The Restoration of Original Paints at Otis House

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THE Society's philosophy in favor of preservation, and opposed to restoration, does admit of a few exceptions. Among these are some buildings which have already undergone considerable restoration work at the hands of the Society. New techniques of analysis now enable us to continue the restoration applying more scholarly standards to the work than was previously possible. In restoring the first Harrison Gray Otis House in Boston, built in 1795, we have learned a number of things about the way the original paints have changed with time, and we have developed a few techniques for reproducing them as they looked when new.

Our findings are based on the chemical and microscopic identification of the pigments, and we are most indebted to Dr. Robert Feller of the Mellon Institute both for his detailed advice and for his analysis of a number of samples by emission spectrograph and X-ray diffraction.

The original finish paints on the walls and woodwork of Otis House consist primarily of the following pigments: white lead, Prussian blue, yellow ochre, lampblack, and chalk. The chalk was used as a cheap extender for the expensive white lead. The medium is a vegetable oil, almost certainly linseed oil. The woodwork is all primed with a thin gray paint which we have not analyzed. In the usual eighteenth-century way the paints were made washable and glossy by means of very thin oil-based glazes. These glazes contain white lead, which served as a drying agent; they also contain chalk, which reduced shrinkage as the glaze dried and which did not seriously impair the transparency of the glaze since the index of refraction of chalk is fairly close to that of the oil medium. One of the glazes was tinted with brilliant green crystals of verdigris.

In the paints themselves the most unstable element has proved to be the oil medium. It is well known to conservators of paintings that paint films and glazes containing vegetable oils slowly turn yellow-brown when placed in darkness. The original color may sometimes be restored by bleaching the paint through exposure to daylight or the so-called "near" ultraviolet light emitted by a flourescent lamp. The original paints in Otis House were put in darkness by the application of later paints over them in the early nineteenth century. When we first exposed samples of the original paints in the early months of 1970 we found mostly yellowish pea-greens and brownish buffs. These samples have been exposed to normal room light for a year. During that time the dark yellowish greens have become a little lighter and more blue-green, and the buffs have lightened toward cream color. One or two small areas of original paint had stood exposed since a restoration of 1960 and had been bleached by normal room light for ten years. One of these samples had become a light Adamesque blue-green, while the same layer of paint when freshly exposed

next to the place exposed in 1960, is the color of pea soup. By illumination of other samples with a fluorescent lamp for trial periods from a week to several months, we were able to duplicate or slightly exceed the bleaching effect of ten years of daylight.

We have found a good deal of evidence to show that what we have observed is in fact a bleaching of linseed oil discolored by darkness. The paint contains no materials except the oil which may be expected to bleach quickly in ultraviolet light. Also, the browning is less pronounced in the centers of any little lumps of the paint which one finds in cracks and similar places; here the paint contains only its own oil, whereas in the places where it is thinner the oil of the glazes penetrated deep into it and thus increased the browning effect.

A possible way to estimate the original color of old paint is to find one of these lumps, cut into it with a scalpel, and then expose the sample to the light of a fluorescent lamp. The lump should be in a place which was always dark, such as the back of an interior shutter. The browning will not have been more severe here than elsewhere in the room, since even the paint in sunny places will have spent many years in the dark under later paints. The advantage of a dark place is that the early pigments will never have been faded by sunlight during the years when the paint was exposed. The paint will thus regain much of its original brilliance after the oil is bleached. If a strong source of light is used, and placed close to the sample, the period of exposure should probably not exceed a week, lest the lamp begin to fade some of the original pigments. In the case of many colors one can judge the best exposure time by comparing the results of shorter and longer exposures and by noting whether the longer ones fade the color.

One should know whether the pigments found are stable or fugitive. Of the pigments used at Otis House the yellow ochre, lampblack, and white lead all resist fading in the light, but the yellow ochre can be reddened by high temperatures and the white lead darkened by exposure to products of combustion. This darkening of ochre and of lead cannot be reversed by exposure to light, so that we know our bleaching of the paint has nothing to do with the ochre or lead. Our only pigment subject to fading in the light is the Prussian blue, long known, incidentally, for its tendency to turn green through the yellowing of oil mediums. We have found that our colors containing Prussian blue are a great deal more intense where the paint was protected from sunlight than they are elsewhere. (It is also interesting that the fading of Prussian blue is partially reversible if the paint is put in the dark.)

Under high magnification all the pigment grains in our old paints seem to have retained their original brilliance, or very nearly so, and the white lead is perfectly white. The pigments are fully as bright as the grains of the same pigments made today, which can still be imported in the old dry powder form. In the case of a paint altered by time the original intention of the painter can often be determined by inspection of the paint at 400X or 500X. For example, we know that some paints at Otis House were intentionally green and that others were originally blue but have turned green because of the oil: samples of the blue contain only Prussian blue; samples of the green contain Prussian blue and yellow ochre, a customary early way of making green.

We feel that it is important to dupli-

cate original pigments as nearly as possible, with respect to particle size and chemical composition as well as color. We have thought too long only in terms of matching the color of early paints. Most of us now understand that old paint has not only color but a ropy, textured appearance, usually showing pronounced brush marks. And, even so, we do not fully appreciate old paint until we recognize that it has more than just color and texture. It also has optical character. Optical character is not only something we feel on entering a room which still has very old paint on the walls; it is something we can define precisely in standard optical terms, such as translucency and opacity. It is the way the paint reflects and transmits light; it is determined by the indices of refraction of the pigment grains, the relative indices of the pigments and the medium, the properties of the pigments with respect to the diffusion of light and the dispersion of light. Light does not merely bounce off a film of paint; it enters the film, passes into all the materials in the paint, and comes out at us in a different form. While we may achieve the same color with pigments unknown in the historic period, we will never achieve the same full range of optical effects as the old paint originally had.

It is possible, for example, that the use of chalk as a cheap extender in old lead paints is responsible for their slightly milky look, as well as for their appearance of being a material rather than simply a color. Being nearly transparent in oil, the chalk admits light deeper into the paint film, so that when the light comes out at us it brings with it the impression of a thick, slightly translucent layer.

Apart from the issue of optical character, there are further advantages in duplicating the original pigments. Not the least is that the process of matching the new color to an old sample suddenly becomes relatively easy, while with different pigments one tinkers endlessly. Furthermore, if one is slightly inaccurate in making the new color, at least one will probably produce a color of the period; with pigments known only at much later periods one may err in the direction of a color totally unknown at the time the original paint was applied. And even if one matches the old paint exactly with modern pigments, the new paint probably won't fade in the same ways as the old.

One important characteristic of old pigments is the large size of their grains. When we buy modern pigments ground in oil, the particles may be so fine that they cannot be seen even at 400X magnification, while the old paints look like a field full of big colored rocks at that power. This is one reason why modern paints look dead and smooth compared to the old. Large, angular grains make a paint film tense and alive, a liveliness analogous to that of French impressionist paintings made with distinct dots of color.

The difficulty in using granular, dry pigments is that some of them cannot be mixed directly into the paint. Their grains adhere together and have to be ground apart before the pigment is put into the paint. A good way to do this is the old way, with a slab and muller. An excellent slab and muller can be made from ¾-inch plate glass, the working surfaces ground with carborundum powder. We have made our slab 15 inches by 24 inches and our muller 7½ inches by 4 inches. Pigments should be ground in linseed oil, which eases grinding and holds down the dust of poisonous pig-

ments. If one uses raw linseed oil, not treated with driers, the ground pigments can be stored for long periods of time.

It is not difficult to match the texture of old paint if the original materials and methods are used. In Otis House the early paints were not pumiced smooth, as became more and more common in the nineteenth century. We reproduced the original brush marks automatically by using lead paint and fine hair brushes. One can make the brush marks more pronounced by using a thick paint or by allowing the paint to stand on the wall a very short while and then rebrushing.

Present-day science cannot answer all our questions about old paints or solve all our problems in restoring them. But architectural historians have not begun to reach the limit of what science can easily tell us. Until more researchers turn their attention to the analysis of house paints, and until scientific methods of restoration have become habitual, our standards of accuracy in this work will remain fairly low.