From Copperplate to Color Lithography: On the Modernization of an Illustrated Flora 1800–1900

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On the Modernization of an Illustrated Flora 1800–1900

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"P.S. The leaves must be copied extremely carefully! They are to be printed without contour, in bold color." This urgent request was written by the Swedish botanist Carl Lindman to the lithographer on the original of the Scandinavian flora *Bilder ur Nordens flora* (Pictures from Nordic flora, 1901–05).[1] In 1900 Lindman had been assigned responsibility for the republication of a one-hundred-year old illustrated flora, J.W. Palmstruch's *Svensk botanik* (*Swedish Botany,* 1802–43). The old hand-colored copperplates were meticulously examined, corrected, and supplied with new magnified details and then printed in color lithographs (Figure 1). Lindman's request indicates one of the advantages of modern color lithography over the older copperplate printing: it enabled the printing of illustrations without black contour.

Botanical illustrations are characterized by a precision of form, simplification, neutral background, and clearly delineated details.[2] The main purpose of botanical illustrations is to convey scientific knowledge. But why are they designed as they are? There are many answers to the question, and the different answers are closely connected. The printing technique is only one of the factors, albeit an important one, governing the form and content of botanical illustrations; others include changes in the book market, economic circumstances, botanical science, ideas about education, and pictorial conventions. According to Lindman, a good illustration was clearer and more concise and precise than the text itself.[3] How could these "good illustrations" complement and enrich the textual descriptions? And how did the shift in printing technique effect the final result? In this article I will discuss the transfer of botanical illustrations from one printing technique to another from the perspective of book history. I will examine the result of this shift and say something about the way in which the change of technique is visible in the final outcome. In addition, I will comment on the process of copying

Figure 1. *Oenanthe aquatica*, original to plate 258, Carl Lindman, *Bilder ur Nordens flora*. Swedish Museum of Natural History, Stockholm.

illustrations as an integral part of more general scientific practice, as the plates in Lindman's flora are closely connected with several other European floras.

In 1900 the publisher Wahlström & Widstrand decided to publish a new Swedish flora including illustrations taken from the well-known but long out-of-print *Svensk botanik* by Johan Wilhelm Palmstruch. The new edition was issued in installments during the years 1901–05 under the title *Bilder ur Nordens flora*, containing a total of 520 color plates.[4] The original idea was that Palmstruch's old copperplates should be transferred to lithographic stone, which would enable them to be reproduced in color at a much lower cost and in a larger print run than the original hand-colored edition. The accompanying text, in turn, was to be rewritten since the descriptions

of plants in *Svensk botanik* were considered out of date and erroneous in parts. On the other hand, it was assumed that the illustrations were timeless and did not need to be modernized beyond supplementation with enlarged images of details. The coloring of the illustrations and the supplementary details were to be carried out by Axel Ekblom, a trained artist working as an illustrator at the Royal Swedish Academy of Sciences and the Swedish Museum of Natural History in Stockholm. Some of the plates from *Svensk botanik* had by then already been reprinted twice: hand-colored engravings in a Danish flora by Jens Stephan Heger, and black-and-white lithographs in a Swedish flora for schoolchildren by Knut Fredrik Thedenius.[5]

Many illustrated botanical works were reprinted in cheaper editions. Because such reprintings drew on the reputation of earlier editions, the publishers tended to place more emphasis on profitability than quality.[6] For example, James Sowerby and James Edward Smith's *English Botany*, initially published 1790–1814 with nearly 2,500 hand-colored copperplates, was reprinted in a lavish second edition between 1835–46. The original plates were used and the illustrations were hand-colored. The print is comparable to the first edition, though the impression of the plates is fainter. During the years 1863–72 it was reprinted with color lithographic copies of the plates. The third edition could have been compared to *Bilder ur Nordens flora*, but the printing quality is considered to be poor.[7] Wahlström & Widstrand had the sound judgment to contact a scrupulous botanist with artistic skills for the republication of the illustrations in *Svensk botanik*.

The task of writing the text to *Bilder ur Nordens flora* was assigned at the end of 1900 to Carl Lindman, who was then a tutor to the children of Crown Prince Gustaf (later King Gustav V) and a teacher at Sweden's most prestigous grammar school, Norra Latin in Stockholm. Lindman was himself a competent draughtsman and was convinced that illustrations were capable of conveying knowledge far more effectively than long textual descriptions. He discovered quite soon that many of the botanical illustrations needed correction as well. This was the start of the extensive work of revising the hundred-year-old illustrations. First, an impression was taken from the old copperplates. On these impressions, here called "originals" (by Lindman called "original drawings"), the coloring, corrections, and new supplements were added. These originals were then handed to the lithographers to be traced onto the lithographic stones. The preserved originals, stored at the Swedish Museum of Natural History where Lindman became professor in 1905, make clear that he put in a great deal of work modernizing the old copperplates. The result was a commercially published flora with

a text written in an accessible style and with scientifically correct illustrations, aimed chiefly at the general public. The flora sold extremely well and was revised and expanded with 144 new plates by Lindman in 1917–26. It subsequently appeared in many editions, including translations into Danish, Norwegian, and Finnish. The latest edition in Swedish was published as late as in 1994 and in Finnish in 1995.

Svensk botanik and *Bilder ur Nordens flora* are both exceptional botanical publications, representing the only full-color illustrated Swedish floras from their respective times. They are used here as a case study for several reasons. The careful republication and meticulous examination of the old illustrations allows for a comparison of views on botanical illustrations over two centuries. But above all *Svensk botanik* and *Bilder ur Nordens flora* are interesting because of the well preserved archival material. Not only are many of Palmstruch's original watercolors, all the copperplates, and nearly all of Lindman's annotated and corrected originals preserved, but also price quotes, printing records, and work logs from the lithographic printing house, as well as correspondence between Lindman and his botanist colleagues detailing the ongoing publication.

During the hundred years that had passed since the publication of Palmstruch's *Svensk botanik*, Sweden had been industrialized and modernized: the population had doubled, a system of compulsory education had been developed, publishing had been professionalized, and printing presses had been improved. Now it was possible to mass-produce illustrations through color lithography on machine-made paper at a reasonable price. All this affected the new flora, and the changes can be seen in the plates.

It is an axiom in book history that the form governs the content. What can be communicated at a certain time is greatly affected by the book market and the conditions and limitations of the medium. Botanical illustrations have been published in many different forms: in scientific journals, on wall charts, in textbooks, and above all in floras. Irrespective of genre, they pass through different stages of production, distribution, and consumption. The medium is not a passive and transparent technology but interacts with and influences what we can record, transmit, and adapt. The form and meaning of texts and images changes over time, and alteration and adaption is necessary for the survival of a work.[8]

A flora can be defined as a publication about the plants from a limited geographical area. Floras have been used as reference books by botanists, physicians, pharmacists, students, and the general public. In floras a great number of plants are presented, and illustrations are used for the sake of

clarity. The illustrations in a flora are not subordinate to the text, but interact with the text on an equal plane. They are a fundamental part of the botanical science that governs the work as a whole. In its illustrated form, a flora is a scientific atlas: that is, it contains selections of illustrations that identify the items most significant and relevant for the discipline.[9] Such atlases have been central to scientific practice in various fields in different times. They are normative inventories which have set the standard for how certain phenomena should be regarded and depicted. Especially important are those that become standard reference works in the fields of education and scholarly communication. As works geared toward breadth rather than precision, they have not always been given the place they deserve in the history of science. Science does not consist only of innovation, but is also characterized by the slowness and sluggishness of its historical development. Images and data remain relatively stable, and are reworked and reused over a long time.[10] By considering botanical illustrations in this way, this article examines the reuse of scientific images as an integral part of scientific practice.

Since the time of Bernhard von Reidenbach's *Gart der Gesundheit* (Mainz, 1485), Otto Brunfels's *Herbarum vivae eicones* (Augsburg, 1530), and Leonhart Fuchs's *De historia stirpium* (Basel, 1542), printed floras have underscored that their illustrations were composed "from nature." The scientific revolution of the seventeenth and eighteenth centuries emphasized the importance of the first-hand study of nature, and criticized a reliance on the opinions of earlier authorities.[11] But science would not develop if it were not built on a combination of earlier investigations and new observations. An individual researcher is incapable of classifying and systematizing areas as vast as flora and fauna based only on his or her own empirical studies of nature.[12] In reality it was rarely possible to delineate or describe the plants properly in nature even during the summer. From the late seventeenth century illustrations of details were often carried out through microscopy, which was not possible to do in the field. On field excursions and research trips, often only rough sketches and notes concerning colors were made. The plants were brought home in fresh condition if practicable, otherwise pressed and dried. In their dried state, plants lose much of their natural form, plasticity, color, and fragrance. But these were elements that after Linnaeus were not considered necessary for classification. Illustrations were an important complement to the empirical study of nature.[13]

To depict nature requires that one has learned how to create the illusion of nature, a skill that can be acquired by studying illustrations. When the

botanical illustrator is out in the field and chooses which plant to depict and what technique to apply, he compares the plant with his memory of earlier encounters with the same species, with other species that are similar or dissimilar, and with illustrations of the species in scientific literature. Even when the plant is depicted on the model of a new specimen, the drawing is affected by the conventions of the genre and the specified context. For example, the convention of drawing the contours of a specimen reduces it to an assemblage of outlines that do not exist in nature. Shape is determined not only by the object, but also by the technical and material characteristics of the medium, as well as by the stylistic conventions of the genre and the idiosyncrasies of the individual artist. When an artist sets out to capture reality, he cannot help but be influenced by existing depictions.[14]

Just as the reproduction technique influences the expression of the printed image, the medium in which the original drawing is executed influences the work of the draughtsman. In the depiction of a plant, the draughtsman has to choose between line and surface. Drawing in pen compels the draughtsman to see the object in terms of lines, and hence lay focus on those aspects that can be rendered in lines. Drawing in pencil, on the other hand, compels the draughtsman to capture the aspects of the object that can be rendered as surface and mass.[15] Whenever the image is intended for reproduction in print, the printing technique determines the choice of medium for the draughtsman.

The historical and social meaning of texts and images is closely connected with and cannot be separated from the technological conditions and material forms through which the works are made available to readers. In order to be disseminated and read, the abstract texts and images need to be given a concrete form.[16] In a botanical illustration, the abstract content (the plant depiction) interacts with the technological medium of its reproduction (the printed image) and the material form or genre in which it is embedded (e.g., a flora).

Printing techniques are one of the main conditions allowing for the mass reproduction of images. Yet they also set limits to varying extents. The printing techniques in use at a certain time have an important influence on the content, the materiality, and the form of the images. Different techniques have offered different possibilities for the reproduction of colors, details, tones, and textures. For example, it is of significance for the content of the printed image whether its original has been cut and scratched on a copperplate or drawn with fat crayon and ink on a stone. The printing techniques set limits and offer opportunities for what can be reproduced and by extension what can be communicated.

The printing techniques used for the reproduction of images have changed from the fifteenth century until today. As an example of the influence printing technology has had on our understanding of nature, I will demonstrate how the characteristic expression of different techniques has affected both the form and the content of two Swedish floras, one from the early nineteenth century (copperplate or line engraving), and another from the early twentieth century (lithography). My examples are taken from the field of botany, but the choice of medium of course influences all kinds of scientific illustrations, and indeed all printed images in general.

The Water Fennel: From Watercolor to Copperplate

The history of Swedish botany belongs to the international history of science. Swedish botanists often wrote in Latin, later in German, French, and English. They were familiar with the leading European scholarly literature, and corresponded with and visited foreign botanists, with whom they exchanged seeds and plants. The most renowned of Swedish botanists is of course Carl Linnaeus, but his extraordinary contribution to botanical science did not result in an illustrated Swedish flora. The publication of illustrated Swedish floras has been extremely limited. With the exception of Johannes Palmberg's *Serta florea svecana* (1683), and the unfinished *Campus Elysii* (1701–02) by Olof Rudbeck the Elder, Palmstruch's *Svensk botanik* was the only fully illustrated catalogue of Swedish plants published in Sweden before 1901, when it was revised and republished in Lindman's *Bilder ur Nordens flora*.[17]

The publication of *Svensk botanik* began in 1802 under the direction of the two cavalry captains Johan Wilhelm Palmstruch and Carl Venus. The plan was to publish one installment, containing six plates with accompanying text, on a monthly basis. In that way all the plants of economic or medical value, totalling approximately 500 species in all, were to have been published within the span of six to seven years. Line engraving was used for the plates, and the illustrations were individually colored by hand. *Svensk botanik* was supported in part both financially and scientifically by the Royal Swedish Academy of Sciences, but the publication had financial problems right from the start and was not finished until 1843. The text was written by the natural historian Conrad Quensel and the botanist Olof Swartz among others.[18]

In my investigation of the two different printing techniques used to produce the illustrations in *Svensk botanik* and *Bilder ur Nordens flora* and the process of modernization discernible in the latter, I will focus as a case study on the illustration of a specific species, the *Oenanthe aquatica*. It is a rare herb which lives in damp marshy ground. Its vernacular English name is "fine-leaved water-dropwort," but it is known popularly as "water fennel." The water fennel can grow up to one meter and is recognised by its branched stem, which is distended and hollow in the lower part, and its small lobated leaves. It flowers in the summer with small white blossoms in wide arched flocks. Although it is poisonous it has been used for medicinal purposes. According to Linnaeus the fruit was used to cure the chills.[19] In addition to the water fennel, I have carried out close studies of another four illustrations from *Bilder ur Nordens flora*. Together these analyses touch on a number of key issues concerning pictorial conventions, copying, coloration, and printing techniques that help to answer the question why botanical illustrations are designed as they are. The illustrations were chosen qualitatively on the basis of several criteria, above all the survival of as many originals, prints, and documentary records as possible. The water fennel is chosen for a close study of printing techniques because of Lindman's comment on contour and its connection to the lithographic novelty of printing in color without outlines.[20]

The illustration of the water fennel in *Bilder ur Nordens flora* is an elaboration of Palmstruch's line engraving in *Svensk botanik* (Figure 2). Palmstruch's original drawing of the water fennel still exists, together with about 400 other original drawings.[21] It is signed and dated in the lower left: "J. W. P. d 1 Augusti 1803 Ulrikdal." The plant is depicted with a stout lightly curved stem that branches into two sections. It has one inflorescence in full bloom, one seed head, and three leaves. In the upper left there are two stems cut off by the picture frame. The contours of a copperplate have been marked in pencil on the watercolor, in order to facilitate the composition and the transferral to print. At the bottom we can see two magnified additional details: a flower and a seed. The seed has been crossed over with a pencil, probably by Olof Swartz, guarantor for the scientific accuracy of the flora. The underlying drawing is in pencil. The contours are filled in with black ink and the picture is colored in watercolor. Presumably this watercolor drawing was used both as a master for the engraver and as a model for the subsequent coloring of the prints.

In *Svensk botanik* the illustrations were printed with black ink on white handmade paper. It is not known where the plates of *Svensk botanik* were

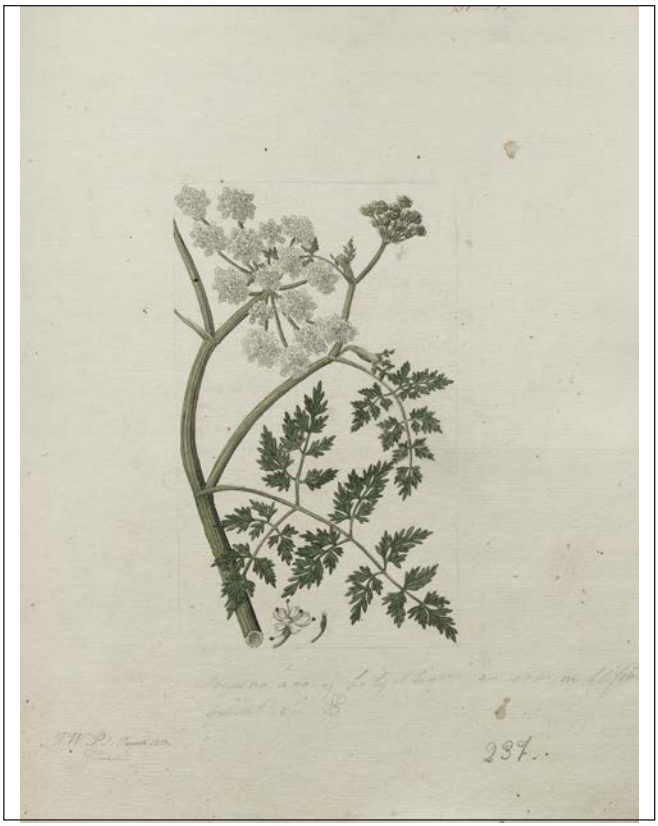
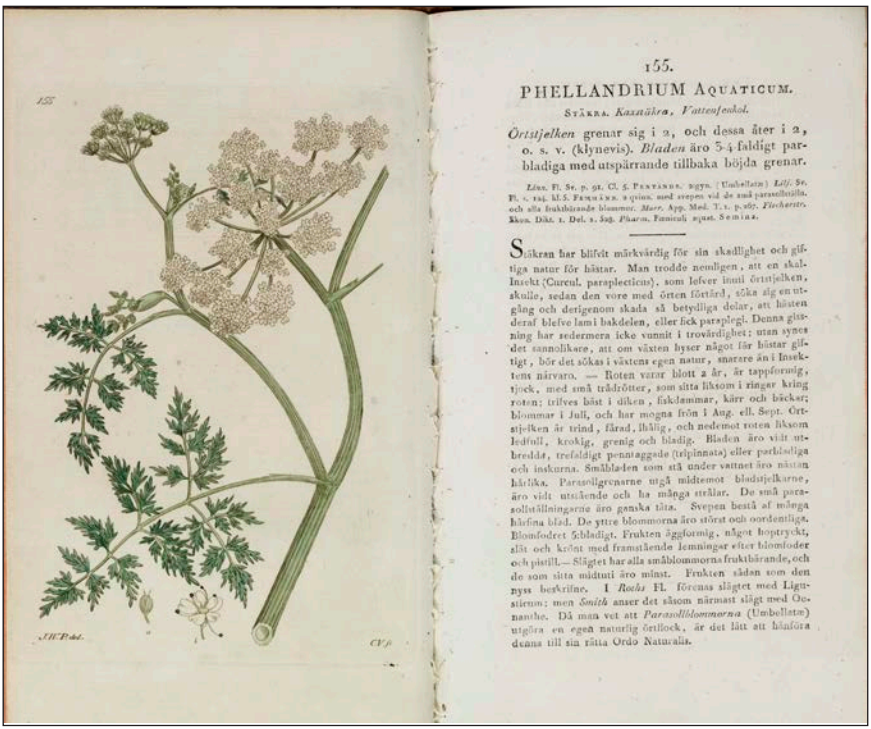


Figure 2. *Oenanthe aquatica*, watercolor by Johan Wilhelm Palmstruch (1803). Jonas Häggblom/Royal Swedish Academy of Sciences.

printed at the time. The individual plates were colored by hand in transparent watercolor, like almost all plates until the invention of color lithography in the mid-nineteenth century. The coloring was carried out by a pair of hand colorists trained by Palmstruch and Venus.

In the printed line engraving of the water fennel in *Svensk botanik*, the main figure nearly fills the entire printing area (Figure 3). At the bottom we find the details of a flower and a seed, the seed here being larger and more circular than in the original drawing. The white sections of the flowers are uncolored, making use of the white color of the paper. Shadings were made with linear crosshatching in the print, and through washing techniques in the subsequent hand coloring.



155.

PHELLANDRIUM AQUATICUM.

STÄKRA. *Kazatåkra, Vattenfenkol.*

Örtstjelken grenar sig i 2, och dessa åter i 2, o. s. v. (klynevis). *Bladen* äro 3-4 faldigt parbladiga med utspärrande tillbaka böjda grenar.

Linn. Fl. Sv. p. 91. Cl. 5. Pentandr. ordn. (Umbellatæ) Lif. Sv. Fl. c. 124. kl. 5. Pentandr. 2 quinq. med svepen vid de små parasollställa. och alla frukthärande blommor. Murr. App. Med. T. 1. p. 167. Fischerstr. Ekon. Diät. 1. Del. 2. Sap. Pharm. Familiæ agent. Semina.

Stäkran har blifvit märkvärdig för sin skadlighet och giftiga natur för hästar. Man trodde nemligen, att en skal-Insekt (Curcul. paraplecticus), som lefver inuti örtstjelken, skulle, sedan den vore med örten förtärd, söka sig en utgång och derigenom skada så betydliga delar, att hästen deraf blefve lam i bakdelen, eller fick parasplegi. Denna gissning har sedermera icke vunnit i trovärdighet; utan synes det sannolikare, att om växten hyser något för hästar giftigt, bör det sökas i växtens egen natur, snarare än i Insektens närvaro. — Roten varar blott 2 år, är tappformig, tjock, med små trådrötter, som sitta liksom i ringar kring roten; trifves bäst i diken, fiskdammar, kärr och bäckar; blommar i Juli, och har mogna frön i Aug. ell. Sept. Örtstjelken är trind, fårad, ihålig, och nedemot roten liksom ledfull, krokig, grenig och bladig. Bladen äro vidt utbredde, trefaldigt pennaggade (tripinnata) eller parbladiga och inskurna. Småbladen som stå under vattnet äro nästan hårlika. Parasollgrenarne utgå midtemot bladstjelkarne, äro vidt utstående och ha många strålar. De små parasollställningarne äro ganska täta. Svepen bestå af många hårfina blad. De yttre blommorna äro störst och oordentlige. Blomfodret 5-bladigt. Frukten äggformig, något hoptryckt, slät och krönt med framstående lemningar efter blomfoder och pistill. — Slägtet har alla småblommorna frukthärande, och de som sitta midtutti äro minst. Frukten sådan som den nyss beskrifne. I *Roths* Fl. förenas slägtet med Ligusticum; men *Smith* anser det såsom närmast slägt med Oenanthe. Då man vet att *Parasollblommorna* (Umbellatæ) utgöra en egen naturlig örtflock, är det lätt att hänföra deras till sin rätta Ordo Naturalis.

Figure 3. *Oenanthe aquatica*, Johan Wilhelm Palmstruch, *Svensk botanik* (Stockholm, 1804), Vol. III, plate 155. Einar Hansen Collection, Lund University Library.

Do Plants Have Contours and Shades?

In the process of transferring the illustrations from Palmstruch's *Svensk botanik* to Lindman's *Bilder ur Nordens flora*, impressions were taken from the old copperplates, which remained stored at the Royal Swedish Academy of Sciences. On these proofs changes were made. Lindman wrote his comments to the lithographer and the printer directly on the proofs. Lindman's revised original of the water fennel shows an unaltered composition in the main figure, but elsewhere the illustration has undergone important changes. The leaves have been redrawn, mostly on a separate paper, and pasted onto Palmstruch's leaves.

Lindman's aforementioned comment that the leaves should be "printed without contour" meant that in the new lithograph the leaves should not retain the black outlines they had in the earlier engraving. The comment indicates a novelty: printing without outlines was possible thanks to the

development of the color lithographic technique. Up to then, printing with black outlines had been necessary if the image was to be colored in an accurate fashion. For its own part, the technique of engraving had facilitated the printing of images with thin contours, in contrast to the relatively thick contours of the woodcut. Color lithography marked a further improvement given that it did not necessitate the use of a specific contour color. Since neither plants nor anything else in the natural world has outlines, this development allowed for increased realism in mass-produced images. Lindman carried on using outlines, as is clear in the printed plate of the water fennel, because he was bound by the decision to reproduce the old illustrations from *Svensk botanik*. Outlines also have pictorial advantages: they bring clarity to forms which might otherwise give the impression of floating away into the background. Scientific illustrations are governed by the conventions of the genre, the expectations and background knowledge of their viewers; otherwise there is a risk they will be misinterpreted.

Sometimes botanical illustrations were printed in colors other than black. In William Curtis's *Flora Londinensis* (London, 1777–87), for example, the mushroom *Agaricus auranthius* is printed in brown ink, the grass *Hordeum murinum* in green ink.[22] During the eighteenth century various methods of color printing were tested, but they were almost as time-consuming and expensive as hand coloring, and the results were not always as good. One example of prelithographic color printing is Pierre Bulliard's four-color engraved *Herbier de la France* (Paris, 1780–98). On the plate of the water fennel Bulliard printed the leaves in green ink without black outlines. Yet Bulliard's color engraving method was too complicated and expensive to have been influential.[23] Printing contours in colors other than black was a way to make them less conspicuous, which was especially suitable for fine details such as small blades of grass. In some cases grey ink was used for delicate details in *Bilder ur Nordens flora*.[24]

Another advantage of the lithographic print can be seen in the methods used in different printing techniques to render an impression of three-dimensionality through shading. Out in the countryside it is possible to study plants on a cloudy day without shadows: they are still perceived as three-dimensional objects. In the two-dimensional representation of a three-dimensional plant, however, the illustrator has to employ pictorial conventions to create illusions of depth, such as overlapping, foreshortening, and the use of light and shadow. In Lindman's plate of the water fennel, the illusion of three-dimensionality is achieved through the use of different nuances of printed color. In Palmstruch's engraving this would have had to have been

carried out during the process of hand-coloring each individual print, which would have been prohibitively expensive. Accordingly, in engravings three-dimensional modeling was normally achieved through closely grouped lines or linear crosshatchings, at a considerably lower cost.

The two different shading techniques are easily discernible in the prints. Hatching with close or sparse, thin or thick lines, is characteristic for engraving. Drawing on a litho stone enabled a different kind of tonal shading, with tones extending from near white to deep black, but also thinner lines. As the art historian William M. Ivins has pointed out: "The advantage of lithography was that the artist's drawing and the print were practically identical." The drawing did not have to be translated into a linear scheme as in the engraving.[25] This is not entirely true in the case of scientific illustrations and book production where exact color separation required the intervention of trained and skilled lithographers and printers.

The ideal for a didactic image was to minimize these artistic devices because they could be perceived as confusing to an untrained eye. One might wonder whether the shaded areas represented a darker, striped part of the depicted plant, or functioned merely to produce an illusion of three-dimensionality. Many of Lindman's comments concern the elimination of "engraving" or "hatching lines," given that they were pictorial devices employed to create an impression of volume rather than features of the actual plant.

Despite Lindman's many comments on the elimination of lines present in the earlier engravings, he was not consistent. He was prevented from realizing the full potential of the lithographic technique by the obligation to reuse the old copperplates. Although in some of the newly added images hatchings are to be found, in general the effect of three-dimensionality was achieved in other ways, such as through the tonal blackness of the lithographic crayon or nuances in the color print. It is possible in most cases to recognize whether a copperplate was used as a prototype for a particular lithograph owing to the different characteristics of the techniques. The newly composed illustrations could have been made to look like line engravings, but there was no point in doing so.

There are no comments on engraving on Lindman's original to the water fennel illustration. The lines engraved by Venus are left on the stem. They contrast sharply with the newly added details of the fruit and the base of the stem, where a striking effect of three-dimensionality was attained through the use of varying nuances of color. The fine modeling in watercolor, probably executed by the artist Axel Ekblom, or his wife Thérèse Ekblom (a trained artist who worked on the flora without receiving acknowledge-

ment), was simplified in the transferral to the lithographic print, where the array of colors was restricted for financial reasons.

Palmstruch and Copying as Scientific Practice

The most conspicuous feature of Lindman's illustrations, however, is not his elimination of hatchings and contours; rather, it is the new details. Instruments like the microscope had improved over the course of the century that had passed between Palmstruch and Lindman, and Palmstruch's details of flowers and fruit were replaced with new, highly magnified elements. The base of the stem in the lower right, with distinct leaves beneath the surface of the water, is a new addition, partly drawn on a separate paper and partly on the proof sheet.

The delicate submerged leaves of the water fennel are specific to the species. Although Palmstruch did not depict them on the plate, they were described in the accompanying verbal description as "hair-like."[26] Perhaps he failed to observe the leaves on that day in August 1803 when he picked the plant and drafted the original watercolor. It would have been possible for him to have copied it from another flora, though he did not. In his preface, Palmstruch stated that although the illustrations were most often based on the observation of natural specimens, they were "sometimes borrowed, with or without improvements," from four earlier publications: William Woodville's *Medical Botany* (London, 1790–95), Sowerby and Smith's *English Botany* (London, 1790–1814), Georg Christian Oeder's *Flora Danica* (Copenhagen, 1761–1883), Joseph Jacob von Plenck's *Icones plantarum medicinalium* (Vienna, 1788–1812), and others (Figures 4, 5, 6, and 7).[27] All of these botanical works were illustrated with hand-colored engravings in natural scale. With the exception of *Medical Botany*, their publication in installments ran parallel with *Svensk botanik*, which meant that in practice they could have drawn on Palmstruch's illustrations as models for some of their plates. Although the different publishers used similar materials and printing techniques, they worked within divergent economic frameworks. *Icones plantarum medicinalium* and *Flora Danica* are lavishly colored folios, whereas *Medical Botany* and *English Botany*, as well as *Svensk botanik*, are smaller and less expensive quartos.

Botanical illustrations are often based on earlier pictorial and textual traditions. In an investigation of botanical illustrations from the eighteenth century, the historian of science Kärin Nickelsen has shown that numerous

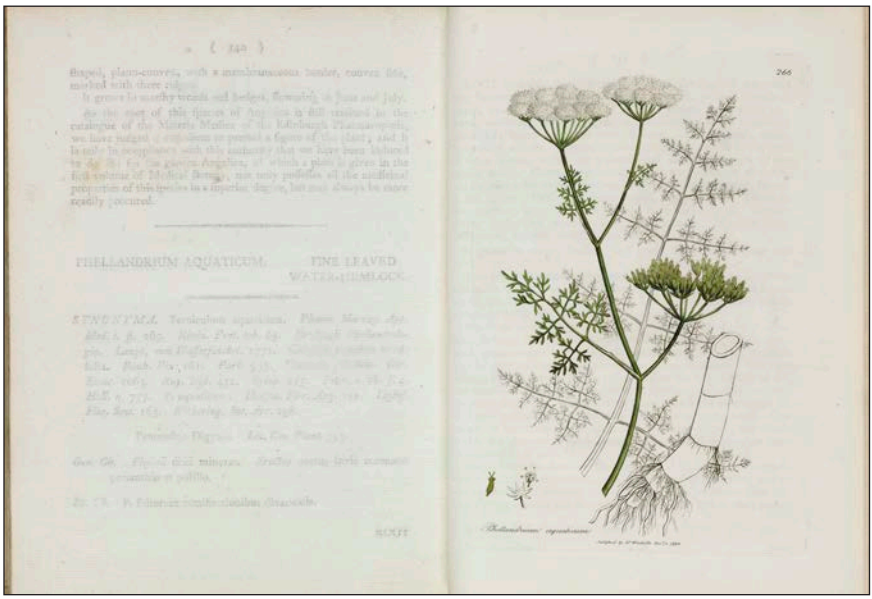
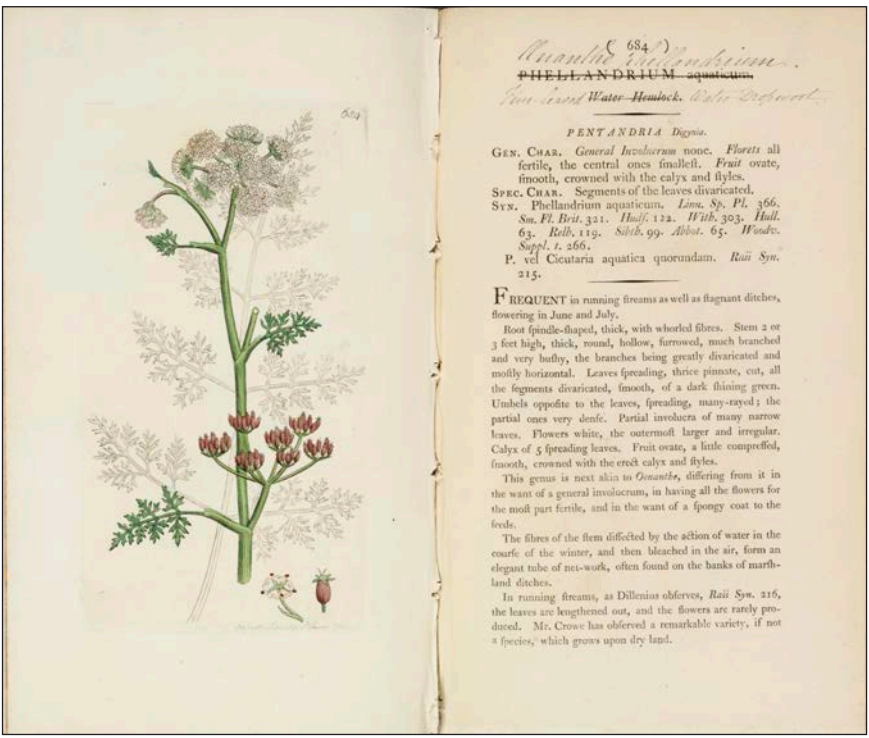


Figure 4. *Oenanthe aquatica*, William Woodville, *Medical Botany* (London, 1794), Vol. IV, plate 266. Einar Hansen Collection, Lund University Library.

illustrations can be tied together in long series or chains, in which images were copied from existing publications, and modified in order to correct errors or add more information. Nickelsen's study of the practices of copying during the eighteenth century demonstrates that botanists examined visual sources as critically as they scrutinized texts.[28]

In general, botanists professed to have based their illustrations on the direct observation of natural specimens. Palmstruch was among the few who actually named his predecessors. By comparing some of Palmstruch's illustrations with those of his four models, I have been able to determine that some of the images are nearly straightforward copies.[29] This entails examining how the same problem—that is, how to depict and reproduce a given plant species—was solved by five different publishers. It reveals the ways in which scientific illustrations, like scientific texts, relate to earlier research, especially in the form of published images. This practice of replication in turn affected the plates that would eventually be reproduced in *Bilder ur Nordens flora*. Through his models, Palmstruch linked Lindman's plates with the pictorial world of the eighteenth century. The persistence of strong pictorial conventions, and hence the received expectations of what a



(684)

~~PHELLANDRIUM aquaticum.~~

~~Water Hemlock.~~

PENTANDRIA Digynia.

GEN. CHAR. *General Involucrum* none. *Florets* all fertile, the central ones smallest. *Fruit* ovate, smooth, crowned with the calyx and styles.

SPEC. CHAR. Segments of the leaves divaricated.

SYN. Phellandrium aquaticum. *Linn. Sp. Pl.* 366. *Sm. Fl. Brit.* 321. *Hudf.* 122. *With.* 303. *Hull.* 63. *Relh.* 119. *Sibth.* 99. *Abbot.* 65. *Woodv. Suppl. t.* 266.

P. vel Cicutaria aquatica quorundam. *Raii Syn.* 215.

FREQUENT in running ſtreams as well as ſtagnant ditches, flowering in June and July.

Root ſpindle-ſhaped, thick, with whorled fibres. Stem 2 or 3 feet high, thick, round, hollow, furrowed, much branched and very buſhy, the branches being greatly divaricated and moſtly horizontal. Leaves ſpreading, thrice pinnate, cut, all the ſegments divaricated, ſmooth, of a dark ſhining green. Umbels oppoſite to the leaves, ſpreading, many-rayed; the partial ones very denſe. Partial involucra of many narrow leaves. Flowers white, the outermoſt larger and irregular. Calyx of 5 ſpreading leaves. Fruit ovate, a little compreſſed, ſmooth, crowned with the erect calyx and ſtyles.

This genus is next akin to *Oenanthe*, differing from it in the want of a general involucrum, in having all the flowers for the moſt part fertile, and in the want of a ſpongy coat to the ſeeds.

The fibres of the ſtem diſſected by the action of water in the courſe of the winter, and then bleached in the air, form an elegant tube of net-work, often found on the banks of marſh-land ditches.

In running ſtreams, as Dillenius obſerves, *Raii Syn.* 216, the leaves are lengthened out, and the flowers are rarely produced. Mr. Crowe has obſerved a remarkable variety, if not a ſpecies, which grows upon dry land.

Figure 5. *Oenanthe aquatica*, Sowerby & Smith, *English Botany*, 2nd ed. (London, 1835–46 [1800]), Vol. X, plate 684. Lund University Library.

botanical illustration should look like, entailed that images could be reused several hundred years later, albeit with certain modifications.

As is clear from a comparison of the different floras, Palmstruch did not copy his illustration of the water fennel from earlier models. The preserved watercolor also suggests he had studied a living or dried plant. All the named floras include details of flowers and fruits, but the submerged leaves are present only in *Medical Botany*. It is possible that Palmstruch observed them in *Medical Botany* but chose not to include them in his own illustration. Since Palmstruch did not indicate his models on the plates themselves, it is not always possible to conclude when and how he used them. Under the heading "Synonyma," the authors of the text mentioned the works they had consulted. A synonyma is a list of the different denominations for a species contained in previous scientific literature, usually placed below the specific name in the description, in order to designate which plant is being described. After Linnaeus's introduction of binomial nomenclature in *Spe-*

Figure 6. *Oenanthe aquatica*, Plenck, *Icones plantarum medicinalium* (Vienna, 1790), Vol. III, plate 210. Royal Library, Copenhagen.

cies plantarum (1753), where plants were given two-word Latin names, this information was no longer as necessary as before.[30]

It is interesting to note that Plenck, Oeder, and Woodville, but neither Palmstruch nor Sowerby and Smith, placed a section of the stem base with roots in the same position as Lindman. But none of them portrayed as elegantly as Lindman the smaller variant of leaf that grows underwater. Woodville was the only other to have depicted this type of leaf, here in the form of a separate uncolored background image. The use of uncolored background leaves was a common convention, employed in order to give room for more information on the restricted surface of the page without disturbing the main figure. In the case of the lobated leaves of the water fennel, they were too narrow to be colored. Even in *English Botany* there is a separate background leaf, but it lacks the fine lobes. Sowerby and Smith thus missed the

Figure 7. *Oenanthe aquatica*, Oeder, *Flora Danica* (Copenhagen, 1797), Vol. VII, plate 1154. Lund University Library.

opportunity to display the characteristic submerged leaves of the plant.[31] Palmstruch's water fennel diverges significantly from the earlier models. The water fennel in *Svensk botanik*, with its natural curved shape, appears the most lifelike of all the illustrations. However, the illustration of the "hair-like" leaves mentioned in the verbal description had to wait for Lindman and the invention of color lithography.

The Color Lithographed Water Fennel

If we examine Lindman's published plate of the water fennel (Figure 8), Palmstruch's main figure is still to be seen with its stem in two pieces, slightly bent, with one inflorescence in full bloom. To the left, new leaves have

Figure 8. *Oenanthe aquatica*, Carl Lindman, *Bilder ur Nordens flora* (Stockholm, 1901–05), Vol. I, plate 258. Lund University Library.

replaced the two largest ones. At the bottom right, just beyond the lower part of the main figure, we find the new base of the stem with rootlets and two leaves with hairlike lobes. Moreover, there are two magnified details, a flower and a fruit, placed to the left. In the textual description, Lindman mentions the narrow underwater leaves, with particular reference to the plate: "The first rosette leaves have as underwater leaves thread-thin lobes Fig. 1."[32] Although he depicts these leaves in the plate, it is only through the text that it is made clear that they grow underwater. Simply mentioning the thin underwater leaves in the text, as in *Svensk botanik*, did not suffice to convey a full understanding of their shape. Text and image cooperate and

together contribute to an understanding of the distinctive character of the species.[33]

Even though color lithography was far cheaper than hand-colored engravings, color print was still expensive. Separate litho stones were used for each color. On budgetary grounds, the publisher Wahlström & Widstrand restricted the use of color to an average of ten colors per illustration. In comparison, for more commercial printing, such as wine labels, soap wrappers, and playing cards, twelve to fourteen colors were often used to satisfy the customers' demands. Reproductions of paintings, in turn, tended to require between ten and twelve colors.[34] Although this restriction was not entirely satisfactory for Lindman, he did his best to make do and supervised the printing carefully throughout the process. Accordingly, the precision of the color prints was sometimes inadequate according to the criteria of botanical science, but nevertheless sufficed for Lindman's aim to spread botanical illustrations among the general public. More scientifically oriented investigations demanded better color reproduction, which was pointed out by some of the book's expert reviewers. In the reviews written by amateurs, however, the color illustrations were praised for their beauty.[35]

The uniform color print made possible thanks to lithography was an important novelty. This meant, for example, that when Lindman noted that the anthers of the mezereon, *Daphne mezereum*, should be yellowish-white, the anthers in all 7,000 copies of the illustration were given exactly the same yellowish-white color. Conversely, on the mezereon plate in *Svensk botanik*, which was published in no more than 500 copies, the color of the anthers varies from one copy to the next, despite the fact that the coloring was carefully scrutinized by Palmstruch and others.[36]

The difference between the two printing techniques is apparent, for example, through a comparison of the stem of the water fennel in Palmstruch's copperplate and the newly designed fruit in Lindman's lithograph. The round shape of the stem in *Svensk botanik* was produced by means of longitudinal lines in the engraving. The roundness of the fruit in *Bilder ur Nordens flora*, however, was achieved through the use of different shades of color. The difference in printing technique between Palmstruch's line engraving and Lindman's lithograph is particularly evident in the formal contrast between the stem in the main figure and the two new leaves to the left. The transparent lithographic inks allowed the chalk drawing to remain visible and retain its modeling features. Even though shading and modeling were mainly executed in color, and with lithographic chalk, original hatchings from the engraving remain visible in the main figure. The new leaves

are all printed in green color, without black outlines, following Lindman's instructions to the lithographer on the original. The result is a more lifelike illustration of the water fennel.

Conclusion

The new lithographic printing technique affected not only the size and cost of the edition, but also the content of the illustrations in *Bilder ur Nordens flora*. The coloring was supervised by the botanist, and it was uniform throughout all the copies. In the linear copperplate, three-dimensionality was suggested above all by means of parallel and hatched lines. Now the illusion of three-dimensional form could be achieved through the use of different nuances of color as in painting. Lithography allowed for printing without outlines, which meant that tiny details such as finely lobed leaves could be depicted more realistically. The detailed texture of the plants could also be rendered thanks to the lithographic technique. The mere existence of the technique, however, did not mean that it was always economically feasible to harness all its possibilities. In the case of *Bilder ur Nordens flora*, Lindman was restricted by the publisher's budgetary constraints and the reuse ot the old copperplates. The full potential of the trained artists and the lithographic printing technique therefore remained unrealized.

The copying of images did not terminate with the invention of printing in the fifteenth century, the emergence of modern science in the eighteenth century, or the arrival of photography and the ideal of objectivity in the nineteenth century. The practice of pictorial reproduction continues today. Yet the copying and reuse of older scientific illustrations should not be seen as second-class science; rather it can be equated with the use of written scientific sources. That images can be used for the identification of species after several hundred years indicates the slow pace of scientific development (or rather the high cost of image reproduction), the ways in which earlier research is tied together with the new, and that temporary innovations belong to a long history of scientific practice. My comparisons of botanical illustrations have thus also become a study of a scientific longue durée, revealing how knowledge encapsulated in imagery is transmitted and reshaped over the centuries, a process in which scientific atlases and textbooks form a necessary foundation.

As I have shown through a close study of the plate of the water fennel, developments in printing technology played an important role in the reuse

and modernization of illustrations. In the early twentieth century graphic reproduction was an expensive procedure, even in the case of the partial reuse of older plates, and it remains so today. The publisher of Lindman's work, Wahlström & Widstrand, originally believed that the images in *Svensk botanik* were in principle timeless, but in fact extensive corrections were required for the illustrations that were new at the start of the nineteenth century to be scientifically acceptable in 1900. One might like to believe that a plant always looks the same, but images are based on the state of the art, not only the art of botany, but also the art of printing. Better microscopes and new printing techniques—not to mention social, cultural, and economic changes—transform the way we perceive plants. The lithographic printing technique and Lindman's careful revision of Palmstruch's century-old illustrations made them live on for another hundred years.

Notes

This study is based on a chapter from my doctoral dissertation in Book History at Lund University, Sweden: Gunilla Törnvall, *Botaniska bilder till allmänheten: Om utgivningen av Carl Lindmans Bilder ur Nordens flora* [Botanical illustrations for the public: On the publication of Carl Lindman's *Bilder ur Nordens flora*] (Stockholm: Atlantis, 2013). The dissertation focuses on the historical background, publication, and reception of the flora. I would like to thank Gustav Holmberg for useful comments on an early draft of this article, Matthew Norris for improving my English with excellent proof reading, and the three anonymous reviewers at *Book History* for their helpful comments and suggestions.

1. "P.S. Bladen måste ytterst noggsamt kopieras! Tryckas sedan utan kontur, med kraftig färg." "Originalteckningar till 'Bilder ur Nordens Flora' med diverse anvisningar till Tryckeriet," Carl Lindman's archive, Botanical Department, Swedish Museum of Natural History, Stockholm, plate 258.

2. On botanical illustrations see, e.g., Wilfrid Blunt and William T. Stearn, *The Art of Botanical Illustration*, new ed. (Woodbridge: Antique Collectors' Club, 1994); Gavin D.R. Bridson and Donald E. Wendel, *Printmaking in the Service of Botany: Catalogue of an Exhibition, 21 April to 31 July 1986* (Pittsburgh: Hunt Institute for Botanical Documentation, 1986); Sachiko Kusukawa, *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-Century Human Anatomy and Medical Botany* (Chicago: University of Chicago Press, 2012); Kärin Nickelsen, *Draughtsmen, Botanists and Nature: The Construction of Eighteenth-Century Botanical Illustrations* (Dordrecht: Springer, 2006); Martyn Rix, *The Golden Age of Botanical Art* (Chicago: University of Chicago Press, 2013); and Gill Saunders, *Picturing Plants: An Analytical History of Botanical Illustration* (Berkeley and Los Angeles: University of California Press, 1995).

3. Lindman writes in the preface to his field guide *Svensk fanerogamflora*: "Lämpliga avbildningar tala nämligen ett kortare, bestämdare och tydligare språk än all text, även den bäst genomtänkta, och böra i samma mån som de äro exakta utesluta varje misstag, då en växt skall bestämmas" (Appropriate images speak namely a shorter, firmer, and clearer language than texts, even the most well-reasoned, and should, to the extent that they are exact, eliminate any misunderstanding when a plant is to be classified). C.A.M. Lindman, *Svensk fanerogamflora* [Swedish phanerogam flora] (Stockholm: P. A. Norstedt & Söners Förlag, 1918), unpag.

4. C.A.M. Lindman, *Bilder ur Nordens flora: På grundvalen av Palmstruchs Svensk botanik*, 3 vols. (Stockholm: Wahlström & Widstrand, 1901–05). An incomplete digitized version of 526 plates from the second edition (1917–26) is reproduced on http://runeberg.org/nordflor/ (accessed April 5, 2016).

5. Jens Stephan Heger, *Afbildninger af danske oeconomiske Planter med Beskrivelser over deres Egenskaber og Anvendelse* [Depictions of Danish economical plants with descriptions of their characteristics and use] (Copenhagen, 1828); Knut Fredrik Thedenius, *Svensk skol-botanik* [Swedish school-botany] (Stockholm, 1852–53).

6. Bridson and Wendel, *Printmaking in the Service of Botany*, 79.

7. According to Blunt and Stearn, *Art of Botanical Illustration*, 220; Claus Nissen, *Die botanische Buchillustration: Ihre Geschichte und Bibliographie*, 2nd ed. (Stuttgart: Anton Hiersemann, 1966), 208. My observations of *English Botany* are based on the first edition at Botanisk Centralbibliotek, Copenhagen, and the second edition at Lund University Library. I have not studied the third edition.

8. See e.g. D.F. McKenzie, *Bibliography and the Sociology of Texts* (Cambridge: Cambridge University Press, 2004 [1986]), 12–13, 32–49; and Thomas R. Adams and Nicolas Barker, "A New Model for the Study of the Book," in: *A Potencie of Life: Books in Society: The Clark Lectures 1986–1987*, ed. Nicolas Barker (London: British Library, 2001 [1993]), 5–43. During the past decade, the importance of the invention of printing has gained a place in the history of science as well. One example of this is James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press), 2000. See also James A. Secord, "Knowledge in Transit," *ISIS* 95, no. 4 (2004): 654–72; Jonathan R. Topham, "Introduction" [Focus: Historicizing "Popular Science"], *ISIS* 100, no. 2 (2009): 310–18; Jonathan R. Topham, "A View from the Industrial Age," *ISIS* 95, no. 3 (2004): 431–42.

9. For a discussion on the relation between illustration and text in scientific atlases, see Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2010), 22.

10. See historian of science David Edgerton's *The Shock of the Old: Technology and Global History Since 1900* (New York: Oxford University Press, 2007), on the importance of a less narrow view of technology and science than the biased focus on innovations; on the use of scientific atlases, see Daston and Galison, *Objectivity*.

11. Ann Bermingham, *Learning to Draw: Studies in the Cultural History of a Polite and Useful Art* (New Haven: Yale University Press, 2000), *64–73;* William M. Ivins, Jr., *Prints and Visual Communication* (Cambridge, Mass., and London: MIT Press, 1996 [1953]), 34.

12. See Elizabeth L. Eisenstein on the importance of the printing press for the development of science in *The Printing Revolution in Early Modern Europe*, new ed. (Cambridge: Cambridge University Press, 2005), 209–85.

13. Nickelsen, *Draughtsmen, Botanists and Nature*, 45, 78–79.

14. The psychological perception of art is studied by art historian Rudolf Arnheim in *Art and Visual Perception: A Psychology of the Creative Eye*, 2nd ed. (Berkeley: University of California Press, 2004 [1974]), 96–161; and E. H. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation*, 5th ed. (London: Phaidon, 1996), 55–78. Art historian Barbara Maria Stafford has studied the perception of images from a scientific standpoint, focusing on the brain and the eye. Her reasoning is largely based on neurobiologist Semir Zeki's research. She holds that vision is a dynamic process in which the brain largely automatically filters, discards, and selects information, and compares it with its own repository of stored images. Semir Zeki, *Inner Vision: An Exploration of Art and the Brain* (Oxford: Oxford University Press, 1999), 1–21; Barbara Maria Stafford, "The Remaining 10 Percent: The Role of Sensory Knowledge in the Age of the SelfOrganizing Brain," *Visual Literacy*, ed. James Elkins (New York: Routledge, 2008), 31–57; and Barbara Maria Stafford, "Thoughts Not Our Own: Whatever Happened to Selective Attention?," *Theory, Culture & Society* 26 (2009): 275–93.

15. My formulation here draws on Gombrich, *Art and Illusion,* 30, 56.

16. See Roger Chartier, *Forms and Meanings: Texts, Performances, and Audiences from Codex to Computer* (Philadelphia: University of Pennsylvania Press, 1995), 22. Chartier does not speak of images. But here I use McKenzie's broad definition of texts, which includes any mediated communication, whether it be verbal, visual, or oral, from maps, films, television programs, and data publication to photographs and other types of images; see McKenzie, *Bibliography and the Sociology of Texts*, 13.

17. On the history of Swedish botany see Gunnar Broberg, "Den linneanska bildvärlden" [The Linnaean world of images], in *Bilden som källa till vetenskaplig information: Föredrag vid Vitterhetsakademiens symposium 13–14 april 1989*, ed. Allan Ellenius (Stockholm: Kungl. Vitterhets-, historie- och antikvitetsakademien, 1990), 29–57; Gunnar Eriksson, *Botanikens historia i Sverige intill år 1800* [The history of Swedish botany until 1800] (Stockholm: Almqvist & Wiksell, 1969); Gunnar Eriksson, "Flora Writing in Norden" in *Flora Nordica: General Volume*, ed. Bengt Jonsell (Stockholm: Bergius Foundation, Royal Swedish Academy of Sciences, 2004), 1–36; and Robert E. Fries, *A Short History of Botany in Sweden* (Uppsala: Almqvist & Wiksell, 1950).

18. *Svensk botanik* and Johan Wilhelm Palmstruch have not been the subject of any further scholarly study. The most detailed presentation is in Sten Lindroth, *Kungl. Svenska vetenskapsakademiens historia 1739–1818, II, Tiden 1783–1818* [The history of The Royal Swedish Academy of Sciences 1739–1818] (Stockholm: Kungl. Vetenskapsakademien, 1967), 434–41; see also Björn Dal, *Med kolorerade figurer: Handkolorering i Sverige under 1700- och 1800-talen* [With colored figures: Hand-coloring in Sweden during the eighteenth- and nineteenth centuries] (Fjälkinge: Orbis pictus, 2001), 103–108, 277–283; Törnvall, *Botaniska bilder till allmänheten*, 86–92.

19. On the *Oenanthe aquatica* see *Den virtuella floran* [The virtual flora] published by the Swedish Museum of Natural History: http://linnaeus.nrm.se/flora/di/apia/oenan/oenaaqu.html (accessed April 5, 2016).

20. Except for the water fennel (*Oenanthe aquatica*), I have studied the illustrations of the mezereon (*Daphne mezereum*), the wood-sorrel (*Oxalis acetosella*), the burnt orchid (*Orchis ustulata*), and the beech (*Fagus sylvatica*): see Törnvall, *Botaniska bilder till allmänheten*.

21. "Originalfigurerne till Svensk Botanik," Ms. Pl.v. 161, Center for the History of Science, Royal Swedish Academy of Sciences, Stockholm.

22. My observations are based on the hand-colored copy of William Curtis, *Flora Londinensis* . . . (London, 1777–87), at Botanisk Centralbibliotek, Copenhagen, plate 308, 325.

23. Bridson and Wendel, *Printmaking in the Service of Botany*, 88–94; Brian Dolan, "Pedagogy Through Print: James Sowerby, John Mawe and the Problem of Colour in Early Nineteenth-Century Natural History Illustration," *British Journal for the History of Science* 31 (1998): 286–88. My observations are based on the copy of Pierre Bulliard, *Herbier de la France* (Paris, 1780–98), Vol. VII, plate 147, at Lund University Library.

24. Lindman, *Bilder ur Nordens flora*, see e.g. small-leaved lime, *Tilia vulgaris*, plate 233.

25. Ivins, *Prints and Visual Communication*, 110.

26. Johan Wilhelm Palmstruch et al., *Svensk botanik*, Vol. III (Stockholm: 1804), textual description to plate 155. The description was probably written by Conrad Quensel.

27. "Stundom lånte, med eller utan förbättringar." Palmstruch, *Svensk botanik*, Vol. 1 (Stockholm: 1802), unpag.

28. Nickelsen, *Draughtsmen, Botanists and Nature*, 203–228. In the large number of illustrated botanical works studied by Kärin Nickelsen, she found the itemization of the artist's models only in two cases. But she did not note the sources mentioned in Palmstruch's preface and thus overlooked the close links between *Svensk botanik* and *Medical Botany*.

29. See e.g. mezereon, *Daphne mezereum*, Palmstruch, *Svensk botanik*, Vol. I, plate 7; and Woodville, *Medical Botany*, Vol. I, plate 23.

30. John Lewis Heller, *Studies in Linnaean Method and Nomenclature* (Frankfurt am Main: Verlag Peter Lang, 1983), 41–44.

31. William Woodville does not mention the artist of the illustrations in *Medical Botany*, but it is assumed to be the same James Sowerby as the artist and publisher of *English Botany*.

32. Lindman, *Bilder ur Nordens flora*, Vol. III, 200. The Swedish original reads: "De första rosettbladen hafva såsom undervattensblad trådsmala flikar, fig. 1."

33. The interpretation, color separation, and transfer of the originals to the lithographic technique was performed by lithographers at Generalstabens Litografiska Anstalt (a renowed lithographical printing house originally founded by the Swedish military), mostly by Henricson, Carlson, and Weichbrodt. The skill of the lithographers and also the printers, among them Ringqvist and Kullenberg, was of great significance for the final result. Usually craftsmen of this sort have remained anonymous in history. Through the examination of work logs and printing records it has been possible to ascertain at least their surnames and how much time was devoted to each sheet. Arbetsjournaler [Work logs] and Tryckerijournaler [Printing records], 1901–05, Archive of Generalstabens Litografiska anstalt, Centre for Business History, Stockholm.

34. Felix Brunner, *A Handbook of Graphic Reproduction Processes: A Technical Guide Including the Printmaking Processes for Art Collectors and Dealers, Librarians, Booksellers, Publishers, Artists, Graphic Designers and the Printing Trade* (Teufen: Tiranti, 1962), 314; Karl Brunnander, "Litografiska tryckets utveckling under 40 år 1918–1958" [The development of lithographic print during 40 years 1918–1958], in *Om litografi: En festskrift: Julius Olséns litografiska anstalt 1918–1958, ed.* Gunnar Jungmarker (Stockholm: Nationalmuseum, 1958), 68.

35. On the reception of *Bilder ur Nordens flora*, see Törnvall, *Botaniska bilder till allmänheten*, 217–36.

36. According to Lindman's comment on the original of the mezereon, "Originalteckningar till 'Bilder ur Nordens Flora' med diverse anvisningar till Tryckeriet," Carl Lindman's archive, Botanical Department, Swedish Museum of Natural History, Stockholm. I have observed three different colors on the anthers in three different copies of Palmstruch's *Svensk botanik* held at Lund University Library: yellow, red, and brown.