Nobel Metal Microscopes . . .

Continued from page 16

these jeweled lenses and references to additional sources can be found in the book by Clay and Court mentioned earlier, and in Bradbury's The Evolution of the Microscope (Pergamon Press, 1967).

George III's silver microscope was made more than 200 years ago, and the jeweled lenses were made over 125 years ago. What of today? Nobody today is making either silver microscopes or jeweled lenses, but in the last 15 years I have managed to acquire two microscopes with the Midas touch, so to speak. Yes, I mean 14 Karat solid-gold microscopes. Admittedly they are a bit smaller than your common garden variety microscope – I show them in Figure 2 next to an ordinary microscope objective for size reference! The microscope on the left, next to the 10X objective, contains a Stanhope lens, the top of which is just visible above the bodytube. The Stanhope lens is a glass cylinder with a convex surface on one end and a plane surface on the other. In practice, a microphotograph is mounted on the plane end and covered with a tiny coverslip. For details of the Stanhope lens and microphotographs, see G.W.W. Stevens' Microphotography, Wiley, 1968. There is a microphotograph mounted in the Stanhope lens of the microscope on the left, which can be seen if the instrument is held close to the eye while looking toward a source of light. This particular microphotograph is a heart, inscribed "I love you" - so what did you expect from a 14K gold microscope, a transverse section of Amphioxus in Mallory's triple stain?

Speculating on the possibility of commissioning Cartier to make a platinum-iridium microscope with gilt drawtube and Wedgewood accessories is good for a quarter hour's escapism.

Ah, for the days of gilt and glass.... of silver and topaz.... when one could say, "let me tell you about this gem of a microscope I just picked up" - and mean it. ■

A Tell-Tale Heartwood

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In Medieval Europe, manuscripts and formulas on the preparation of colors and *dyes* used by chemists and artists contained many references to natural plant extracts. The yellow stigmas of aromatic saffron (*Crocus* sativus) were crushed and used both as a medicine and colorant as far back as the ninth century BCE. In 1437 CE, a manual was written by Cennini, *Il Libro del Arte*, a collection of recipes on the preparation of tempera and block-printing inks from saffron and brazilwood (*Caesalpinia echinata*). Finely divided brazil wood was prepared by scraping sticks with a knife. One could then:

> Place it directly in 'glair' paint medium (egg white) with alum – or boil it in red wine and urine and alum, dry and then grind. Boil with 'lye' (alkaline wood ash), then mordant onto an inert base by adding marble dust and alum in quantities equal to that of the brazil. They seem to disagree on the necessity of an alkaline bath (urine or lye), but agree on alum as necessary to prevent colour loss. (Translation from Cennini text 1437 CE.)

The pods of several South American species of *Caesalpinia*, including *C. brevifolia* (algarobilla), *C. coriaria* (divi-divi) and *C. spinosa* (tara) yield an important source of natural tannins. The tannins react with collagen protein in animal skin, converting the skin into leather. The heartwood from a thorny South American tree called brazilwood contains a red dye used for cotton, wool and preparing inks. During the Middle Ages, the main commercial source of this dye came from an Indian species (C. *sappan*), called "bresil" or "brasil" by Portuguese traders, referring to the bright red heartwood. Early in the sixteenth century, the Portuguese discovered the South American species and transferred the Old World name to it, eventually becoming known as brazilwood. In fact, brazilwood is the national tree and namesake of the country Brazil. Brazilwood is also highly prized for the crafting of violin and viola bows, ranging in price from $400 to $800 each. It is also cultivated as an ornamental tree in southern California.

In the early 1900's the red dye of brazilwood, brazilin [C.I. 75280], was highly acclaimed as a nuclear stain in histological techniques and as an indicator in acid-base titrations. The dye becomes yellowish in acid solutions and carmine-red in alkaline solutions. Brazilin is similar in its properties, chemistry and uses to hematoxylin [C.I. 75290], another dye from a Central American tree called logwood (*Haematoxylon campechianum*). Powdered brazilin and hematoxylin extract powder can be used interchangeably in Harris's, Mayer's and Ehrlich's alum nuclear stains. Brazilin and hematoxylin have no staining properties of their own until they have been 'ripened' by oxidation into brazilein or hematein. This ripening is achieved by the addition of an oxidizing agent such as mercuric oxide, potassium permanganate or sodium iodate. The reaction or compound that results in the combination of the mordant and dye is known as a "lake". Brazilein imparts a burgundy red staining result and hematein a deep violet.

Because of the striking red heartwood, logwood is also called "brasil" or "palo de tinta" in Mexico. Brazilwood contains approximately 40% brazilin, and logwood contains about 50% hematoxylin. The exportation of logwood was an important factor in the early settlement of British Honduras, known today as Belize. In Spain in 1763, the Treaty of Paris allowed the British settlers of Belize to engage in the logwood industry. This was also reaffirmed by the Treaty of Versailles in 1783.

Natural plant extracts were very big business in industrialized countries in Europe and the Orient in the 18th and 19th centuries. It was estimated by the Scottish architect Rhind in 1872 that 40,000 tons of logwood, 20,000 tons of brazilwood, 19,000 tons of madder (*Rubia tinctoria*), 13,000 tons of Sumac (*Rhus coriaria*) and 3,000 tons each of Indigo (*Indigofera tinctoria*) and Oak bark (*Quercus velutina*) were exported to the United Kingdom from 1862 to 1864 (Phil Shaw, pers. comm.).

A multitude of books and manuals were published throughout the 18th and 19th centuries outlining the procedures involved in plant color extraction. One of the most popular of the time was titled *Experimental Researches Concerning the Philosophy of Permanent Colours* by Edward Bancroft. It was published in 1813 and an original first printing recently sold at auction at Sotheby's for $2,500.

Brazilin used in nuclear stains fell out of vogue with pathologists in the early 1900s. It became more expensive to import, and did not contrast visually well with the cytoplasmic counterstains available. Hematoxylin was less expensive to import, and when combined with eosin Y [C.I. 45380] became the tissue stain of choice for microscopic examination, and remains so today. ■

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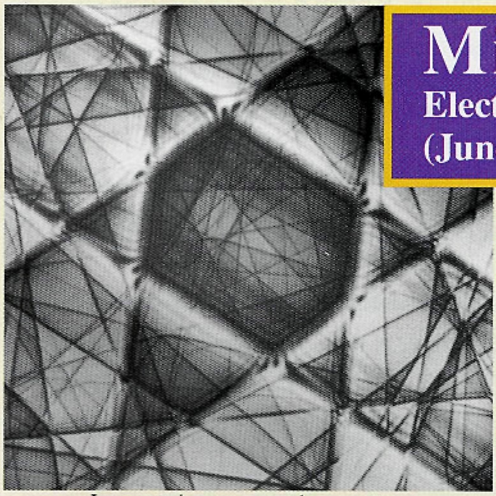

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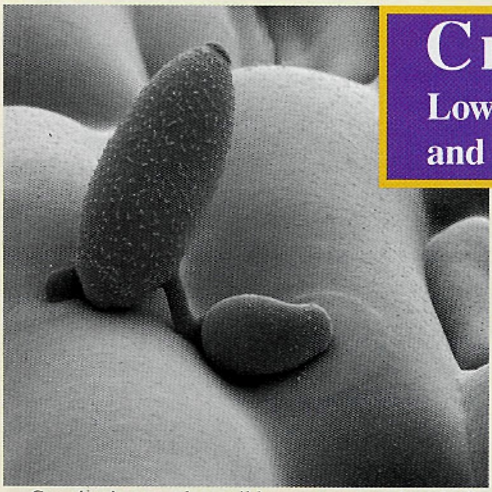

(Courtesy Alison Daniels, ArgEvo UK)

Germinating powdery mildew spore on a wheat leaf imaged at 5kV and -150°C in an FEG-SEM

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1

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1a

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4

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