

Detection of Underpainting Using SWIR Hyperspectral Imaging

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The meaning of paintings is usually obtained predominantly by visual analysis of what we can see, that is the appearance of the works. Analysis of the iconography, together with the context of the production of the painting, provides most of the information one needs. However, an intriguing possibility is offered by looking behind the surface: to see how the painting developed, what was covered by later modifications, repairs, and even to detect the presence or absence of underdrawing sketches distinguishing original from a fake.

The Babbling Tower is a fascinating example of a painting whose analysis was aided by looking under the surface. Larry Elliott, the recently deceased polymath, painter and musician, was well known for his complex works representing a rich palette of imagery using exquisitely detailed components from iconic classical images, found objects and religious, allegoric and philosophical representations, drawing the epithet of “magic realism” to describe his style.

Figure 1 shows The Babbling Tower as it hung on the artist’s wall when he died in 2019. The subject and the title reference the biblical Tower of Babel that came to represent the difficulties, even impossibility, of communication and understanding between peoples when they aspire to reach God. Full and in-depth analysis of the iconography is beyond the confines of this brief note, but even to the casual observer the juxtaposition of the characters from different religions is trivially apparent.

Researching the history of this work, it transpired that in a booklet *New Paintings* (Figure 2) by Larry Elliott published in 1984 a black and white image



Figure 1. Larry Elliott: *The Babbling Tower*. Oil on panel, 24 x 20 in. Signed, upper right (catalog #E-60/3461). Estate of the late Larry Elliott

of an earlier picture with the same title is shown, demonstrating a dramatic dissimilarity. Was that a different painting? Was it a different ‘version’ or an original that underwent modification by the artist after being shown to the public?



Figure 2. Richard H. Love: *“New Paintings” by Larry Elliott, Synthesis of Fantasy and Reality*, Haase-Mumm Publishing Co. Inc, Chicago 1984

Examination of the extant work using the novel technique of SWIR Hyperspectral Imaging provided the answer. The painting was brought to the application laboratory of Middleton Spectral Vision in Middleton, WI. A [Reveal Scan 100](#) hyperspectral imaging system (Figure 3), equipped with an extended range SWIR (1000-2500 nm) hyperspectral camera from Specim Spectral Imaging Ltd was used to scan the painting. The hyperspectral scans were stitched using kemoQuant™ (Middleton Spectral Vision, Middleton, WI) chemometric imaging software to show the possible information below the visible paint layer.



Figure 3. [Reveal Scan 100](#) Hyperspectral Imaging System for art art cultural heritage from Middleton Spectral Vision.

Figure 4 shows the scanned image using an RGB representation of the SWIR data. In this example the hidden underpainting of two additional figures of a male and a female characters are very clearly visible, exactly as seen in the 1984 illustration. Their prominent position underlines the importance of those two heads, and thus their later removal also represents a striking alteration of the meaning of the work.

It is, of course, not known what induced Larry Elliott to make the change. Perhaps the original intention included man-woman communication conflicts in



Figure 4. Scanned image using an RGB representation of the SWIR data

addition to the religious and racial. Perhaps the reasons were esthetic rather than intellectual. In any case, this novel technique authenticated the work as a modified version of the original, rather than a copy or a new different painting.

The SWIR hyperspectral scan of paintings is in many cases very informative of underdrawings, revealing small chemical differences. In some cases, this can even suggest copying techniques (e.g. a grid drawn may have aided the forger) or demonstrate tentative changes that show the exploration of the best design by the artist, strongly supporting that the work is original. The information about the chemical constitution of the paint layers may further help authentication of cultural heritage items.