington, D. C.: Butterworths, 1963, R. L. Feller, Science, 142, 1565 (1963).

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"Synthetic Materials Used in the Conservation of Cultural Property", R. L. Feller, G. Thomson, and A. E. A. Werner, Rome Centre, 67 pp. (1963).

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