Logwood Dye on Paper

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Logwood

Logwood is a large sinuous tree that grows naturally in tropical regions of South and Central America to the height of 30-45 feet. It is commonly called Campeachy wood, the name given by the Spanish following its discovery at Campeche bay in Mexico. It is listed on the *Colour Index* as Natural Black 3 (75291). The botanical name for the logwood is *Haematoxylon campechianum*, and it is a member of the pea family, *Leguminosae(Caesalpiniaceae)*.

The dyestuff originates in the yellow heartwood which contains the substance *haematoxylin* ($C_{10}H_{14}O_6$). When exposed to air, *haematoxylin* is oxidized, and the purple compound *haematine* (or *haematein*) is formed. This reaction is apparent when the cut ends of the harvested wood turn a blackish color. The plant bears relation to soluble, dye-producing redwoods of the same family, including Peachwood, Sappanwood, and Pernambuco. The latter are used in combination to produce brazil wood dye, a red-purple dye that contains *brazilein* as the principle coloring matter. Logwood may contain amounts of *brazilein* (James: 26), as the redwoods listed above contain some of its primary coloring matter (Cannon and Cannon 36). The two compounds have been proven to be quite similar in constitution (Mayer and Cook 241-5).

History and Manufacture

The wood is said to have been discovered and subsequently named by Spanish conquistadors, but it was most likely used by the Aztec inhabitants of Mexico before this time (Cannon and Cannon 74). Not long after this discovery, the wood was imported to various European dyeing centers, and it has since been used primarily for the dyeing of cloth. The dyestuff reached England by the middle of the 16th century, during the reign of Queen Elizabeth. Because of its initial use without mordant or with experimental mordants, it garnered a reputation as being quite fugitive to light (Cannon and Cannon 74). Not long after its first use in England, a decree was passed in 1581 that prohibited use of the dyestuff in that country; the reasons given were to foster sales of woad grown locally and to inhibit the use of an 'impermanent' dye. Woad is another natural blue dye that was commonly used in Europe for the dyeing of textiles. The dye comes from the *Isatis tinctoria* plant and was cultivated in England for centuries. Importation of logwood continued to a lesser extent under the decree; this much can be gathered from the 'Proclamation for Prevention and Restraint of the Abuses and Inconveniences, Occasioned by Dying with Logwood", issued in 1619. In 1661, the law was lifted, and an increase in imported logwood was reported subsequently.

There was virulent competition between Spain and England for the dyestuff, and according to John and Margaret Cannon, the "squabbles between the Spanish and the British … became increasingly bitter, involving sea battles, pirates, and buccaneers" (74). The wood was eventually cultivated in Jamaica and Belize to provide for the demand, and in addition, England signed a treaty that allowed them to harvest from Campeachy.

Logwood was introduced to the United states by the mid-17th century (Catesby qtd. in Robertson 84), and it had continued importance as a dyestuff in England into the 18th and 19th centuries. A report following the Great Exhibition in 1852 shows that almost six times the amount of logwood than indigo was being imported into Liverpool, mostly from Mexico but including substantial amounts from Haiti, the Indies, Honduras, and the United States. (Nieto-Galan 16).

The wood was imported as logs with the bark removed, and it was brought to market in extract or chip form. According to Rupe there were three methods employed in the production of commercial logwood extracts.

> "The finely divided chips are frequently digested with hot water under a pressure of 1 to 2 atmospheres, this process yielding a large extract, which, however, contains a considerable proportion of resins, fats, and other impurities; (2) the French method of boiling chips with water at the ordinary pressure, which yields a smaller though purer extract; and (3) a diffusion process, in which an apparatus similar to that used in the sugar industry is employed. The yield by this process is smaller than in (1) or (2), but the shades of colour are finer" (qtd. in Mitchell and Hepworth 90-1).

The discovery of the first synthetic colorant by William Perkin in 1856 ushered in a new era of dyes. The role that natural dyestuffs held in the coloring industry was almost completely supplanted by the new, more intense dyes. The natural dyes were barely worth mentioning according to Charles Pellew in his 1913 Dyes and Dyeing. He says with disbelief, "all over the world, craftsmen are still pottering with long since obsolete dyestuffs and obscure and antiquated formulaie, instead of spending their energies in getting, with the minimum expenditure of time and trouble, results of a quality never dreamed of by the most skilful dyers of half a century ago" (7).

Logwood was employed much later than the other natural dyes for commercial use, largely because of its low cost and versatility. In 1901, logwood, along with quercitron, was mentioned by Jules Erfurt, a German paper colorist, to be one of the "few natural organic colouring matters…now used for the dyeing of paper pulp"(64). Indeed many of the recipes and dyed paper samples included in his book <u>The Dyeing of Paper Pulp</u> contained logwood extract in combination with other, almost entirely synthetic, dyestuffs. According to William Haynes, 'in the 1920s, logwood was used by British dyers as a source of black, and it was still a regular trade product in the 1950s as an alternative, or sometimes a complement, to artificial dyes" (qtd. in Nieto-Galan 195). The British Dyewoods Company in Jamaica, a producer of logwood, was reported to have been open until 1942, and it is said to be one of the few natural dyestuffs that was used industrially in the United States until the 1970s.

Use on Paper

There are a number of ways in which logwood has been employed in the coloring of the paper furnish. As mentioned previously, the dye was used extensively for the coloring of textiles; many of the early blue papers, particularly wrapping papers that were oftentimes used for artists' works, were the results of these colored rag pulps. In her article on the manufacture of blue paper, Irene Brückle mentions imported logwood as one of the colorants for these blue rags (6), however analysis of 18th century paper has determined that indigo was the primary colorant for the rag furnish (Bower 46).

The method of adding dye to the pulp vat produced more intense colors and became a preferred method of creating colored papers. Peter Bower describes the process of dyeing the white or off-white rag pulp in the vat with such substances as blueberries, logwood, lichen, and indigo (46). As with textile dyeing, this often required the addition of a mordant to the pulp to aid absorption and fixation of the dye. A single dye can produce assorted colors when applied with various metallic mordants. The color of logwood is also reactive to pH and therefore produces reddish colors in an acidic medium and bluer shades in alkaline solutions. There are many instances of logwood dye samples with various mordants on wool. Dyes behave differently, however, when applied to proteins than to cellulosic materials such as paper, cotton, or linen. Brückle lists litmus and logwood, with an alum or Veridgras mordant, as the most common dyes employed for vat coloring of blue paper during the eighteenth century (6).

Julius Erfurt, describes turn-of-the-century commercial papermaking methods which made use of dyed rag and white rag furnish. He cites the use of logwood in the production of red paper from a yellow straw furnish, dyed with logwood extract and hydrochloric acid in the vat (65). The extract was also combined in small to large quantities with mixtures of inorganic dyes and organic dyes such as quercitron, fustic, sumac leaves, and catechu to create blue, grey-green, beige and black packing papers. Erfurt mentions the use of stannous (tin (II)) chloride for reddish-purple, copper sulfate for blue, sodium or potassium bichromate for gray or black, and aluminum sulphate for violet (65).

Paper could also be colored after formation with a colored glaze or wash. There has been no mention of logwood for this application, however, it is quite possible that it was used in this way. Logwood has also been used on paper as a watercolor and as a component of some inks including iron gall ink, chrome logwood ink with potassium chromate, haematein inks, and logwood inks for copying papers (Ainsworth, 90-97). Ainsworth includes recipes for all of these inks in his book Inks: Their Composition and Manufacture (97). Broad mentions an interesting quality of logwood ink, "One reason why the dye remained in commercial use longer than any other natural dyestuff was that it has excellent bleed fast properties, yet can be completely bleached out with a 5% solution of sodium hydroxide." This reversibility made it suitable for use on paper meant for recycling, and one of the more recent uses of the ink was for the printing of telephone directories. Broad also mentions that the dye was still being used in the 1970s for typewriter ribbons and the coloring of leather (qtd. in Koretsky: 38). Its relative impermanency and low cost made it appropriate for use on wallpapers as well. According to Delamare and Guineau, in the 18th century "wallpaper was by definition a form of decoration that could readily be changed; its colors therefore did not need to be as stable as those used in a quality cloth. Often they were inexpensive, easy-to-use paste inks made from domestic vegetable colors…"(83).

Lightfastness

There have been no comprehensive studies of the stability of logwood dye on paper. Its lightfastness could depend on the mordant, the method of application, and the quality and nature of the substrate. Logwood without mordant is not lightfast. Some mordants are less successful at fixing the dye, as noticed by Erfurt, "the blue produced with copper sulphate is very unstable. It was formerly extensively used in the manufacture of green straw paper" (65). In 1984, a study was conducted by Cordy and Yeh to test the stability of blue coloring matters on cellulosic fibers. 19th century dye recipes were used with iron mordant to test the fastness of Prussian blue, indigo, and logwood on flax thread. After artificial aging and light exposure at atmospheric temperatures, logwood proved to be by far the least fast of the three, with the thread fading to beige after 10 hours of light exposure and to dark brown after 10 hours of heat exposure (33-39). A more recent and related study involved the mechanical and strength changes in cotton samples treated with two natural coloring matters (including haematein) and a variety of mordants after exposure to simulated sunlight. It was found that the type of mordant had a significant effect upon the color and the strength of the fabric, and that iron-mordanted fabrics were weakened and faded the most by light exposure (Kohara et al. 85).

Identification of Logwood

Logwood may be identified by a number of means. A test developed by B. L. Browning enables the identification of logwood extract that has been applied with a tin mordant. Application of a drop of concentrated sulfuric acid causes the sample to turn red. If this color is transferred to filter paper and treated with sodium aluminate, a blue stain will appear (165). This test highlights the dye's ability to indicate acidic or alkaline solutions. The logwood-dyed flax thread samples in the aforementioned study were identifiable with UV-VIS spectroscopy, but only before the color had faded (Cordy and Yeh 33-39). Cordy and Yeh have also developed a flow chart for the identification of blue dyes on cellulosic fibers manufactured in the years between 1850 and 1870 (33-39).

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