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Combining Art and Science

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Research Project in Artists' Materials

By ROBERT L. FELLER PH.D. '50

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The author installs paint samples in the fadeometer.

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The National Gallery of Art Research Project in Artists' Materials

By ROBERT L. FELLER Ph.D. '50

MORE THAN fifteen years ago, John Walker, the present director but then the chief curator of the National Gallery of Art, Washington, D.C., called to the attention of authorities at Mellon Institute the fact that the contemporary artist was still using linseed oil, canvas, resins and pigments that had been traditional for several hundred years. Moreover, the conservator or "restorer" of paintings was still mainly using traditional techniques in the important task of preserving paintings in museum collections. In spite of the development of many remarkable new materials in industry and commerce, the introduction of modern pigments, adhesives and drying oils was noticeably slow in these two areas of application. Walker suggested that a research laboratory should be established to facilitate the development and introduction of improved materials for use by the conservator and creative artist.

The result of these discussions was the establishment of the National Gallery of Art Research Project at Mellon Institute, Pittsburgh, Pennsylvania, in 1950. This long-term program has been made possible through the generous support of the Old Dominion and Avalon Foundations. It is the longest continuous research effort in this country directed specifically toward the development of new materials and techniques for the artist and the museum conservator.

The research project at Mellon Institute has concentrated on basic research. In fifteen productive years, the work has attracted international attention. In these busy years, however, we have seldom found time to discuss the principles that have guided the work. I would, therefore, like to outline some of the concepts that have given direction to the research project and to review some of the accomplishments.

The major museums of the world today call upon technical advisers to assist them in the care of their collections. The National Gallery of Art chose to take advantage of the personnel at Mellon Institute in this capacity. This was an ideal choice. This institution brings together, under one roof, a technical staff of more than three hundred and fifty persons engaged in fundamental and applied research in the physical sciences. As such a laboratory, Mellon Institute has more than fifty years of experience in providing technical advice on such diverse subjects as corrosion, analytical chemistry, plastics, paper and microbiology. Thus, over the years, the experts here have not only assisted in the work of the research project, but have been called upon to advise the National Gallery of Art and other museums regarding a wide range of problems: illumination; the preservation of silk, photographs and prints; and the examination of pigments, resins and solvents.

In view of the diversity of technical problems that confront a modern museum, we believe that significant advances in the conservation of museum collections can best be achieved if the specialist with advanced knowledge and training is introduced to the museum problem that needs solving. The research project has done much to foster liaison and interdisciplinary cooperation between technical specialists and museum personnel. We have not only drawn upon the personnel at Mellon Institute but also upon experts in other institutions within the Pittsburgh research community and elsewhere. Educational institutions and industrial cor-

porations have been particularly generous in giving expert assistance when called upon.

Providing technical advice is an important function of the research project, but the National Gallery of Art definitely did not wish the laboratory to concentrate on its own day-to-day problems. The research project was commissioned specifically to conduct research on problems of general concern to museums and to the creative artist.

Because of numerous technical problems involved both in the creation and in the care of paintings, a limited area of investigation had to be selected and defined. It was decided that many aspects of the care and repair of paintings would benefit from fundamental and long-range investigation. Moreover, it was considered that learning about the properties of traditional materials, how they deteriorate and how they must be repaired, would be a sound approach to helping the contemporary artist. By studying the traditional artists' pigments, we would be aided in selecting more lightfast modern pigments. By seeing the traditional paints crack and peel from the canvas, we would be in a better position to recommend tough modern vehicles and supports.

Rarely has the opportunity for the long-range study of basic technical problems been provided in the museum world. To fill this vital need, it was decided to devote the principal work of the National Gallery of Art Research Project to basic research. A basic understanding of the methods and materials was sought, from which practical applications could later be derived. In the fifteen years, the investigations have concentrated on two main subjects. The first was the study of spirit or "solvent-type" varnishes; the second, a study of the photochemical deterioration.

The findings of Dr. Feller and his coworkers led to the installation of special plastic ultraviolet filters over the ceilings at the National Gallery of Art.

The subject of solvent-type varnishes is in keeping with the intent to study problems with broad implications. These varnishes, consisting simply of a resin dissolved in a solvent, represent a basic type of coating that finds wide application in varnishes, adhesives and paints. Not only are they of interest to the conservator of museum objects but to the creative artist as well.

The investigations began with a number of basic questions: how viscous are typical varnishes; how does the mode of flow and drying control their appearance; what factors control their brittleness? Only by asking such questions did we consider that the properties could be improved significantly and that distinctly new varnishes could be produced. For example, it was soon shown that certain polymers were to be completely avoided for this use, since they were technically in their liquid state at room temperature and, therefore, had a marked tendency to absorb dirt. One of the most important developments from these studies was the finding of two polymers that would remain easily removable, colorless and tough almost indefinitely, a distinct improvement over the traditional varnishes based on natural resins.

When a study of the aging of varnishes was initiated, it was found that certain of the methacrylate polymers, although satisfactory in many respects, exhibited an unfortunate tendency to become insoluble under the influence of ultraviolet radiation. The problem was one mainly encountered in accelerated aging tests in the laboratory. Nevertheless, it was also found that a loss of solubility could take place slowly in a museum, particularly on paintings that might be exposed to daylight or ultraviolet radiation from fluorescent lamps. Sensitive methods were developed to detect the beginning of insolubility, and a number of resins were found that did not exhibit the tendency.

The discovery of this phenomenon emphasizes the value of study in depth and of research devoted to the special problems of our field. Industrial laboratories, primarily interested in the long-lasting toughness of films rather than their continued solubility, had not had the occasion to investigate the problem. Several museum laboratories had been gaining experience with butylmethacrylate polymers in recent years. Yet they, too, had given little attention to the very slow changes that take place as the films age.

In the course of the investigations, it was found that the various stages through which these films passed in the process of becoming insoluble were much the same in many coatings. Hence, these basic studies have provided new insights into two problems of fundamental importance: 1) the gradual loss of solubility in certain modern protective coatings and 2) the action of solvents on aged paints and varnishes of many types.

The discovery of the changes that occur during the aging of varnishes aroused our interest in the many other effects that light might have within a museum. At about the time that this occurred, Ernest R. Feidler, then administrator of the National Gallery of Art and now the secretary-treasurer and general counsel, became concerned with the possibility of fading by natural illumination. Both he and the director encouraged the research project to turn its attention to a general study of photochemical damage in museums.

Even before we were able to publish findings in this new area of investigation, the problem was considered so important that the director of the International Council of Museums asked the research project to prepare a review of the subject for the UNESCO journal, *Museum*. This extensive review was published in 1964 both in English and French, with summaries in Spanish and Russian. In the same year, a review was prepared on the principles of photochemistry and on the action of light on paper and varnishes.

Facts already uncovered have many practical consequences. Although ordinary window glass filters some of the ultraviolet radiation in daylight and in fluorescent lamplight, a trace passes through: the so-called "near ultraviolet" radiation between 320 and 400 millimicrons. We have been able to show that this radiation can noticeably accelerate the fading of various pigments, the embrittlement of cloth and the deterioration of varnishes and paint vehicles. In addition, the National Gallery of Art had been plagued for some years with an annoying problem in the deterioration of "retouching" done in the repair of paintings; the cause was traced to the combined interaction of zinc oxide pigment, dammar varnish and ultraviolet radiation.

Our findings concerning the potential hazard of ultraviolet radiation were of such significance that the trustees of the National Gallery of Art authorized the installation of special filters over the entire system that emits diffused daylight to the principal galleries. The intensity of illumination is also reduced during summer months to minimize further the possible photochemical effects.

The basic studies of color measurement, fading and various types of photochemical deterioration are still in an early stage. Yet important conclusions have already been reached regarding the effects of light. The installation of the ultraviolet filters at the National Gallery of Art is an excellent example of the immediate

and practical applications already realized.

When the investigation of varnishes had advanced sufficiently that practical tests could begin, the research project fully recognized the importance of "technical service" and advice. A regular practice was made to answer the call of colleagues and to visit museums on short notice to answer questions concerning the use of new materials. It was not enough to have found durable new resins, for example. It was also necessary to recommend solvents that would allow the new varnishes to be brushed or sprayed. Traditional solvents had to be replaced with new ones.

Working closely with the practitioner in the field, we have assisted him in learning how to use the new products, to reduce as much as possible the time between development in the laboratory and practical application. There are, however, a number of fundamental reasons for slow acceptance of new methods in this work. A major reason is that the museum objects are of great historic and artistic value. It is necessary to be especially cautious in the application of new materials on such irreplaceable items. Accelerated aging tests can give only partial help. New methods and materials must also be given the test of time. Our tests on new varnishes now extend over twelve years and the fading tests on pigments, about seven.

New information does little good, of course, if it is not passed along. The studies on varnish were summarized in a book, *On Picture Varnishes and Their Solvents,* published in 1959 by the Intermuseum Conservation Association, Oberlin, Ohio. Much of the background information on the photochemical problem has appeared in two extensive reviews. On the average, one publication on each of the two main areas of investigation has appeared every year.

At about the time that the research project was established, the International Institute for the Conservation of Historic and Artistic Works (IIC) was founded. This professional society, which now numbers more than a thousand members, has been served by the research project in a number of ways. The semi-annual *Bulletin of the American Group—IIC* has been edited and published by the author for the past five years. Abstracts of technical publications have been regularly prepared, and for the past three years the author has served as associate editor of *IIC Abstracts.* During the past year, the research project also sponsored the publication of a much-needed subject index to an important early journal in the field, *Technical Studies in the Field of the Fine Arts.*

To provide a sound foundation of knowledge upon which to build greater understanding and future developments, long-term investigations of basic problems are vitally needed. Through the generous support of the Old Dominion and Avalon Foundations, the National Gallery of Art has pioneered in sponsoring such an approach to the problems of the materials used by the museum conservator and the creative artist.

Samples of varnish being inserted into accelerated-aging chamber.

Dr. Feller is shown measuring the color in a sixteenth-century painting.

About the Author

DR. ROBERT L. FELLER'S work brings together a long association with art and with science. A native of New Jersey, he studied drawing and painting as a hobby early in life and continued the study of art at Dartmouth, where he received his bachelor's degree in chemistry in 1941 and where he was art editor of the campus humor magazine. He entered the Graduate School at Rutgers and received his M.S. in 1943 and his Ph.D. in physical organic chemistry in 1950, finding time while a graduate student to contribute cartoons and drawings to *Anthologist.*

In 1950 Dr. Feller joined Mellon Institute as Fellow in charge of the National Gallery of Art Research Project on artists' materials and became Senior Fellow in 1963. For half a year in 1961 he was on leave of absence as visiting scientist at the newly-established Conservation Center at the Institute of Fine Arts of New York University. His work at Mellon Institute has earned him considerable repute in this country and abroad.

Dr. Feller is a member of numerous honorary and professional societies, including Sigma Xi, Phi Lambda Upsilon, American Chemical Society, American Association for the Advancement of Science, Federation of Societies for Paint Technology, museums associations in the United States and England, the Inter-Society Color Council and the International Institute for the Conservation of Historic and Artistic Works (IIC). A Fellow of IIC since 1956, he is a member of its governing council, associate editor of *IIC Abstracts* and editor of the *Bulletin of the American Group—IIC.* For the past two years he has been chairman of the American Group—IIC.

His work has led to appointments in an advisory capacity to many museums and professional organizations. He is a member of the advisory board of the Intermuseum Laboratory at Oberlin, Ohio; the Board of Consulting Fellows of the Conservation Center, Institute of Fine Arts, New York University; the committee on laboratories and the committee on the introduction of synthetic resins in conservation of the International Council of Museums; and the National Bureau of Standards' standing committee on permanent artists' pigments. Last year he was invited to become a consulting fellow of the Museum of Primitive Art in New York City.

Dr. Feller is co-author of a book, *On Picture Varnishes and Their Solvents,* and has published and lectured extensively on varnishes, resins, solvents and the deteriorating effects of light.