THE MECHANISM AND MATERIALS OF PAINTING COLOUR 'AD VIVUM' IN THE EIGHTEENTH CENTURY

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Introduction

The semantics of *ad vivum, naar het leven, au vif* and so on to describe artists' work in the early modern period has been well-studied by Swan and others.[1] However, although study has been carried out on the general construction and publishing mechanisms of natural history illustration in the eighteenth century, the materials and procedures artists used to record lifelike scientific images in colour to provide an accurate description of the natural world has received little attention.[2] In this chapter, I will argue that Newtonian approaches to theories of light and colour together with the introduction of Linnaean taxonomical classification were the driving force in creation of accurately coloured natural history images in the 1700s. Furthermore, changes in the function of images of plants from what were essentially functional diagrams to images produced from the observation of multiple specimens to describe generic traits of a species meant that illustrations bore a lifelikeness that was markedly different to that of earlier images. By the end of the eighteenth century, botanical artists had adopted strategies such as simplification, exaggeration and the combination of elements from multiple lifecycle stages of plants that rendered their *ad vivum* images quite un-lifelike from a certain point of view.[3]

Ulisse Aldrovandi (1522–1605), the sixteenth-century naturalist, conceived of scientific illustration as a separate discipline arguing that certain kinds of images painted from life could supplant knowledge gained from access to the physical object itself. The means of disseminating these images however – the woodcut print – typically precluded finer detail from being depicted, and colour was usually perfunctory, decorative, or omitted entirely. Collections of natural history images described as *ad vivum* were generally a combination of specimens drawn from life and copies from earlier sources. In Conrad Gessner's *ad vivum* encyclopaedia *Historium animalium* (1551–1558) for example, the images were collated from dried specimens, copies of images from books, maps, manuscripts and illustrated folklore, and sketches sent to Gessner by a growing network of European naturalists. In her study on Gessner however, Kusukawa has observed that rather than demonstrating a lack of truth, the

[1] For example: Swan, C., "Ad Vivum, naar het leven, from the life: Considerations on a Mode of Representation", *World and Image*, 11 (1995) 353–372; Turel, N., "Living Pictures: Rereading 'au vif', 1350–1550", *Gesta*, 50, 2 (2011) 163–182; Bakker, B., "Au vif – naar 't leven – ad vivum: The Medieval Origin of a Humanist Concept", in Boschloo A.W.A. et al. (eds.) *Aemulatio: Imitation, Emulation and Invention in Netherlandish Art from 1500-1800: Essays in Honour of Eric Jan Sluijter* (Zwolle: 2011).

[2] Karin Nickelsen's comprehensive study of botanical illustration in the eighteenth century is an exception, but although it discusses artists' practice to an extent, its focus is generally on the complex production and function of illustrations and their publication: Nickelsen, K., *Draughtsmen, botanists and nature: the construction of eighteenth-century botanical illustrations* (Dordrecht: 2006).

[3] Nickelsen, *Draughtsmen, botanists and nature: the construction of eighteenth-century botanical illustrations*, 11.

multifarious nature of these sources, were in fact vital for the 'practice, authority and identity' of the newly emerging scientific disciplines in the eighteenth century.[4]

Ad Vivum Images in Early Modern Printed Herbals

Debates about knowledge, vision, colour and the senses in the seventeenth and eighteenth centuries produced popular studies that emphasized empiricism and practical experiment rather than the elucidation of classical ideas about nature. Isaac Newton's *Optiks* (1704), Robert Hooke's *Micrographia* (1665) and Robert Boyle's *Experiments touching colours* (1664) were particularly influential on the discussion on imagery and colour by both artists and naturalists. The formation of scientific societies, growing networks of scientists, and the improved accuracy of scientific instruments also widened the divide between natural and classical philosophy, and the essential properties of heat, light and colour were topics of debate. This Baconian intuitivism was typified by Newton and Hans Sloan, who argued for an approach to nature based on observation that was an aid to knowledge, rather than evidencing a classical analysis of the causes of things. Discussions on the properties of colour highlighted by Descartes and others in the mid–seventeenth century – particularly in the linking of colour to the science of light, not as sensation or as a property of the mind – prompted the development of empirical colour theories and systems that could be used to accurately describe and depict colours in the natural world.

Colour in early botanical illustrations however, was often haphazardly and inexpertly applied, typically carried out in the printers' workshop with little or no attention to veracity.[5] The poor quality of early hand–colouring demonstrates that colour was not considered a priority for the practical of identification of plants for the purposes of medicine. This of course, had been outlined as early as the first century by Pliny who warned '…not only is a picture misleading when the colours are so many, particularly as the aim is to copy nature, but besides this, much imperfection arises from the manifold hazards in the accuracy of copyists'.[6] Early naturalists and publishers adhered to the classical tradition observed particularly in the illustrated manuscript copies of Dioscorides' first century *de Materia Medica*, known in Europe from the sixth century, and the standard reference on medicinal botany until the mid–eighteenth century.[7]

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[4] Kusukawa, S., "The Sources of Gessner's Pictures for the 'Historia Animalium'", *Annals of Science*, 67, 3 (July: 2010) 303-328. 328.

[5] The notion that prints were coloured by much later hands is somewhat overstated. The practice of colouring prints in the workshop prior to sale was probably common practice in the Renaissance and Baroque periods. In a technical study of the pigments found in sixty early modern prints from a range of artists and publishers, Dackerman found that only seven were likely to have been coloured in the eighteenth century or later. See: Dackerman, S., *Painted Prints: The Revelation of Color in Northern Renaissance and Baroque Engravings, Etchings and Woodcuts* (Pennsylvania: 2002) 50.

[6] Pliny the Elder, *Natural History*, XXV, iv. trans. W.H.S Jones (Cambridge, MA: 1980) 37.

[7] The earliest known copy of Dioscorides' is the Juliana Anicia codex (known as the *Codex Vindobonensis Medicus Gaecus*, Nationalbibliotheck, Vienna). It was richly illustrated by an unknown Byzantine artist and presented to the daughter of Emperor Anicius Olybrius in Vienna in 512.

In the earliest printed copy of the *Pseudo Apuleius Platonicus* (1481) for example, it is clear that application of colour was mechanical, perfunctory, and rapidly applied. In the *Apuleius*, opaque watercolour (bodycolour) is applied to the woodcut illustrations via stencils to expedite the efficient colouring of numerous plates. The illustrations use four or five simple colours with little or no attempt at mixing, and the stencils are more often than not poorly registered to the prints. Published a little later in Germany in 1485, Johann von Cube's *Hortis Sanitatus* contains an early reference to the importance placed on *ad vivum* colour:

> …I took with me a painter ready of wit, and cunning and subtle of hand….In wandering through these kingdoms and lands, I diligently sought after the herbs there, and had them depicted and drawn, with their true colour and form.[8]

However, colours are applied in much the same manner as the *Apuleius*, and while the illustrator of the *Hortis* may have made his original sketches from nature in 'true colour and form', certainly this attention to detail is not observed in the subsequent hand colouring of the printed images.

References to *ad vivum* depictions of plants also accompany the title pages and prefaces of three influential illustrated herbals of the sixteenth century. In his introduction to *Commentarii in sex libros Pedacii Dioscordis* (1544) for example, Pietro Andrea Mattioli cites the Italian variants *dalle vive piante* and *da i vivi animali* to hint that not only were the specimens lifelike, but to allude to the physical action of drawing from life, informing the reader that he:

> … added the lifelike and natural figures of plants with huge expense and effort, helped not a little by the refined painter, Giorgio Liberale da Udine: who with art, ingenuity and inestimable patience, has drawn everything from live plants, and likewise from the living animal.
>
> Aggiunto le figure vive e naturali di tutte le piante con grandissime spese e fatiche, aiutato pero non poco da Giorgio Liberale da Udene gentilissimo di pintore: il quale con arte, ingegno e patientia inestimabile ha disegnato il tutto dalle vive piante e parimente da i vivi animale. [9]

The woodblocks [FIG 1], show remarkable artistry and skill, particularly in their use of delicate striated shading and definition of volume. The delicately cut, densely packed lines in the leaves of the illustrations and the plants are rich with detail and although some editions were coloured, the addition of colour only serves to obscure the finely printed lines.

In Otto von Brunfels (1488-1534) herbal *Herbarium Vivae Eicones* (1532 – 1536) the true to nature character of the illustrations was proclaimed loudly. The title of the book, 'Living portraits of plants'

[8] von Cube, Johann, *Hortis Sanitatus* (Mainz: 1485) preface, trans. E.G. Tucker and quoted in A. Arber, *Herbals: Their Origin and Evolution: A Chapter in the History of Botany 1470-1670* (Cambridge: 1986) 24.
[9] Mattioli, Pietro Andrea, *Commentarii in sex libros Pedacii Dioscordis* (Venice: 1544) preface.

demonstrates the regard Brunfels held for his artist, Hans Weiditz (1495-1537). Weiditz is often cited as the defining example of a new literal approach to lifelikeness that occurred in sixteenth century botanical illustration.[10] Trained in both painting and engraving by Hans Burgkmair (1473–1531) he would have certainly been aware of Dürer's ground breaking natural history watercolours and his literal approach to copying nature. Specimens in Weiditz's original watercolours are depicted exactly as he found them, with meticulously painted drooping or withered leaves, and in the precise stage of their lifecycle in which they were encountered. His attention to detail and botanical knowledge impressive, but was ultimately an impediment to the accurate classification and identification of the plants he painted.

Despite Brunfels' intentions, he did not grasp the fundamental principle of classification, realised by later botanists, that 'the drawing which is ideal from the standpoint of systematic botany avoids the accidental peculiarities of any individual specimen, seeking rather to portray the characteristics fully typical for the species.'[11] Weiditz's original watercolours are however an important landmark in the history of botanical illustration. Highly accurate for their time, the work stands out for other reasons - particularly the acute observations and annotations he made on the size, colour and texture of plants. His work was thus characterised by both a new standard of visual accuracy, and notable for creating a shorthand method for recording detail that demonstrated both botanical knowledge and artistic skill – something that became a necessity for the travelling botanical artist in the eighteenth century.

Leonhard Fuchs's (1501–1566) *De historia stirpium* (1542) represented a more significant move towards modern systematic taxonomical botany and *ad vivum* rigour. Portraits of Fuch's artists appear in woodcut on the last page of the herbal depicted working directly from a specimen [FIG 2]. Despite this visual proclamation to veracity, each illustration distilled characteristics from a number of plant specimens, and for the first time amalgamated the various parts of a plant's lifecycle so that a reader could therefore see all variations of the plant in one illustration. Furthermore, Fuchs assured his readers that his artists were instructed not to indulge in any kind of expressiveness, or to embellish their illustrations with unnecessary detail. The images are diagrammatic, sparse and linear with almost no detail or shading, and intentionally so, as to reveal the basic structure of the plant and – crucially – to allow colour to be added [FIG.3].[12] Fuch's images are not direct portraits of living plants, as proclaimed by Brunfels and Mattioli, but rather they capture the relevant characteristics of the species in a way that the previous *ad vivum* botanical images did not.

De Historium Stirpium was extremely influential. Its images were copied and published well into the eighteenth century, suggesting that their accuracy was still relevant to herbalists, druggists and

[10] See in particular: Blunt, W. and Stearn, W.T., *The Art of Botanical Illustration* (London: 1955) and Saunders, G., *Picturing Plants: An Analytical History of Botanical Illustration* (London: 1995).
[11] Arber, A. *Herbals: their origin and evolution: A Chapter in the History of Botany 1470-1670,* 206.
[12] '…we have purposefully and deliberately avoided the obliteration of the natural forms of the plants by shadows, and other less necessary things, by which the delineators sometimes try to win artistic glory; and we have not allowed the craftsmen so to indulge their whims as to cause the drawing not to correspond accurately to the truth.' Quoted Blunt, W.T.S., *The Art of Botanical Illustration. An Illustrated History* (London: 1950) 51.

physicians some two hundred years later.[13] Colour was an integral factor. Fuchs' prints are designed to be coloured, and he used colours in his text to refer to aspects of a plant's lifecycle that could not be observed in nature at the same moment. A single image of a maize cob for example, contains four different colours, each depicting the cob at a different stage of its lifecycle, and each referred to in the accompanying text. The description would have therefore been completely meaningless without a correctly coloured illustration.[14]

The Influence of Linnaeus

By the end of the eighteenth century illustrations were considered to be of sufficient accuracy that they could be published without supporting textual description. The images Franz Bauer produced for *Delineations of Exotick Plants Cultivated in the Royal Garden at Kew* (1796) for example, prompted Joseph Banks to opine that:

> it is hoped that every botanist will agree […] that it would have been a useless task to have compiled, and superfluous expense to have printed, any kind of explanation concerning them; each figure is intended to answer itself every question a botanist can wish to ask, respecting the structure of the plant it represents. [15]

The century brought increased education, a wide interest in botany, and the translation of many classical texts into vernacular language, enabling those who had not studied the Classics to read and study them. Nurseries and gardens, public and private, flourished as new and exotic species arrived in England. The prevailing Aristotalian approach to botany, based on general principles of nature, moved toward the implementation of systematic botany that was hinted at in the sixteenth century by Andrea Cesalpino but ultimately expressed in Carl Linnaeus' binomial taxonomical system, published in full to great acclaim in 1753.[16]

Classification of course was not solely the preserve of naturalists. It fascinated a growing number of amateurs and lay readers. The first English translations of Linnaeus were published from the 1760s onward, and lavish hand–coloured printed books on natural history were sold to subscribers not merely as expensive picture books, but as a practical scientific reference. The simplicity of Linnaeus's system meant that it could be used to identify species by anyone, and thus a link was created between accurate representations of plants and an interest in the means by which an amateur might identify and

[13] Blunt notes that copies of Fuch's illustrations appeared during the next two centuries in numerous herbals published in England, Holland and France. The original blocks were reprinted several times, and as late as 1774 in Salomon Schinz's *Anleitung zu der Pflanzenkenntniss.* See: Blunt, *The Art of Botanical Illustration,* 56.
[14] Arber, A., "The Colouring of Sixteenth Century Herbals", *Nature*, vol. 145. May (1940) 803. Reprint in Arber, A. *Herbals*. Appendix V.
[15] Joseph Banks, *Delineations of Exotick Plants Cultivated in the Royal Garden at Kew* (London: 1796) Preface, 61.
[16] Cesalpino, Andrea, *De Plantis* (Florence: 1583). By 1583, Andrea Cesalpino had already observed the value of depicting the essential nature of plants, rather than characteristics accidental to one specimen. *De Plantis* is probably the first modern text book on botany to describe plant development, physiognomy and taxonomy. Linnaeus acknowledges the debt he owes Cesalpino in his introduction to *Genera plantarum* (1737).

classify them. In his preface for the *Flora Londinensis* (1777–1779), William Curtis states not only that his images were 'drawn from the living specimens most expressive of the general habit and appearance of the plant as it grows wild', but also that his subscribers, familiar with Linnaeus, could use that system to arrange and bind the plates, or indeed to classify and organise the images in any manner of their choosing.[17]

Fewer references to *ad vivum* as a term are found in the text of prefaces and introductions of these publications, but the importance of highlighting the practice of painting from life was not ignored. In the first volume of *Natural History of Carolina, Florida and the Bahama Islands* (1731), Mark Catesby assures his subscribers that 'in designing the plants, I always did them while fresh and just gathered; and the animals, particularly the birds, I painted while alive.'[18] And although Christoph Trew's highly influential *Plantae Selectae* (1750–73), does not refer to the practice in the text, it contains a large mezzotint portrait of Trew's artist, George Dionysus Ehret (1708–1770), in the act of drawing, holding a recently-picked specimen in one hand and a drawing stylus in the other.

On the other hand, *ad vivum* and its related terms seem to have been applied in numerous cases to the accuracy of colour in the eighteenth century. In Nikolaus von Jacquin's *Florae Austriacae* (1773) for example, the title page states that his illustrations were created with 'lifelike colours' ('icones ad vivum coloridatae, et descriptionibus'). Similarly, the London Bookseller, James Robson (1733-1806) makes a clear distinction between natural history picture books that he describes as *elegantly coloured*, and scientific books whose images were portrayed with 'lifelike' colours. The terms *Ad vivum coloratis, after nature, aprés la nature,* and *vivis coloribus depict*. are found throughout a list of natural history books in a sales catalogue by Robson from 1780, now in the Bodleian Library. In another, Robson describes botanical volumes as 'most beautifully coloured from the life' or 'copied immediately from nature'.[19] Robson was nether botanist nor artist, but his attention to colour suggests that *ad vivum* colour was a desirable quality in the eighteenth century book trade.

The demand for exquisite and accurate and colouring of botanical images in the eighteenth century also meant that publishers' costs were vastly increased, and hand colouring engraved images for publication was often a trade–off between cost and skill. Accurately replicating the colours of an artist's original paintings was a difficult and frustrating task for publishers. Acquiring the services of a skilled printmaker was paramount, but the cost of colouring thousands of engravings consistently and with precision was extravagant and the quality frequently variable. The coloured edition of Curtis's

[17] Curtis, W., Preface to *Flora Londonensis* (London: 1777). King notes that despite the popularity of Linnaeus' 'artificial' system, there were still over fifty 'natural' botanical classification systems in use in England throughout the eighteenth century. King, A. *Bloom: The Botanical Vernacular in the English Novel* (Oxford: 2003) 15.
[18] Catesby, M., *Natural History of Carolina, Florida and the Bahama Islands* (London: 1731) Introduction.
[19] Robson, J., *A Catalogue of upwards of twenty-thousand volumes of the most valuable books in all languages and sciences comprehending the most Capital and Curious Collections of Prints, Books of Natural History, Antiquities, &c.* (London: 1780) and *A catalogue of upwards of twenty thousand volumes of books including the remaining part of the valuable library of His Grace the Duke of Newcastle; and the entire Collection of a Person of Distinction, lately deceased* (London: 1770).

Floris Londonensis (1777–9) required the work of thirty colourists, and subscribers paid twice the price of the uncoloured edition. Colourists were typically amateurs – often women, and occasionally children – whose skills varied widely. It was a time–consuming and repetitive task which involved matching colour by eye from an exemplar print – often coloured by the original artist – then mixing the correct colour from a set of often lower–quality pigments or prepared watercolour cakes to replicate the original as perfectly as possible.[20]

Maintaining colour accuracy was notoriously difficult, and there are numerous instances of complaints from publishers to their printers on the poor quality of their coloured reproductions. Christopher Trew for example, seems to have had endless problems with the colourists used for the *Plantae Selectae*.[21] He wrote in despair to his engraver, John Jacob Haid in 1750:

> Nothing remains to be censured but simply everything. The illumnist must have done this at night, or in his sleep, or while drunk, or must suffer from a considerable defect of the eyes. Otherwise he could not have mutilated it more, so that Ehret's delicate hand has been totally spoiled.[22]

George Edwards also made claims to *ad vivum* colour in the preface for *A Natural History of Uncommon Birds* (1743). The plates, engraved by Edwards himself, were taken from live or sometimes stuffed and preserved specimens. Edwards notes in his preface however, that the colour descriptions in his text were sufficient enough that the plates might be 'tolerably colour'd for the future by any curious observing person from the Descriptions only.'[23] Indeed Edwards was so concerned that colours should be replicated accurately, that he went to the trouble of colouring twelve sets of reference prints himself, depositing one at the Library of the Royal College of Physicians for the consultation of those who had purchased the book uncoloured.[24]

The painting of botanical and zoological subjects in colour in watercolour seems to have developed as a discrete technique in the late–fifteenth century. Watercolour painting is mentioned in artists' manuals as early as the sixteenth century as a technique used in either colouring maps and prints (staining) or for miniature painting (limning). The technique of natural history painting in opaque

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[20] A notable exception is James Sowerby's work for the *Flora Graeca* (1806–1840). The colours in Sowerby's prints are expertly applied and are remarkably accurate to Ferdinand Bauer's original paintings. It is likely however, that Sowerby, a talented botanical artist himself, employed skilled colourists for the endeavour. Invoices from the Sowerby company archive show that he employed his equally skilled son, James de Carle Sowerby, to colour several of the plates. I thank Paul Henderson, for drawing my attention to this.

[21] Nickelsen, *Draughtsmen, Botanists and Nature: Constructing Eighteenth Century Botanical Illustrations*. There is certainly a marked variation in quality that can be observed in some of the colouring in the Bodleian Library copy of the *Plantae Selectae* (Arch. Nat. hist.M3). For example in the rather crude, hastily–applied washes in the plate *Tacamahaca Folus* (Tab XLVI).

[22] C.J Trew to J.J. Haid, 15 October, 1750, trans. K. Nickelsen. Quoted in K. Nickelsen, *Draughtsmen, Botanists and Nature: Constructing Eighteenth Century Botanical Illustrations*, 66.

[23] Edwards, George, *A Natural History of Uncommon Birds* (London: 1743), Preface, xix.

[24] See: Jackson, C.E., 'The materials and methods of hand–colouring zoological illustrations', *Archives of Natural History*, 38, 1 (2001), 53–64.

watercolour had its roots in both manuscript illumination and miniature painting, and remained largely unchanged until the late eighteenth century when the technique of painting in transparent watercolour was mastered by Gerard van Spaendonck and Pierre–Joesph Redouté in Paris and the Bauer brothers in England.

Possibly the earliest known example of the technique used for a stand–alone botanical study is a group of peonies painted by Martin Schongauer (1448–1491) in the mid-1470s. Koreny has identified this study as a likely antecedent for the natural history studies painted by Albrecht Dürer in the early 1500s which are often cited as the first truly naturalistic nature studies.[25] The technique itself was formulaic. An initial outline drawing was made in graphite, charcoal or silverpoint. Tonal areas were then laid in using a thin wash of Indian ink.[26] With this technique, colour value (its relative lightness or darkness) was adjusted by means of the underpainting, rather than a via darker or more saturated hue of the same pigment, or by adding a second colour which might reduce the saturation or change the hue of the original. Thin layers of colour were then built up in increasingly opaque layers, working from light to dark. Highlights were added last, provided by the naked paper or parchment or (more commonly) with a thick, opaque white.

Lists of recommended colours were published in artists' manuals for miniature painting, oil painting and washing/staining, and certain pigments had desirable or undesirable working properties in each technique.[27] Pigments recommended for the specific painting of natural history subjects were listed as early as 1686, and continued to be published throughout the eighteenth and nineteenth centuries.[28] Analysis of the pigments used by both Ferdinand Bauer (1760–1826) and George Dionysus Ehret has also found that both artists' palettes were remarkably similar to those listed for miniature painting by Edward Norgate as early as the 1640s, and still listed in 1733.[29] It seems worthy of note therefore,

[25] Koreny, F., "A Coloured Flower Study by Martin Schongauer and the Development of the Depiction of Nature from van der Weyden to Dürer", *The Burlington Magazine*, 133, 1062 (Sept. 1991) 588-597.
Although landscape painting in transparent watercolour emerged as a technique in the late eighteenth century, its status as a medium remained low. The Royal Academy, which opened in 1768, permitted watercolours to be submitted for exhibition as 'paintings' only in 1804. Prior to this, they were exhibited as 'stained or tinted drawings' and relegated with sculpture to the lower galleries.

[26] The practice of laying in tonal areas with Indian ink did not fall out of favour until the early nineteenth century when Paul Sandby, Thomas Girtin and J.W.M Turner popularised landscape painting in transparent watercolours. As noted, the practice was already in use in botanical illustration in Paris in the 1780s by the Netherlandish painters Gerard van Spaendonck and his pupil, Pierre–Joseph Redouté.

[27] Manuals that specifically discuss technique in watercolour painting appear from the mid–seventeenth century onwards, largely on the practice of miniature painting. For example: William Sanderson's, *Graphice. The Use of the Pen and Pensil, or The Most Excellent Art of Painting in Two Parts* (London: 1658) in England, Gerard ter Brugghen's *Verlichtery Kunst–Boeck* (Amsterdam: 1667) in Holland and H. Gautier's *L'Art de Laver ou Nouvelle Maniere de Piendre sur le Papier* in France (Nimes: 1687). Large parts of these manuscripts were copied directly from earlier treatises. The second part of *Graphice*, for example, was almost entirely plagiarised from Edward Norgate's manuscript, *Miniatura, or The Art of Limning*, originally written around 1630 and known from a number of revised copies from the 1640s and 50s.

[28] Richard Blome, *The Gentleman's Recreation* (London: 1686).

[29] Pigments in ninety paintings by Bauer and seven by Ehret were analysed by Raman Spectroscopy, X–Ray Fluorescence spectroscopy and hyperspectral imaging by the author between 2014 and 2017. Both artists used carmine, vermillion, red lead, lead white, indigo, gamboge and copper green pigments in their work. These are all listed in Norgate's 1640 manuscript. They are listed almost unchanged in Anon, *The school for miniature*

that the techniques of botanical painting in particular took its cues from miniature painting until at least the 1780s.

Ferdinand Bauer and the *Flora Graeca*

Botanical watercolour painting entered a golden age in the eighteenth century, exemplified by artists such as Pierre Redouté, George Dionysus Ehret and, in England, by two relatively unknown brothers – Ferdinand and Franz Bauer. The Bauers, born in Feldsberg (present day Valtice, Czech Republic), were apprenticed at an early age to the physician and naturalist, Norbert Boccius (1729–1806), Prior of the monastery of the Brothers of Mercy in Feldsberg and personal physician to the Prince of Lichtenstein. In 1776, Boccius published fourteen volumes of botanical illustrations by numerous artists, including the Bauers, titled *Liber regni vegetabilis retinens plantas ad vivum pictas* ('Book of the Plant Kingdom containing plants painted from life') known as the *Codex Lichtenstein*. Lack suggests that the Bauers contributed around 1600 paintings, some of which were copies of earlier works (notably from the *Plantae Selectae* and *Flora Austriacae*). The majority of the paintings however, appear to have been taken from live specimens, several of which were coloured using a numerical colour code system developed by the two brothers.[30]

The *Flora Graeca* [FIG.4] was the legacy of the third Professor of Botany at Oxford University, John Sibthorp (1758–1796), who commissioned and funded two expeditions to the relatively unexplored Eastern Mediterranean with the intention of documenting the flora described in Dioscorides. Stopping at Vienna on a visit to Nikolaus von Jacquin, Sibthorp encountered Ferdinand Bauer and immediately contracted him as his travelling artist. An enormous endeavour, the *Flora Graeca* took thirty years to publish in its entirety, and was one of the most lavish and expensive books of its age. It epitomised a change in character in the illustrated botanical book in the eighteenth century. Rich and detailed, these books functioned to document the botanical diversity of a specific area, rather than to assist scholars in the identification of particular species. All of Bauer's specimens were sketched from life, but like Weiditz, his paintings were definitively portraits of individual plants. Partially this was due to the nature of the expedition – Bauer and Sibthorp reached their destinations at particular times of the year, collecting and documenting only the plants that were in flower at the time. Many more common species that were not encountered when flowering were omitted, and thus the work is far from encyclopaedic. However the *Flora Graeca*'s editors took pride in the accuracy of its description and images. Sibthorp's will dictated that only plants observed and sketched in the field by Bauer were to be included in the book, and James Edward Smith, editor of the volume, assured subscribers that both colour and form were accurate to Bauer's original paintings: 'Before the illustrations were engraved

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published from an old manuscript (London: 1733).The yellow pigments, mascot orpiment and Naples yellow however, are missing from both Bauer's and Ehret's work, likely due to the known poisonous nature of those pigments.

[30] Lack, *The Bauers*, 33.

on copper' he states, 'I took care to compare each one with the original, and then I checked diligently that the colour and appearance of each coloured illustration were correct.'[31]

Travelling artists on large and fast-moving expeditions were of course subject to the limitations of working in the field. Botanical artists typically made rapid sketches in pencil, and annotated them with either notes in longhand or the addition of small patches of colour to use as references for painting at a later stage.[32] Bauer followed a similar pattern. Basic plant structure and scale were replicated in his paintings using his rapidly produced field sketches, and by referring to the dried specimens collected for Sibthorp's herbarium. However, the crucial colour information for the specimens was recorded and replicated solely by means of a series of numerical codes. [FIG. 5] [FIG.6]

What is remarkable about these field sketches is that they are almost entirely devoid of detailed visual information. The drawings are little more than quickly sketched outlines, containing no shading, no indication of texture, gloss or other tactile qualities, and contain no further written annotations regarding colour tone, value, hue or intensity. The drawings are rather indiscriminately arranged on the pages, and it is often difficult to understand exactly which element or area in the drawing the numbered colour codes refer to. There are almost no written annotations, and the code appears to be the only reference that Bauer required to achieve an incredibly high degree of colour fidelity in his paintings.[33] Furthermore, he had observed and sketched many of his specimens live sometimes seven years prior to painting them in full size in his Oxford studio. It is astonishing therefore that Bauer's final paintings contained almost no errors, that they remain a significant resource for the study of the flora of the eastern Mediterranean today, and were used throughout the nineteenth century to describe botanical types in the absence of a specimen.[34]

Yet it seems unusual that Bauer did not paint in colour in the field. Watercolour painting is a highly portable technique. Although artists still prepared their own colours from dry pigments, the portable, reusable moist watercolour cake had been developed by George Reeves, the London Colourman, some years before – around 1766 – and sets of solid watercolours were certainly available from around 1770.[35] Previously, raw pigment was either purchased from apothecaries, druggists or

[31] Smith, J.E., Introduction to *The Flora Graeca* (London: 1806–40). trans. P. Henderson in Henderson, P., *James Sowerby, The Enlightenment's Natural Historian,* (London: 2015) 158.
[32] See: Lack H.W. and Ibanez V., "Recording Colour in Early Eighteenth Century Botanical Drawings: Sydney Parkinson, Ferdinand Bauer and Thaddeus Haenke", *Curtis's Botanical Magazine*, 6 (1997) 87–100.
[33] In fact the only written text found in the approximately 100 pages of extant sketches for the Fauna and Flora Graeca occurs in a drawing of a skate. Too large to draw in full scale on paper, a note in Bauer's hand simply describes the length of the specimen: 'This is 3 ½ feet' ('Dies its 3 ½ Fu'). Bodleian Library. MS. Shepard 247, ii.
[34] For example, *Orchid Genoplesium baueri*, first described by Robert Brown using Bauer's original illustration made during the Flinders expedition to Australia; in R. Brown, *Prodromus floræ Novæ Hollandiæ et Insulæ Van-Diemen : exhibens characteres plantarum quas annis 1802-1805*, London, 1810). Throughout the nineteenth century, Bauer's images were used as the sole basis for a number of plant and fish taxa: David Mabberley, personal correspondence to the author, 2015.
[35] Reeves added honey to gum Arabic and pigment to make cakes of paint that stayed moist, and were easier to dissolve with water.

colourmen and mixed by the artist, or paints were purchased ready made in dry cakes or in oyster or mussel shells.[36] Portable watercolour boxes were in use before this however. A description of a 'portable case for colours' to be used for painting flowers is found as early as 1731:

> Let me advise such persons who are curious in making observations of the colours of flowers to have always in their pocket a small case with colours in it, about the bigness of a snuff box, made of ivory, about half an inch thick in which should be scooped several concaves about half an inch in diameter, and as deep as the ivory would bear, without going through: These cavities, may be placed as near one another as possible, and fill'd with colours of several sorts.[37]

Bauer, of course, did not arrive in England until 1787, and it is possible that Reeves's invention was not widely known amongst artists in Vienna, where he was living prior to leaving for Greece, or that he preferred to simply control the quality and consistency of his own materials. It was reported in many artists' manuals of the time that druggists and other vendors sometimes mixed pure pigments with inferior materials in their ready-made watercolours to lower their costs. Bauer sketched topographical and costume studies in ink wash for Sibthorp's travelling companion John Hawkins, but there is no evidence that he made further colour sketches in the field. In their diaries, Bauer's travelling companions, refer to his collecting specimens, 'sketching outlines' and numbering colours in the field, but never mention his working in colour. The astonishing accuracy of his system and memory for colour is observed in the remarkable fact that all but one of the 966 specimens Bauer painted for the *Flora Graeca* are recognisable without any doubt and perfectly accurate in their colour.[38]

Colour codes: Bauer's Shorthand

Colour charts and systems of ordering colour were nothing new. Isaac Newton had identified the prismatic spectrum of daylight in 1672, and a number of systems followed developing Newton's ideas. In the eighteenth century however, it became a popular preoccupation.[39] A fascination with light and colour, together with the notion that colour systems could be used as a tool to assist naturalists, provided the background for a number of publications on the classification and ordering of

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[36] By the eighteenth century, artists' Colourmen were well established in London, although artists continued to source pigments and other materials from druggists, apothecaries and grocers. There is no record of where either Franz or Ferdinand Bauer purchased their materials while in England, but since Franz was well-established at Kew under the patronage of Joseph Banks, it is perhaps reasonable to assume that both brothers would have had access to quality pigments.

[37] Anon, *The Art of Drawing and Painting in Watercolours* (Printed for J. Peele, London: 1731). Much of the text is taken from Robert Boyle's *Experiments* (1664), and is a similar to that published in an earlier text written by 'the late ingenious Mr. Smith' *A Short and Direct Method of Painting in Water-Colours* (London: 1730).

[38] After comprehensive analysis, Lack found only one minor colour error in the 966 Flora Graeca paintings. Bauer's depiction of *Anchusa cespitosa* (MS Sherard 244 f35), is coloured grey–blue where it should have been a deep, striking blue. Lack, *The Bauers*, 156.

[39] For a comprehensive discussion on systems of ordering colour in the eighteenth century, see: Lowengard, S., *The Creation of Colour in Eighteenth Century Europe* (New York: 2006). E-book, <http://www.gutenberg-e.org/lowengard/index.html> (accessed Sept. 2016).

colour.[40] Richard Waller's attempt to classify and systematise colours in his *Table of Physiological Colors Both Mixt and Simple*, presented to the Royal Society in 1686, is probably the earliest example specifically aimed at the artist and naturalist, but several others followed.[41] However sophisticated these investigations into colour were however, there is little evidence that the charts themselves were used by artists, craftsmen or naturalists in a significant way. They may have been considered irrelevant by artists who knew their colours intuitively, or were simply too unwieldy for practical use.

Much of the literature on Bauer suggests that he worked directly from a physical colour chart. – a series of watercolour swatches that acted as a visual reference for his code. However, if it existed at all, no colour chart survives from either his expedition to Greece or his later expedition to Australia (1801–1806), and there is no mention of one in the inventory of his estate. Furthermore, nowhere in the writing of Bauer's two travelling companions on the Sibthorp expedition, or in those of his three companions on the Flinders expedition to Australia, is there any reference to the existence of a physical chart. Given that such systems were not widely used by artists in the field, it is perhaps unusual that none of these diarists noted its existence. Lack has observed that although Joseph Banks does make reference to the fact that Bauer painted referring to 'a table of colours as to enable him to finish items at his leisure with perfect accuracy', Banks himself never witnessed Bauer at work in person and likely misunderstood the technique.[42]

It is certain that Bauer experimented with arranging colours as a young artist in Feldsberg and Vienna, but whether this was a method he used as a mature artist is not clear. An early table of colours discovered in the library of the Real Jardín Botánico in 1997 by Lack, and described by Lack and Ibanez in 1999 seems likely to have been created by one or both of the Bauers.[43] [FIG. 7] The chart contains a sequence of 140 painted watercolour swatches, numbered in a hand that appears to be similar to that of Ferdinand Bauer. The numbered colours in the chart correspond with some of the codes found in sketches for the *Codex Liechtenstein* and their subsequent paintings, although not always, and not perfectly. The link to the Boccius florilegium suggests that it was used very early in the careers of the Bauers and there is no reason to suggest that it was anything more than an apprentice's experiment in developing skill in mixing colours. The chart was in the possession of the naturalist Thaddeus Haenke by 1787,who seems to have had an interest in using it as a practical tool and extended the system. Haenke titled this extended version *Systema Colorum tabulare atque comparativum pro expeditiori plantarum cum vivis coloribus adumbratione in itinere cum hispanis*

[40] See Mulholland, R., "Ferdinand Bauer's Flora Graeca Colour Code", in Evens, H. and Muir, K. (eds.), *Technology and Practice: Studying Eighteenth Century Paintings and Works of Art on Paper* (London: 2015) 153-163.
[41] See: Kusukawa S., "Richard Waller's colour chart (1686)", in Steinle, F. and M. Bushart, M. (eds.), *Colour Histories: Science, Art, and Technology in the 17th and 18th Centuries* (Berlin: 2015).
[42] Joseph Banks, letter to William Marsden, Secretary of the Admiralty, 1806. Quoted in Lack, H.W., "Die Stenographie-Zeichnungen und Farbkodes der Brüder Bauer", in Karliczek, A. (ed.) *Farre* (2015) 143.
[43] The discovery was first published in Lack and Ibanez, "Recording colour in early eighteenth century botanical drawings: Sydney Parkinson, Ferdinand Bauer and Thaddeus Haenke". An in–depth discussion of the chart is also found in: Mabberley, D.J. and de San Pío Aladrén, M.P., *La carta de colores de Haenke de la Expedición Malaspina: un enigma* (Madrid: 2011).

navibus circa globum terraqueum annis 1789 –1793. ('Tabular system of colours for comparison to the true colours of plants sketched on an expedition while travelling around the world on Spanish ships in the years 1789 to 1793'). However, it does not appear to have been used by either Haenke himself or the artists used on his botanical expedition to South America, and may have been little more than an academic exercise.

There are scattered examples of colour notations of various types used throughout the history of art. Bauer may have been trained in the method, as it was somewhat prevalent in the practice of miniature painting.[44] Swan notes that the Dutch painter, Jacques de Gheyn (1565–1629), used a table of painted colours to develop the lifelikeness of a series of miniatures of flowers he wished to depict *nae t'levan.*[45] Similarly, William Wood, the eighteenth century miniaturist, also made use of a complex colour code, described in detail in his account books.[46] And the engraver and botanical painter James Sowerby, who had engraved and coloured the *Flora Graeca,* also developed a colour classification system that was heavily influenced by Newton (and almost certainly by Bauer) shortly after he began work on Bauer's paintings.[47]

Bauer, for example, does not appear to follow his code to the letter. It is clear that in some instances that he used a particular colour code more as a guide than to reference a specific hue or pigment. His codes are often placed rather chaotically in his sketches and without guiding arrows or lines to suggest exactly to what part of his specimen a given number might refer. This in itself is hard to comprehend, given the sheer number of plants sketched, many of which were very similar. Additionally, numbers that correspond to certain colours in one painting have been found to refer to a slightly different version of that colour in another painting. Some sketches contain up to fifty numbers, where others – often with more complex colours are described using only four or five.

At first glance the system appear to run from darker, saturated hues to lighter washes of the same hues and then to lighter tints (with the addition of white pigment). However, analysis of both the extant Madrid chart and the theoretical Flora/Fauna Graeca chart, this appears not to be the case. The 140 colour Madrid system divides the spectrum into forty swatches of each hue. It begins with red (1-40), then yellow (41-79), blue (80-120) and then twenty of green (121-144) and a smaller range of blacks (145-146), whites (147-148) and browns (149-160). The chart is numbered in a hand that may or may

[44] Colour annotations have been found in the underdrawings of Tibetan Thang–kea paintings from the seventeenth and eighteenth centuries. See: Duffy, K. I. "An Investigation of Palette and Color Notations Used to Create a Set of Tibetan Thangkas", in Waller, A., Herman's, E. and Peek, M. (eds.), *Historical Painting Techniques, Materials and Studio Practice* (London: 1995) 78-84.

[45] Swan, C., *Art, Witchcraft and Science in Early Modern Holland* (Cambridge: 2005) 74. The description in van Mander's biography of de Gheyn suggests that the table of colours may have been an initial experiment into achieving and mixing accurate colour with the correct pigments, rather than a practical tool used for day to day painting.

[46] William Wood, *Account of Finished Drawings* (189–1809), Manuscript, National Art Library, London: MSL/1944/436.

[47] Sowerby, J., *A New Elucidation of Colours; Original, Prismatic, and Material* (London: 1809). Sowerby appears to have used textual and painted colour annotations in his sketches, rather than numerical codes. (Sowerby Archive, Natural History Museum, London).

not be Bauer's, but only to the end of the green range (140). The brown, black and white range at the bottom continue the table to 160, but these are numbered in another hand (presumably Haenke's), and though is unclear whether these were painted by Bauer, it would seem unusual for a botanical colour chart not to contain these colours.

The Flora/Fauna Graeca code (used between 1786-94) and the Flinders/Australia code (1801-05) differ slightly from the Madrid chart. The Madrid chart follows the sequence: reds, yellows, blues, greens, blacks and browns. Both the Flora Graeca and the Flinders codes follow the sequence: whites, blacks, oranges, reds, pinks and purples, blues, greens, yellows and browns.[48] Obviously, as Bauer's sophistication and comfort with the code increased, more numbers were added. Interestingly, neither scheme corresponds closely to the order of the Newtonian spectrum (ROYGB), or indeed to other published colour schemes of the period.

Conclusion

Henry Wooton's description of Kepplar's use of a camera obscura in a letter to Sir Francis Bacon in January 1620 expresses his astonishment at a painter creating a landscape using 'science', and painting *non tanquam pictor, sed tanquam mathematio,* ('not as an artist, but as a mathematician').[49] It encapsulates the spirit of the empiricist approach to the creation of images with accuracy at the dawn of modern science. It's clear that eighteenth-century natural history artists employed strategies and techniques to impart accuracy to their depictions of the natural world, in both colour and form, while botanists and publishers went to great extremes to ensure colour was replicated accurately in their publications. The many stages involved in bringing botanical works to publication meant that consistency and accuracy were difficult and expensive to achieve. In the eighteenth century, Ferdinand Bauer's work stands out in a period that saw significant developments in the quality and technical aspects of botanical illustration, but still relied on traditional painting techniques. In most literature on Bauer, his story begins from an assumption that he used a simple, efficient mnemonic device to replicate colour accurately from nature to the painted page. This assumes that colour perception and colour memory are in themselves simple functions, which they are demonstrably not.[50] As an artist, Bauer's achievement stands almost at the end of a long history of natural history image–making, and his recollection of colour is astonishing not least because of the arduous task of painting almost one thousand plant specimens – almost eighteen full size watercolours each month – in

[48] The 999 code used for the Flinders voyage (1801–06) was described and decoded by Mabberley in: Mabberley, D.J. with Pignatti-Wikus, E. and Riedl-Dorn, C., "Ferdinand Bauer's field drawings of endemic Western Australian plants made at King George Sound and Lucky Bay, December 1801–January 1802 (I and II)", *Rendiconte Fisiche Accademie Lincei* 9. 11 (2000/2001) 201–244. The present author confirmed that the ca.300 number code Bauer used for the Flora Graeca in 1787 followed the same general pattern in 2014.
[49] Henry Wooton, *Reliquiae Wootonianae*, (London: 1651) 38.
[50] See for example: Allred, A.R. and Flombaum, J., "Colour Perception and Visual Memory", *Trends in Cognitive Science,* 8.11 (November: 2014) 562-565 and; Shevell, S. K. and Kingdom, F.A.A., "Color in Complex Scenes", *Annual Review of Psychology*, 59 (January: 2008) 143-166.

accurate colour, several years after seeing and sketching the originals from life, and that his work remains scientifically relevant today is a testament to his skill.

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