

A Multi-Disciplinary Approach to Analysis of Historical Red Lake Pigment Samples

Diane Kunzelman^{1*}, Ezio Buzzegoli², Mattia Patti², Claudia Marchese², Daniele Uldank³, Ilaria Degano³, Francesca Modugno³, Margherita D'Ayala Valva⁴, Francesca Rosi⁵, Francesca Gabrieli⁵, Austin Nevin⁶

¹Opificio delle Pietre Dure di Firenze, Florence (Italy) ²Università di Pisa, Dipartimento di Civiltà e Forme del Sapere, Pisa ³Università di Pisa, Dipartimento di Chimica e Chimica Industriale, Pisa ⁴Scuola Normale Superiore di Pisa ⁵Istituto di Scienze e Tecnologie Molecolari (CNR-ISTM), Perugia ⁶Istituto di Fotonica e Nanotecnologie (CNR-IFN), Milan.
Contact: ilaria.degano@unipi.it

Extensive interdisciplinary investigation of a group of historical red lakes and colorants, provided by the Lefranc&Bourgeois Archive in Le Mans (France), has produced interesting results about their nature and significance in terms of production of new formulations for commercial organic dyes and pigments at the beginning of the XX century. The materials were sampled for study in relation to the Italian research project *FUTURAHMA* (<http://www.futurahma.it/>), which unites art historians, conservators and scientists.

In detail, we characterised a group of lake pigments found in 20 original jars labelled with inscriptions and dates from 1890 to 1921. The results of historical investigations were complemented by non-invasive multispectral imaging of the samples at various wavelengths. Invasive chemical and physical analysis followed: the survey comprised the identification of the actual colouring materials by HPLC-DAD and HPLC-ESI-Q-ToF, Raman spectroscopy and Fluorescence Lifetime Imaging; FT-IR and XRF were also applied to assess the presence of inorganic salts used for lake production. Focus has been placed on discriminating among dyestuffs and lake pigments, and among their naturally derived and synthetic versions.

The most interesting results dealing with the interpretation of mass spectrometric results will be presented, along with relevant information acquired by complementary techniques.