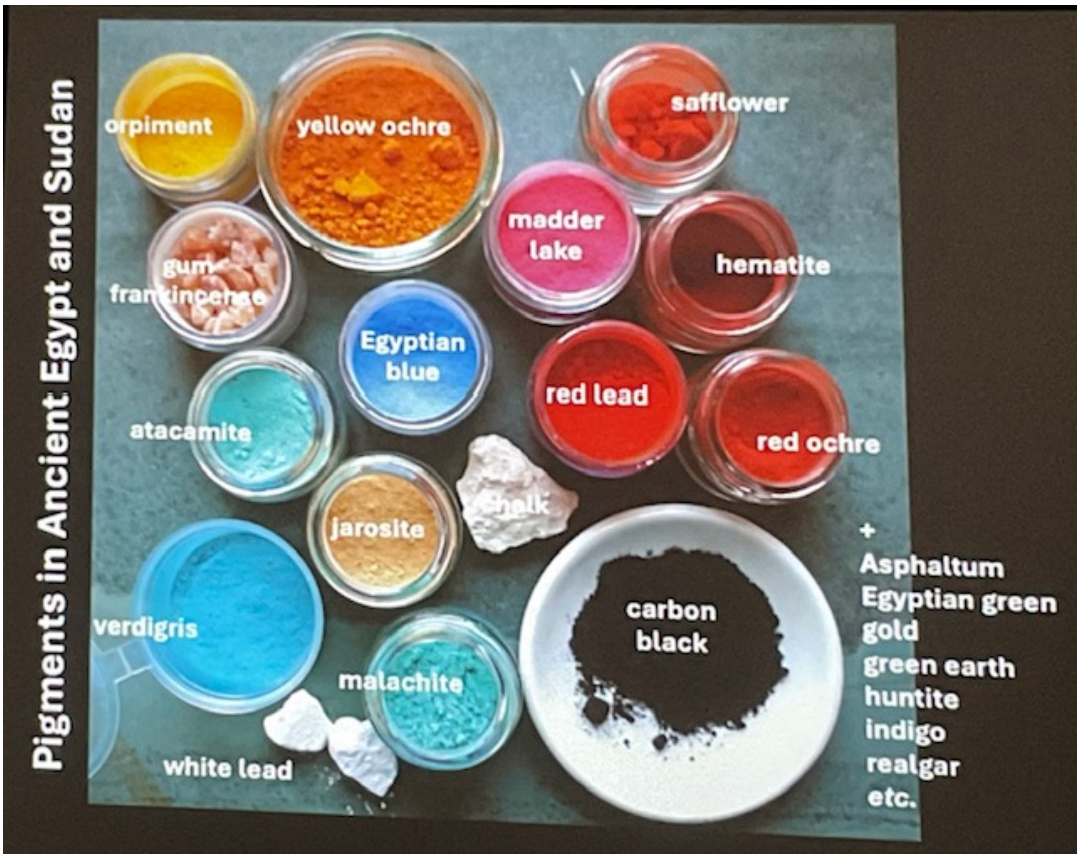
Essex Egyptology Group: Sunday 5 March 2023: Painting Materials in Ancient Egypt:
A talk given at Witham by Dr Ruth Siddall, UCL.

Dr Ruth Siddall outlined how natural materials are sourced to make pigments, and cited two of her case studies of Egyptian artefacts where specialist analysis techniques can reveal the source materials of the pigments used by the ancient Egyptians. In the second half of the meeting, Dr Siddall gave a practical demonstration of preparing some pigments for use as paints.

Dr Siddall introduced herself as a geologist, not an Egyptologist. She has experience of working in Bronze Age archaeology and has worked with Egyptian material in various museums. Her interests as a geologist include minerals used as pigments. Her 2008 co-authored book 'Pigment Compendium: A Dictionary and Microscopy of Historic Pigments' has been recently contracted for a second edition. She is interested in the characteristics of ancient materials, and the archaeology of Mediterranean and Roman painting techniques.

A wider range of pigments were used in ancient Egypt than in other cultures. Pigments for different colours derive from mineral (inorganic) and plant (organic) sources. Paint types in modern use include watercolour, tempera, gouache and oil. Extracting colouring pigments from mineral bearing rocks and grinding them to a powder using a pestle and mortar is an arduous and time-consuming process. The pure powdered colourants need mixing with a medium to give the pigment the necessary adhesive properties. This can be plant gums, gum mastic, gum Arabic or egg yolk plus a little water.



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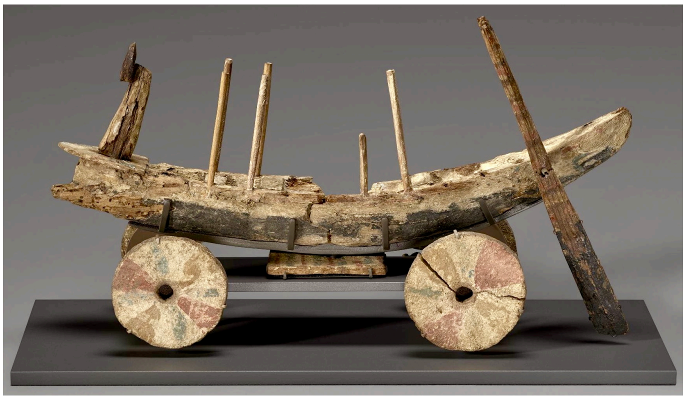
Dr Siddall then gave the group an introductory outline of some inorganic and organic materials that give particular colours:

- Reds come from, hematite, red ochre; and red lead (in the Ptolemaic and Roman Periods).
- Safflower gives an orange-red.
- Yellow ochre (hydrated iron oxide) gives an orangey-yellow, while orpiment produces a vivid golden yellow. Yellow-arsenic sulphide is a toxic mineral – very poisonous to use.
- Greens can also be produced by mixing orpiment with Egyptian blue.
- 'Green earth' – a naturally formed clay variety gives a muted green.
- Verdigris is a blue powder – a mix of copper or bronze with vinegar that gives a rich deep blue-green.
- Copper proteinate (verdigris plus egg yolk) gives a blue-green; adding saffron produces a strong grass green colour.
- Blue-greens are made from malachite or atacamite.
- Egyptian Blue is a synthetic pigment made by mixing sand and limestone.
- Azurite gives a brilliant, rich blue.
- Madder, an organic pigment, gives pink.
- Purple may be achieved with a mix of madder and indigo – possibly an accidental, temperature-related discovery.
- Black comes from soot or charcoal (and occasionally asphaltum).
- White directly from chalk.

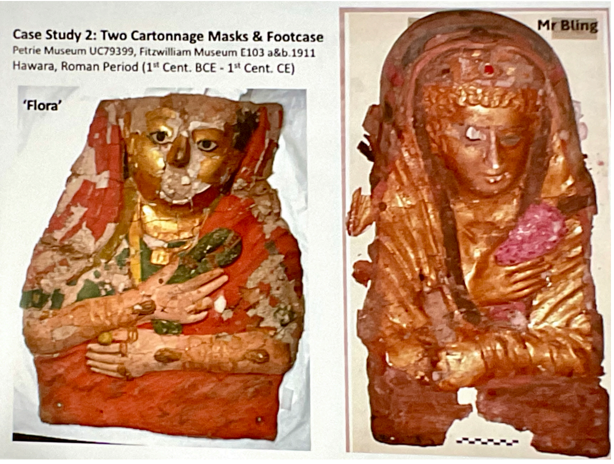
Evidence of ancient pigments has been found on some scribal palettes. Also Evidence of pigment processing and preparation using pebbles to grind source materials on stones to make pigments. Mixing palettes came from Wadi Hammamat, and brushes were made from reeds or linen. Organic materials were used to decorate some New Kingdom coffins – Egyptian blue, and a resin made from pistachio trees that gave a dark green background.

Analytical techniques used include ultraviolet fluorescence, X-Ray Diffraction / Fluorescence, and various types of dispersive spectrography and chromatography.
With mineral pigments and some organic pigments, differences in lightwave patterns can identify the various colours used and can tell if a paint colour comes from a single pigment or mixtures of pigments. It can also identify the presence of fillers added to provide bulk. The technique has also been used to reveal that Impressionist paintings were really painted 'en plein air' due to the presence of pollen grains. XRD (X-Ray Diffraction) reveals the pigment particles, its crystalline structure and how rocks were ground.

Dr Siddall then illustrated the outcomes of some of these analytical techniques with two case studies she has undertaken:



Case Study 1: Gurob Ship Cart – a New Kingdom replica of a boat on wheels (possibly made as a toy) in the Petrie Museum UC16044. Careful dusting of the object releases tiny amounts of material, sufficient to analyse. This



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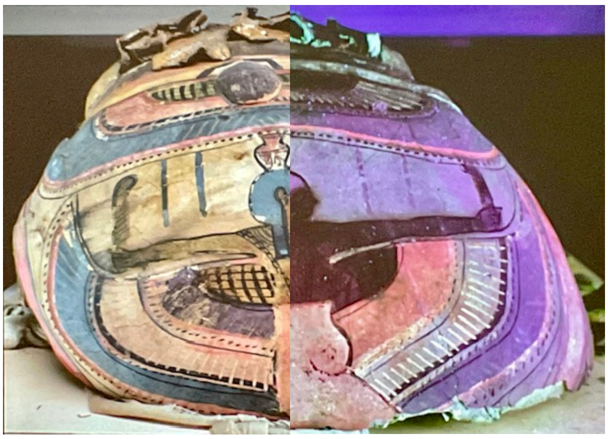
showed fluxes coming from either natron or potassium, Egyptian blue and red ochre particles (red ochre made from heating yellow ochre), yellow was not saffron but powdered safflower, its 50 micron particles show biological structures and inorganic matter. Safflowers were known in ancient Egypt. Very few plant materials can be used directly.
The safflower needs to be soaked in water for 3-4 days to separate the dye. The underside of the model boat was painted black, derived from asphaltum rather than charcoal. Asphalt is known to have been used to coat the bottom of boats to render them waterproof.

<u>Case Study 2:</u> Two cartonnage masks and footcase - Petrie Museum UC79399 and Fitzwilliam Museum E103 1911, Hawara, Roman Period (1st Century BCE - 1st Century CE).
Analyses of these artefacts shows red ochre (a metal hydroxide of iron - Iron ochite). The pink lozenge decoration on her dress is madder as it shows in fluorescent light. Madder, a dye pigment is extracted with difficulty from the plant's root, soaked soak for weeks, which have to be heated to 60°c. Dyes are soluble in water, unlike pigments. Aluminium sulphate and sodium carbonate / chalk precipitates were detected. Alum mineral was available in the Eastern Desert.

At the base of one of the cartonnage bodies, the green colour has 'gone off' but particles under cross-polarised light appear black, revealing the original colour.
On the Footcase, under X-Ray lead paints (and gold) appear white and opaque.
Egyptian gold leaf - a natural gold/silver alloy was applied over a red bole undercoat of red-ochre.

Appropriate expert specialist analysis is important to counter previous assumptions in some literature rather than analysis to accurately differentiate source materials used in ancient Egyptian pigments.



The left half of the image is seen under natural light. The right half under uv light shows the skin as black though it was originally green.

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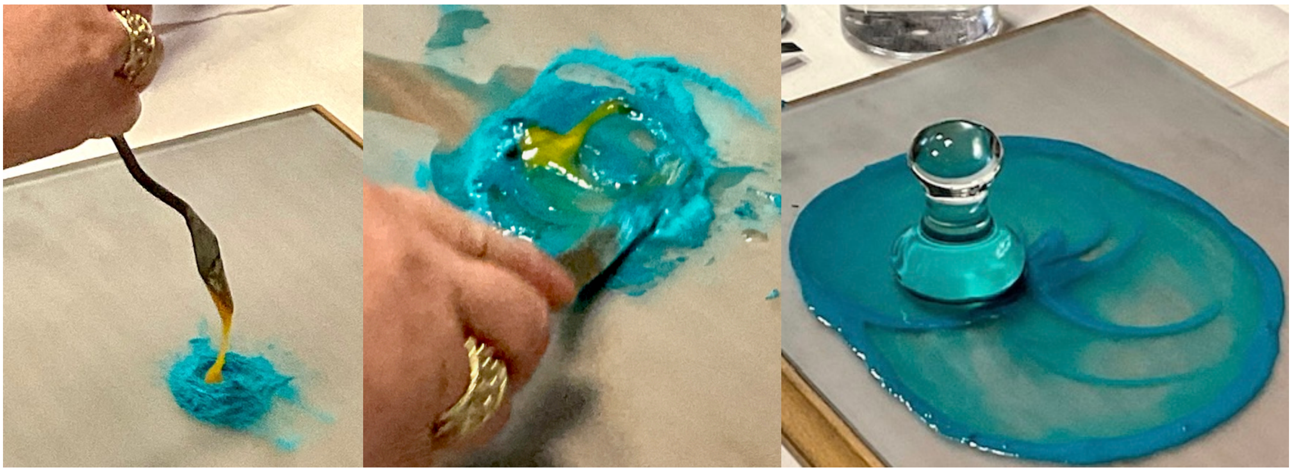
After the break, Dr Siddall gave the group to a practical demonstration of mixing paints from pigments. Firstly, a small mound of powdered verdigris was placed on a glass plate. A well was made in the middle of the powder, then some gum Arabic and a small amount of egg yolk was added and mixed in with a palette knife. A few drops of water were then incorporated. A 'muller' (a mushroom-shaped glass tool) was then used to thoroughly mix the pigment powder with the media, to expel all the air and ensure that every individual pigment grain is coated with the medium. It is not used for grinding pigment powders (a pestle and mortar is used for that purpose).



Group members were invited to try out the rich turquoise-green colour on watercolour paper. For the second colour, Egyptian blue powder was mixed up with gum Arabic and a few drops of vinegar. This gave a strong blue paint when applied neat but paler when diluted. The last coloured paint was a softer green, made from malachite pigment with gum Arabic and water.

See also Dr Siddall's 'Beginner's Guide: How to make a paint from pigment powder' – https://www.ucl.ac.uk/~ucfbrxs/Homepage/Recipes/Paint.pdf

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6/3/23