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Leonardo, Volume 11, Number 3, Summer 1978, p. 213 (Article)

Published by The MIT Press

Leonardo, Vol. 11, p. 213.

0024—094X/78/0701—0213$02.00/0

INTENSITY-MODULATED ILLUMINATION OF PAINTINGS AND AN UNEXPECTED 3-DIMENSIONAL EFFECT

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The whitest paints used by artists reflect about 90% of the light incident upon them, while black surfaces still reflect as much as 4 or 5%, so the maximum luminance scale that can normally be realised upon an opaque base is of the order of 20:1. Most older paintings would be expected to show a shorter range than this, due to such factors as sulphide darkening, fading of pigments and the yellowing of oily media and varnish.

In a real 3-dimensional scene, objects seldom receive the same illumination. Objects in shadow receive much less radiation than those in direct sunlight, so that still less light is reflected if they are inherently highly absorbing. The result is a much longer luminance scale. L. A. Jones and H. R. Condit gathered quantitative photometric data for a wide selection of scenes and found that an average range was 160:1, with values going up to 760:1 for scenes containing brightly sunlit white clouds and deep foreground shadows[1]. It is therefore apparent that the luminance range of a painting will rarely match that of the scene depicted, particularly for an outdoor or sunlit subject [2]. Some compression of the scale is inevitable, and no amount of 'flat' illumination directed upon it will correct this. This argument does not apply to pictures painted in transparent colours on a transparent support such as glass, which (like photographic colour slides) may be illuminated and viewed by *transmitted* light. However, only a few painters have worked with this medium, for example Gainsborough [3].

In order to extend the luminance scale of a painting upon an opaque support, light must be directed preferentially upon the lighter areas of the work with progressively lesser amounts upon the darker portions. Around 1908 R. W. Wood realised that intensity modulation could be obtained by illuminating a painting through a photographic diapositive (slide) of itself[4], but the techniques and apparatus available at that time rendered the procedure clumsy and impracticable, and his scheme was not published. I have investigated the effects of illuminationg high quality reproductions of works by Vermeer and by other artists in this manner,using modern 35-mm monochrome transparencies and associated equipment. I found that precise registration between the projected image and the original was most important. This was facilitated by adding a zoom lens plus vertical and horizontal screw adjustments to the slide projector.

When exact alignment was achieved, it was observed that Vermeer's works, in particular, were dramatically transformed: one appeared to be viewing the actual scene through an open window rather than a flat representation of it. As well as the glowing brilliance of sunlit areas, resulting from the extended luminance scale (an effect shared by the paintings of other artists), an unexpected 3-dimensional appearance was apparent to many independent viewers looking at Vermeer's 'View of Delft', 'Head of a Girl' and 'Lady and Gentleman Drinking Wine'. Normal binocular vision was effective in the darkened room.

The reasons for this illusion are not entirely clear to me, but they are no doubt related to other methods of achieving an apparently stereoscopic effect [5]. The reasons appear to depend on the skill of the painter and on viewers' experience of pictures: (1) The skill of Vermeer in constructing the perspective and modelling the shadows, colours and textures. His suggested use of some form of optical aid, such as the camera obscura [6], is significant. Presumably works by other artists that similarly embody strong and geometrically correct depth information [5] would be equally effective. (2) A longer luminance scale is normally associated only with real scenes. Also the low visibility of the picture frames used renders it difficult to localise the surface of the pictures, which appears to be important in normal viewing [7]. Mixing the intensity-modulated illumination obtained with a slide with a certain amount of ordinary light modifies the effect and may improve the subjective impression.

I do not suggest that this form of lighting should replace that normally employed in galleries, but it would appear to merit consideration for certain exhibitions and studies, including those in the psychology of perception [2, 8]. The technique would also appear to offer a means of 'restoring' without harm certain paintings in which one pigment (for example a red lake upon a white ground) has faded in the course of time. Transparent dyes need only be applied to appropriate areas of a large-format diapositive (slide).

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REFERENCES

1. L. A. Jones and H. R. Condit, *J.Opt.Soc.Amer.* **31,** 651 (1941).
2. E. H. Gombrich, *Art and Illusion* (Oxford: Phaidon Press, 1977).
3. Anon., Gainsborough's Show-Box, in *Illus. London News* (20 Jan. 1934). The apparatus and paintings are now in the Victoria & Albert Museum, London.
4. W. Seabrook, *Doctor Wood* (New York: Harcourt Brace, 1941) p.132.
5. A. Ames, *The Art Bulletin* **8,** 5 (1925–26).
6. A. Fink, *The Art Bulletin* **53,** 493 (1971).
7. M. H. Pirenne, *Optics, Painting and Photography* (Cambridge: Cambridge Univ. Press, 1970).
8. J. J. Gibson, *The Perception of the Visual World* (Boston: Houghton Mifflin, 1950).