

Material Forms in Nature: The Photographs of Karl Blossfeldt

HANAKO MURATA

What today has come to be regarded as among the finest bodies of work in early-twentieth-century photography began as a teaching experiment. Karl Blossfeldt, a new lecturer at the *Unterrichtsanstalt des Königlichen Kunstgewerbemuseums Berlin* (The institute of the royal arts and crafts museum Berlin), was looking for a way to showcase examples of the forms and patterns he discovered in the natural world that he believed should inspire his students' own work.¹ An excellent sculptor, he first created a large, finely modeled dragonfly's wing, but this was dismissed as trivial by the school's director.² Blossfeldt came up with an idea of making greatly enlarged photographs of the insect instead.³ "This enlargement then proved to be most useful to me in my studies, and thus I hit upon the use of enlarged photographs of small plant forms to assist as yet unskilled students in their work," Blossfeldt recalled in 1929. "[I]t is due to this incident and this photograph that I am now publishing my enlarged plant photographs thirty years later."⁴

Indeed, it would not be until close to the end of Blossfeldt's teaching career—and but four years before his death, in 1932—that his photographic work would attract broad public attention and critical acclaim. His first collection of photographs, *Urformen der Kunst* (Art forms in nature), published in 1928, caused an immediate sensation and would go on to appear in numerous editions in several languages. This was followed by *Wundergarten der Natur* (Magic garden of nature) in 1932 and, a decade later, the posthumous *Wunder in der Natur* (Magic in nature).

Long before Blossfeldt's photographs were hailed alongside the work of Albert Renger-Patzsch and August Sander as essential representatives of *Neue Sachlichkeit* (New Objectivity), they allowed the instructor of decorative arts to do what he otherwise couldn't, which was to preserve the ephemeral forms of nature for classroom teaching (fig. 1). The difficulty of using fresh plants for his classes were numerous: specimens were hard to gather, they tended to wither, and during much of the year, the only way to collect them was to have access to a greenhouse. Around 1900, Blossfeldt recognized the potential of photography to supplement fresh plants as teaching tools and sought financial support for his project from the school's director, but to no avail.⁵ In a move that represents the remarkable extent to which Blossfeldt was a self-taught photographer, he constructed his camera himself, one that allowed him to capture a wide variety of fragile botanical



fig. 1 Karl Blossfeldt. *Equisetum hyemale* (Rough Horsetail Enlarged 25 Times) (*Equisetum hyemale* [Winter-Schachtelhalm in 25facher Vergrößerung]). 1898–1928. Gelatin silver print, 1920–32, 23 ⁷/₁₆ × 9 ⁵/₁₆" (59.5 × 23.7 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Thomas Walther (MoMA 1627.2001)

specimens in both horizontal and vertical orientations.⁶ With a bellows approximately one meter long, the camera also permitted him to magnify even the tiniest and most delicate plant forms, which he printed at a scale considerable for the time.⁷ Over the course of the next thirty years, Blossfeldt would produce hundreds of prints that are striking for both the elegant simplicity of their compositions and the uniform precision of their production: botanical specimens, magnified to various degrees, are shown in isolation against a plain background.

A letter written by Blossfeldt to the director of the Königliche Kunstgewerbemuseum in April 1906 is telling in many regards:

I hereby respectfully submit to the director a collection of enlargements of plants. Some of the main subject teachers to whom these photographs have recently been shown have been positive in their comments and consider them suitable for lessons....

In many cases, these photographs were made by enlarging small details that students could not easily make out in evening light.... I probably have more than a thousand of such photographs, from which, however I can only slowly make prints. Because they are the fruit of years of work and considerable material sacrifice, I would very much welcome their being used in some way, either as inspirational material in individual classes, libraries, etc. for a wider audience and, above all, for all students.... The sculptor... can only make profitable use of the smaller, simpler plants that grow wild. There plants are a treasure trove of forms—one which is carelessly overlooked only because the scale of shapes fails to catch the eye and sometimes this makes the forms hard to identify. But that is precisely what these photographs are intended to do—to portray diminutive forms on a convenient scale and encourage students to pay them more attention....

To facilitate discussion of these photographs, I feel it would be advisable to affix these prints in advance to a wall. I will gladly be of service here. There are 210 sheets measuring 20 × 30 cm each, and they would require an area of around 12 square meters.⁸

Blossfeldt makes clear that by 1906 he had already made more than a thousand negatives and at least 210 enlarged prints, 7 ⁷/₈ by 11 ¹³/₁₆ inches (20 by 30 centimeters) each, and he expresses a desire to see the fruits of his labor find a broader audience. Slowly but surely, interest in Blossfeldt's work began to expand. In 1920, the institute in Berlin where Blossfeldt taught purchased thirty prints, 9 ⁷/₁₆ by 11 ¹³/₁₆ inches (24 by 30 centimeters) each.⁹ Blossfeldt's work was exhibited at the school in 1925, which may have led to its discovery by the influential gallery owner and art collector Karl Nierendorf. The following year, Nierendorf mounted the first exhibition of Blossfeldt's images outside the academic context at the eponymous gallery he had established with his brother in Berlin; Blossfeldt was sixty-one.¹⁰ The

success of the exhibition expedited the publication of *Urformen der Kunst*, with the result that Blossfeldt's photographs were included a year later in both the Stuttgart and the Berlin venues of the landmark 1929 exhibition *Film und Foto*.¹¹ He retired on October 1, 1930, and died two years later at the age of sixty-seven.¹²

In the decades that have followed, Blossfeldt's exquisite body of work has continued to attract widespread interest, even as exhibition of his original prints is relatively rare. The group of seven gelatin silver prints in the Thomas Walther Collection at The Museum of Modern Art is the largest collection of Blossfeldt prints outside his native Germany, and it offers a unique opportunity to understand trends in the artist's work through data gathered from close examination and instrumental analysis of his material choices. This examination—the first to consider the material aspects of Blossfeldt's photography—also provides insights into critical questions surrounding the dating of the artist's work as well as additional perspective on exactly how this visionary pioneer achieved his trademark consistency of style.¹³

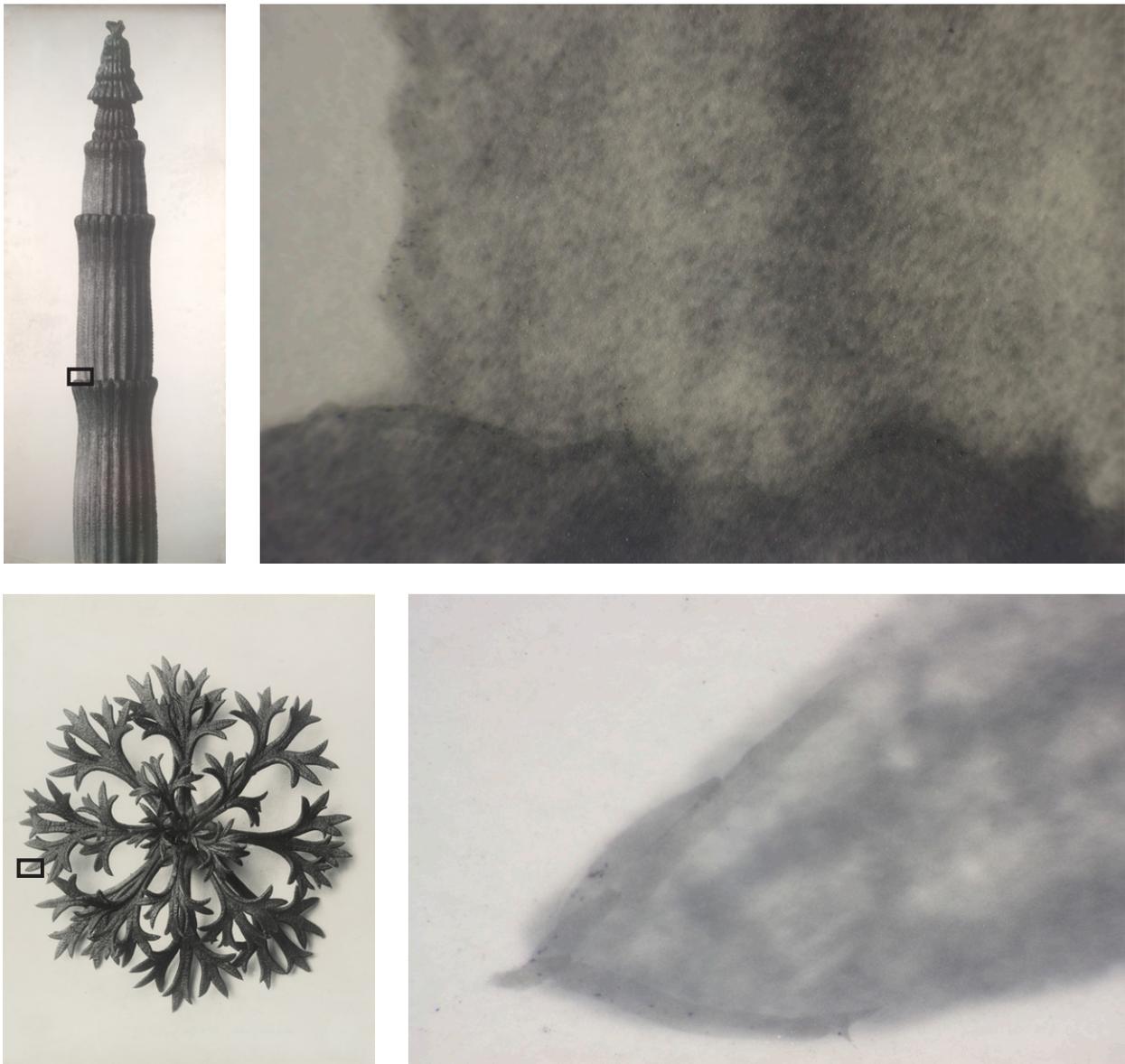
Blossfeldt's ultimate vision of a characteristic, relatively homogenous style would have started with the negative. From existing documentation we know that he made at least some of his negatives in soft daylight so he could better capture the details of his plant specimens in an even tone, using an Aplanat 1:36, F=50-cm lens and an exposure time of eight to twelve minutes.¹⁴ An examination of data for 460 negatives in the online catalogues of both the archive of the Universität der Künste Berlin and the Deutsche Fotothek, SLUB, Dresden, determined that Blossfeldt used four major formats of glass-plate negatives: 6 by 9 centimeters (2 ³/₈ by 3 ⁹/₁₆ inches), 9 by 12 centimeters (3 ⁹/₁₆ by 4 ³/₄ inches), 9 by 18 centimeters (3 ⁹/₁₆ by 7 ¹/₈ inches), and 13 by 18 centimeters (5 ¹/₈ by 7 ¹/₈ inches), the latter three accounting for 96 percent of his negatives.¹⁵ Such large-format negatives would have been more expensive to produce, but Blossfeldt likely found the benefits outweighed the cost, considering that larger negatives are easier to retouch and require less enlargement (thus providing sharper images).

The striking uniformity of Blossfeldt's photographs suggests an excellent mastery of studio technique, and indeed, for all the prints' subsequent associations with New Objectivity, Blossfeldt's work was decidedly subjective, insofar as he was not shy about modifying his subjects or his images to achieve his final vision. Not only did he carefully select, arrange, and in some cases physically modify his specimens, but his meticulous attention to detail and image refinement continued throughout each step of production, beginning with his negatives. Firsthand examination of 110 of Blossfeldt's glass-plate negatives at the Deutsche Fotothek revealed that the artist readily retouched and carried out chemical intensification (to

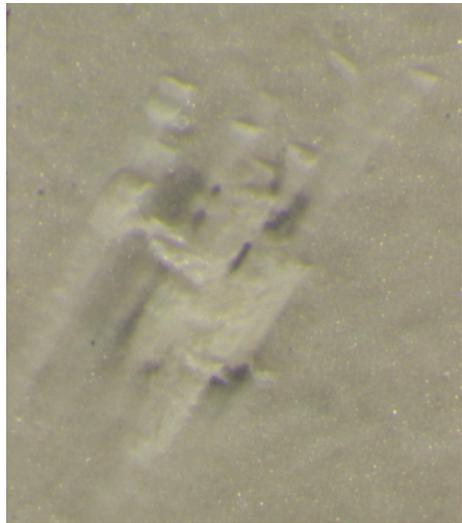
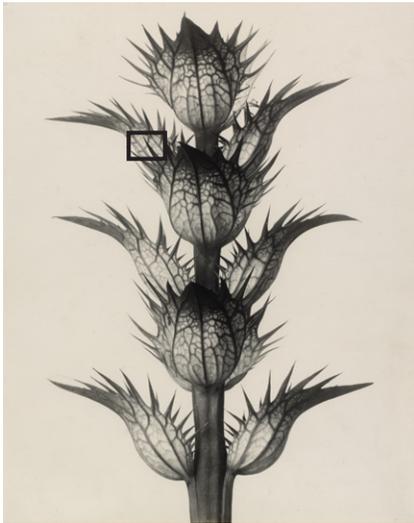
increase image density) and reduction (to reduce density), both overall and locally. These steps allowed him to attain the characteristic uniform image density in his prints, from highlights to deep shadows, without the loss of mid-tone detail. Blossfeldt's impressive skills at retouching were no less instrumental to achieving his desired effect, and he used various materials, including pencil (either soft, dark-colored pencil or graphite) and varying degrees of light- and dark-colored wash applied with a brush.¹⁶ Examination indicated that while Blossfeldt did sometimes reinforce the outlines of the plant forms or, on occasion,

extensively re-form the image, it is on the backgrounds that we see the most evidence of retouching, such as the elimination of white dots or halos that would have marred the finished photographs with black spots. Such painstaking retouch of the negatives ensured a clean background, void of distracting marks, which is essential to the ultimate impact of Blossfeldt's final prints.¹⁷

In the service of his particular vision, it appears that Blossfeldt did not hesitate to retouch his prints as well (figs. 2-6).¹⁸ Although the materials and techniques he used were common at the time, the surface work is



figs. 2, 3 Examples of retouch on Blossfeldt prints in the Walther Collection: *Equisetum hyemale* (MoMA 1627.2001), additive retouch using aqueous medium to delineate plant edges (area of detail is 13 × 19 mm); *Saxifraga wilkommiana* (MoMA 1629.2001), additive retouch using aqueous medium to delineate plant tip and edges (area of detail is 6 × 8 mm). Courtesy Hanako Murata



figs. 4-6 Examples of retouch on Blossfeldt prints in the Walther Collection: *Acanthus mollis* (MoMA 1625.2001), additive retouch using pencil to emphasize detail of vein pattern (area of detail is 13.5 × 18.5 mm); *Chrysanthemum segetum* (MoMA 1629.2001), reductive retouch by etching print surface to reduce unwanted black dots (area of detail is 2 × 1.3 mm); *Passiflora* (MoMA 1631.2001), additive retouch using pencil to hide white shadow of pin made during lateral enlargement (area of detail is 4 × 3.5 mm). Courtesy Hanako Murata

remarkable for its near invisibility to the naked eye. Under magnification, however, a world of image modification and enhancement can be readily observed. The Blossfeldt prints in the Walther Collection, with their matte surface sheen and delicate paper texture, exhibit pencil and wash applications. For comparative purposes, 195 prints were examined at the Universität der Künste Berlin and the Pinakothek der Moderne Munich, and these photographs exhibited the same retouching materials and techniques as the Walther prints, with washes observed in a variety of tones, some of which may be due to color shifts over time. The pencil, on the other hand, perfectly matched the color and texture of Blossfeldt's photographic paper, as is beautifully demonstrated on *Acanthus mollis*. The outlines and tips in many of the plant forms have been enhanced with a fine brushstroke, and additive retouches of lines of color to emphasize and reinforce the forms of the plants and the veins of leaves, stems, or stalks are evident as well. In addition to these additive techniques, Blossfeldt also employed reductive ones, excising minute portions of the emulsion to achieve a light, speck-free background and fine scratch marks to enhance shapes. Such intense workmanship on both his negatives and prints yielded stunning results:

photographs that showcase in dramatic detail often minute botanical forms with clear contours and flawless backgrounds that might serve as inspiration for Blossfeldt's students—and ultimately come to be regarded as artworks in their own right.

During the course of his career, Blossfeldt made more than 1,600 prints, and his ability to attain such an exceptional degree of precision and uniformity relied on many fine, meticulous adjustments as he enlarged his negatives onto photographic paper. Even as he employed but a relative handful of backgrounds, staging methods, and lighting effects in his studio, there were nevertheless many irregularities he had to contend with. For example, he often photographed several plants at a time, which appear in a single negative (fig. 7). While this allowed him to economize, it could also result in different image densities in both the backgrounds and the specimens themselves and a negative with either excessive or insufficient contrast. Yet in Blossfeldt's final prints, the specimens share similar proportions within the paper, the highlights are consistent, and the image density is maximized without loss of mid-tone details.



fig. 7 Karl Blossfeldt. *Acanthus and Scabious*. Before 1928. Thirty-three contact prints of various photographic processes mounted on cardboard, 21 × 25 3/4" (50 × 65.5 cm). Karl Blossfeldt Archiv/Stiftung Ann und Jürgen Wilde, Pinakothek der Moderne, Munich. One of Blossfeldt's so-called working collages—he often photographed multiple plant specimens on one negative, resulting in a variety of image sizes, densities, background tonalities, and contrasts. The contact print of the negative *Acanthus mollis* (MoMA 1625.2001) with white background appears in the second row, fourth from left.

Tantalizing clues regarding Blossfeldt's enlargement process can be found on the verso of many of his prints, including those in the Walther Collection. There, graphite inscriptions often identify the name of the plant specimen as well as magnification and coding that consists of letters and numbers. Each of the Walther prints exhibits inscriptions in Blossfeldt's handwriting, based on comparison to known examples, although some inscriptions are by Blossfeldt collector Jürgen Wilde or another person, as yet unidentified.¹⁹ Blossfeldt used a mix of older German blackletter handwriting as well as *Sütterlinschrift*, a script adopted in Germany in 1915. Such inscriptions are not uncommon: when photographers make multiple prints from the same negative over time, they often record information such as lens, f-stop, distance and positioning between negative and paper, and exposure time in order to replicate their work later. They may even note the type of paper used. Previous studies have remarked upon the degree of variation in the magnification and other coding that Blossfeldt inscribed on prints of the same image, and the photographer's prints in the Walther Collection are no exception.²⁰ It is not known at this time whether this is due to an inconsistency in recording or whether Blossfeldt's code evolved over time. He did make at least one formal comment about his process: in *Das Deutsche Lichtbild* he reported that he enlarged a 9-by-12-cm ($3\frac{9}{16}$ -by- $4\frac{3}{4}$ -inch) negative onto 30-by-40-cm ($11\frac{13}{16}$ -by- $15\frac{3}{4}$ -inch) Lumarto paper manufactured by Leonar-Werke, a gaslight paper most likely comprised of a silver chlorobromide emulsion, as well as onto 30-by-40-cm Bromid, a silver bromide paper by Agfa.²¹ Evidence of Blossfeldt's enlargement process can be seen on his prints as well. All seven prints in the Walther Collection, as well as most of the prints examined by the author in other collections, have pinholes in each of their four corners and occasionally a few pinholes along the sides. Especially visible in prints with dark backgrounds, the shadows of the pins are seen as highlights, which Blossfeldt retouched with dark color. These pinholes signal the use of a lateral enlargement process, in which the paper is mounted vertically opposite the enlarger (fig. 8).²²

The following highlights some of the coded inscriptions seen on the seven Blossfeldt prints in the Walther Collection (figs. 9, 10), which were compared with information from the online database of the UdK Berlin Archive regarding the inscriptions on other Blossfeldt images.²³ Because different codes appear on prints made from the same negative, it does not seem as if Blossfeldt's coding system is related to identification of the negative used or the plant specimen.

- Two numbers with an "f" or "-" in between (e.g., "230f12"): Among photographers in general, an "f" appearing between numbers typically suggests focal length of lens (in millimeters) and f-stop (aperture of lens/opening). However, it is



fig. 8 Advertisement for a Curry Utility Enlarging and Cropping Board, a horizontal enlarger, showing photographic paper affixed with pins. Reproduced in John A. Tennant, *Bromide Printing and Enlarging: A Practical Guide to the Making of Bromide Prints by Contact, and Bromide Enlarging by Daylight and Artificial Light, with the Toning of Bromide Prints and Enlargements* (New York: Tennant and Ward), 1912.



figs. 9, 10 Details of the versos of *Adiantum pedatum* (MoMA 1626.2001) and *Hordeum distichum* (MoMA 1630.2001), showing inscriptions. Courtesy Hanako Murata

also possible that Blossfeldt recorded information about the enlargement process, such as exposure time (most likely in seconds) or the distance (in millimeters or centimeters) between the unexposed paper and the lens, negative, or other point on the enlarger. We know that Blossfeldt used a camera of his own construction; he may also have used a modified enlarger as well, which may have had nonstandard f-stop measurements. Prints of the same image enlarged to similar size do not have the same inscriptions. Further study is necessary to understand Blossfeldt's coding system.

- "abgeschm" or "abg.": *abgeschw* or *abgeschm* translates directly as "attenuated." In the context of Blossfeldt's inscriptions, these likely mean "lighten," "weaken," "reduce," or "make thin." Through a comparison with the online catalogue of the UdK Berlin Archive, ninety-three Blossfeldt prints were found to have this inscription. Tellingly, the word is most often written after the numbers with "f," which strongly indicates that the "f" or "-" inscription refers to the enlarging process.²⁴

- “hy” or “hg”: more research is needed to determine the meaning of these inscriptions. At present, it is not certain that they are written in Blossfeldt’s hand, or whether “hy” or “hg” is an accurate transcription. They may also refer to words in Greek or Latin. The inscription can be found on a hundred prints in the online catalogue of the UdK Berlin Archive, sometimes with *viel* (“much” or “lots”), *unten* (“down”), and *mit* or *Mitt* (“also” or “as well”). The majority are written following numbers, such as “30f12 hy” or “15 hy.”
- “K 75” or “K”: these inscriptions are always written in the second row and separate from other inscriptions. One print with “K” and four with “K 75” can be found in the Walther Collection; the latter all share the same material paper characteristics (see discussion below). In addition, forty-seven prints with “K 75” are found in the online catalogue of the UdK Berlin Archive. Blossfeldt could have used such codes to identify the paper he used. Historically, manufacturers of photographic paper used an alphanumeric system to identify their products. However, each company used its own codes, and product lines changed over time, making it extremely difficult to identify a print’s paper based on such coding unless the date and information about the paper’s manufacturer is also present. For example, the code “K” was used by Berlin-based Neue

Photographische Gesellschaft to denote a “matte, middle heavy, white” gaslight paper, and it was also used by Mimosa of Dresden to identify its Platin-Bromsilver, a glossy, white, heavy-weight, high-contrast paper.²⁵

- “N88”: located on the verso of *Equisetum hyemale*. The handwriting is probably Blossfeldt’s but cannot be definitively confirmed. Rajka Knipper suggests that “N” with a number indicates prints that are part of Blossfeldt’s “working collages,” contact print sheets that Blossfeldt made from his negatives.²⁶ Indeed, eighteen prints coded with “N,” including *Equisetum hyemale*, are all included in Blossfeldt’s working collages (fig. 7).

The format of 719 Blossfeldt prints was compared to that of the seven prints in the Walther Collection. Six of the Walther Collection prints are approximately 24 by 30 centimeters (9 7/16 by 11 13/16 inches), while the last, *Equisetum hyemale*, is an unusual and striking 59.5 by 23.7 centimeters (23 7/16 by 9 5/16 inches). Blossfeldt primarily used three print sizes—12 by 30 centimeters (4 3/4 by 11 13/16 inches), 20 by 30 centimeters (7 7/8 by 11 13/16 inches), and 24 by 30 centimeters (9 7/16 by 11 13/16 inches)—employing the latter two for 75 percent of his known prints. His paper sizes can be mapped against the standard print sizes that were available during

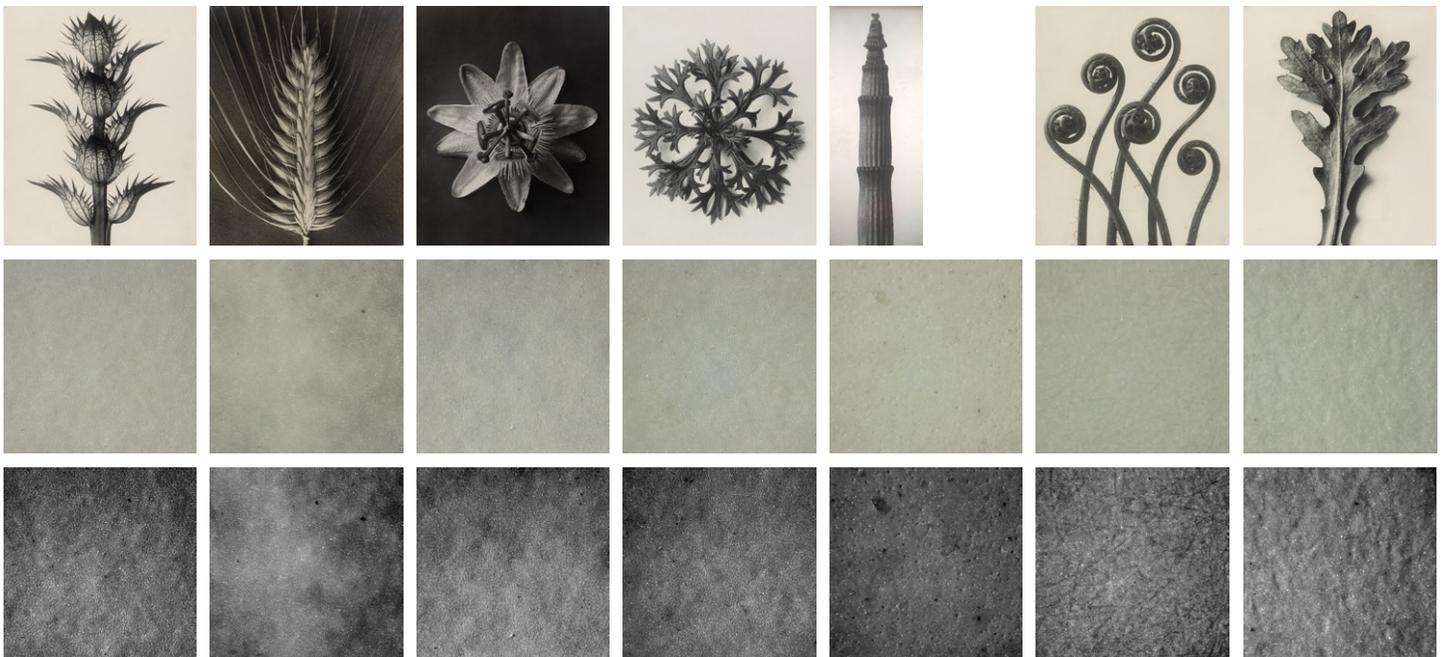


fig. 11 Comparison of surface textures on the rectos of the seven Blossfeldt prints in the Walther Collection. The first row shows the entire recto of the print; the second row shows a magnified color image of a section of the print surface (3 × 3 mm) under raking light; the third row shows the same image in black and white to enhance the texture pattern. Left to right: *Acanthus mollis* (MoMA 1625.2001), *Hordeum distichum* (MoMA 1630.2001), *Passiflora* (MoMA 1631.2001), *Saxifraga wilkommiana* (MoMA 1628.2001), *Equisetum hyemale* (MoMA 1627.2001), *Adiantum pedatum* (MoMA 1626.2001), and *Chrysanthemum segetum* (MoMA 1629.2001). The results are grouped to show similar papers.

IMAGE							
TITLE	<i>Acanthus mollis</i>	<i>Hordeum distichum</i>	<i>Passiflora</i>	<i>Saxifraga wilkommiana</i>	<i>Equisetum hyemale</i>	<i>Adiantum pedatum</i>	<i>Chrysanthemum segetum</i>
MoMA ACCESSION NO.	1625.2001	1630.2001	1631.2001	1628.2001	1627.2001	1626.2001	1629.2001
HARDWOOD BLEACHED SULFITE	-	1	1	1	-	-	2
STRAW	27	27	32	35	39	15	-
RAG (COTTON)	18	17	13	17	14	11	38
BAST	4	3	4	5	6	2	20
SOFTWOOD BLEACHED KRAFT/SODA	-	-	-	-	1	-	-
SOFTWOOD BLEACHED SULFITE	51	52	51	41	41	72	41

fig. 12 Results of fiber-content analysis conducted on the seven Blossfeldt prints in the Walther Collection, giving percentages of fiber type per print.

the 1920s and 1930s.²⁷ In the German market, this primarily included 24 by 30 centimeters and 30 by 40 centimeters (11¹³/₁₆ by 15³/₄ inches), suggesting that for Blossfeldt's smaller print sizes, he used the 30-centimeter length for the longer side and cut the paper to fit the shorter one. It seems the photographer logically chose a full-sized sheet of 24-by-30-centimeter paper for the square- or round-shaped plant specimens he photographed and utilized a half-sized 30-by-40-centimeter sheet for long vertical specimens. The largest size available without resorting to an uncut roll of paper was 60 by 50 centimeters (23⁵/₈ by 19¹¹/₁₆ inches), which likely explains the unusual size of *Equisetum hyemale*: Blossfeldt probably cut this paper approximately in half.

A closer technical examination of the paper Blossfeldt used for the Walther prints serves as an example of the insights that can be discovered regarding a photographer's practice through the systematic gathering and comparison of data from multiple photographs within a collection. The seven prints appear very similar, yet detailed research reveals that Blossfeldt used at least three different photographic papers, a fact that could be of significance in answering key questions about his career, such as helping to narrow the dates of his prints. The very fact that his papers appear almost indistinguishable but are in fact not always the same serves as further evidence of the care he took to ensure remarkable consistency. Five material aspects of the photographic paper used by Blossfeldt were evaluated through technical analysis: image surface sheen,

surface textures (recto and verso), print thickness, paper fiber content, and inorganic composition based on X-ray fluorescence analysis (XRF; again, both recto and verso).

Various and somewhat inconsistent terms were used in the photographic-paper industry to describe surface sheen.²⁸ For the purposes of this study, sheen was classified as glossy, semireflective, and matte. Each of the Blossfeldt prints in the Walther Collection have nearly identical matte surfaces, and at first glance, the subtle surface texture looks almost identical as well. When the prints are examined under a microscope with raking light, however, finely nuanced differences appear in three dimensions. Unique crisscross patterns characteristic of those formed by fibers appear in two prints, *Adiantum pedatum* and *Chrysanthemum segetum*, whereas there is a distinctive pitting (or dots) on the large-scale *Equisetum hyemale* (fig. 11).

The paper thickness of the prints was also evaluated, and six measured between .170 and .179 millimeters (with a margin of error of +/- .003 millimeters).²⁹ These can be grouped as such: a) *Acanthus mollis* (.179 millimeters), *Saxifraga wilkommiana* (.179 millimeters), and *Hordeum distichum* (.178 millimeters); b) *Adiantum pedatum* (.173 millimeters) and *Equisetum hyemale* (.174 millimeters); and c) *Chrysanthemum segetum* (.170 millimeters). Surprisingly, *Passiflora* registered at two different thickness values, making it difficult to compare with the others.³⁰ All seven prints can be categorized as being on single-weight paper. Although Blossfeldt's prints do not feel particularly fragile

when handled, when their paper thickness was compared to 221 prints in the Walther Collection they were among the thinner prints, even among single-weight prints and even as they are some of the larger prints overall. These results were rather unexpected. Double-weight paper for larger prints would be a more natural choice, since the extra weight would give the prints greater physical stability over time (especially if they were intended for classroom use). Neither are the Walther prints mounted on thicker board. Blossfeldt's choice of thinner paper could be due to a number of factors, including the fact that single-weight paper was less expensive than heavier paper, requires less washing and drying time, and was more readily available.

It is the analysis of fiber content that appears to offer the most promise in efforts to more accurately establish dates for Blossfeldt's prints. Prior research has shown that fiber content in photographic paper changed over time as manufacturers adopted new technologies and adjusted their formulas in varied ways to meet supply and demand. Past studies have also revealed that the same manufacturer could use the same or different paper base for different

product lines, as well as for satisfying demand for different handling properties or visual effects.³¹

The general trend, however, was to replace rag (cotton) with wood pulp, a process that appears to have been completed by 1935, with rag disappearing almost entirely. More specific analysis of individual Blossfeldt prints, wherein the fiber content of the photograph's base is considered relative to historical information about the composition of photographic papers, could serve to refine the possible print-date range. For this study, the fiber content and the relative proportions of compositional material were examined for the seven Blossfeldt prints in the Walther Collection (fig. 12).³²

With the exception of *Chrysanthemum segetum*, the six other prints contained between 15 percent and 39 percent straw fiber. Lee Ann Daffner has discussed this development in the paper industry, and, in particular, why straw is characteristic of paper manufactured in Europe, probably Germany, between 1915 and 1932.³³ *Equisetum hyemale* and *Saxifraga wilkommiana* are similar to one another, with more equal amounts of two fibers: softwood-bleached-sulfite pulp and straw. *Acanthus mollis*, *Hordeum distichum*, and *Passiflora*

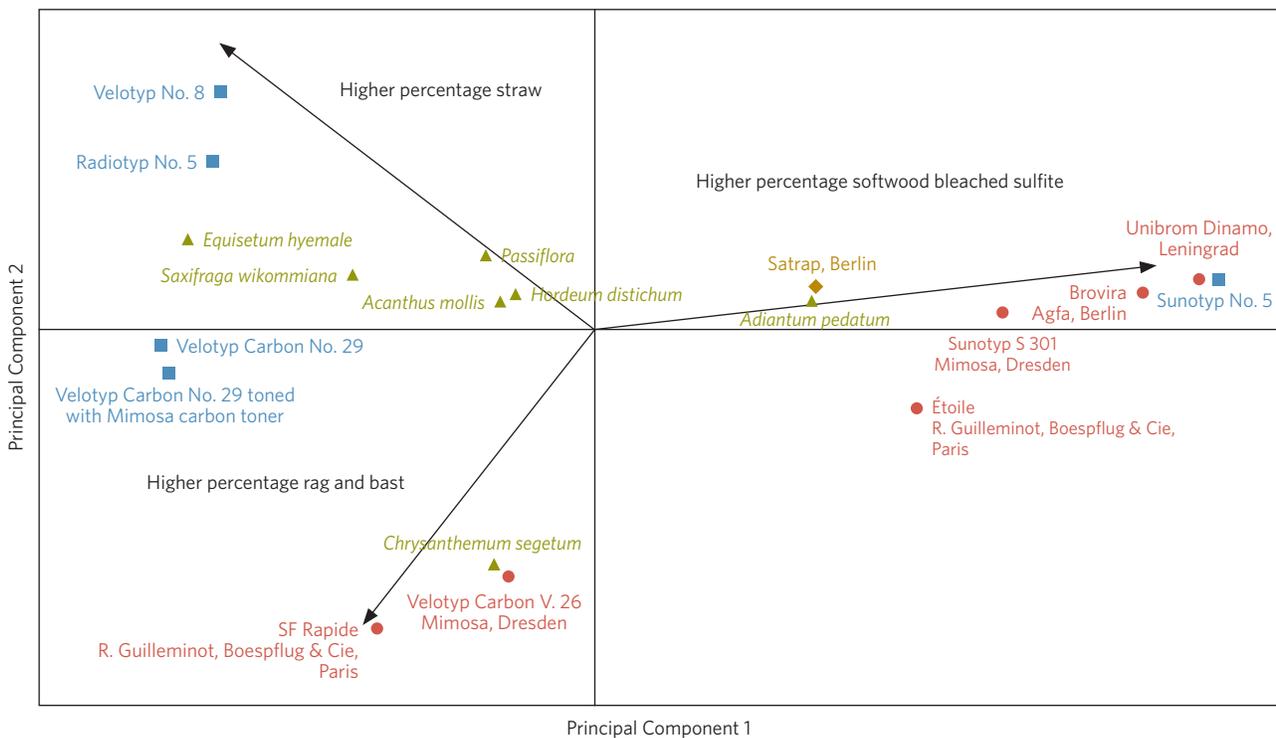


fig. 13 Principal Component Analysis statistical comparison of the results of fiber analysis of the seven Blossfeldt prints in the Walther Collection; one other print by a German-based artist in the Walther Collection (El Lissitzky's *Self-Portrait [The Constructor]*; MoMA 1764.2001); five types of paper manufactured by Mimosa of Dresden, all dated 1922; and six other papers with similar fiber contents analyzed during the project. The graph plots each photographic paper according to its fiber content, with the directions of the arrows indicating an increasing percentage of straw, cotton, or softwood bleached-sulfite fibers. Plotting multiple papers this way can reveal similarities among various papers of both known and indeterminate origin, with similar papers appearing grouped in closer proximity to one another.

- ▲ Walther Blossfeldt prints
- ◆ Walther print on German paper
- Mimosa papers from 1922
- Other paper samples studied

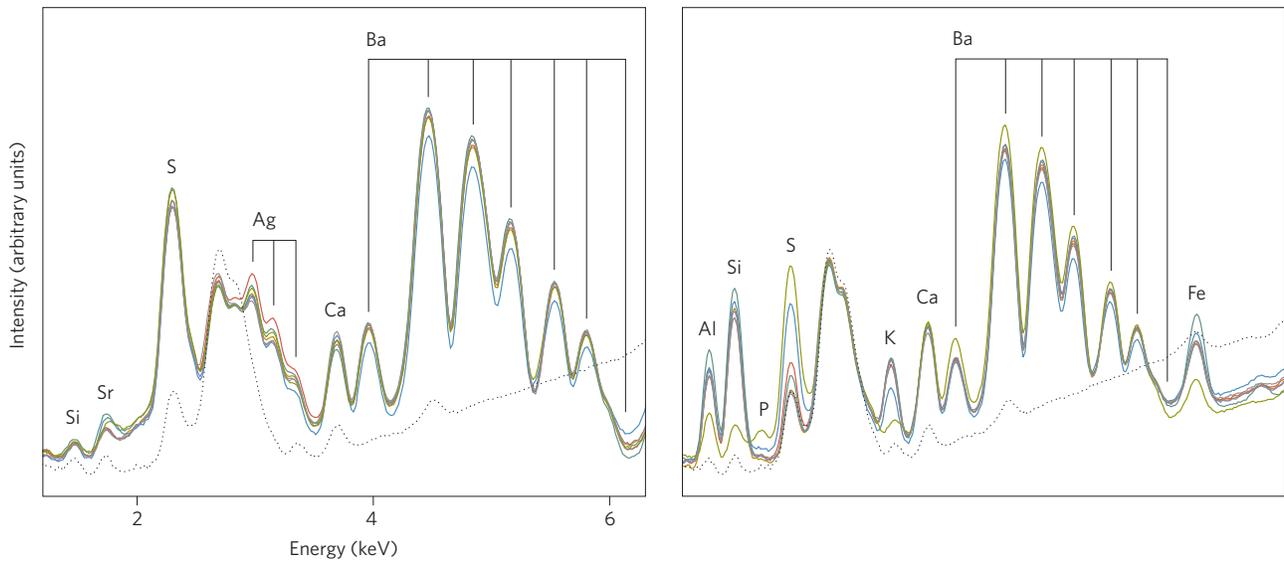


fig. 14 Spectra obtained from X-ray fluorescence analysis of recto (left) and verso (right) of the seven Blossfeldt prints in the Walther Collection, showing relative abundance of the chemical elements aluminum (Al), barium (Ba), calcium (Ca), iron (Fe), phosphorus (P), potassium (K), silicon (Si), silver (Ag), strontium (Sr), and sulfur (S). Courtesy Ana Martins

- *Acanthus mollis*
- *Adiantum pedatum*
- *Equisetum hyemale*
- *Saxifraga wilkommiana*
- *Chrysanthemum segetum*
- *Hordeum distichum*
- *Passiflora*
- Background

IMAGE							
TITLE	Acanthus mollis	Hordeum distichum	Passiflora	Saxifraga wilkommiana	Equisetum hyemale	Adiantum pedatum	Chrysanthemum segetum
MoMA ACCESSION NO.	1625.2001	1630.2001	1631.2001	1628.2001	1627.2001	1626.2001	1629.2001
SURFACE SHEEN							
SURFACE TEXTURE	RECTO						
	VERSO						
THICKNESS			-				
FIBER							
XRF	RECTO						
	VERSO						
OVERALL EVALUATION							

fig. 15 Summary comparison of the results of material analysis of image-surface sheen, surface texture (recto and verso), print thickness, paper fiber content, and inorganic composition based on X-ray fluorescence analysis for the seven Blossfeldt prints in the Walther Collection. Matching colors signify matching results for each characteristic, with an overall match across all characteristics suggesting photographs printed on the same paper. No definitive measurement for print thickness was available for *Passiflora* due to variation in the results obtained.

are also very similar, with corresponding proportions of softwood bleached sulfite pulp, straw, and white rag. These two groups have a fiber composition indicative of a manufacture date between 1920 and 1932. The very high softwood-bleached-sulfite content and relatively low proportion of straw and cotton in *Adiantum pedatum* suggests a date between 1924 and 1932. Distinct from the other six prints, *Chrysanthemum segetum* has a much higher rag and bast content, but no straw, indicating that it was made between 1915 and 1932.

The fiber content of these prints was also charted in comparison with other prints in the Walther Collection, as well as with other material studied during the Walther research project (fig. 13). The results hint at the vast potential to identify photographic papers through fiber analysis, and thus aid in more accurately establishing print dates. For example, the paper used for *Equisetum hyemale* shows close similarity with the Radiotyp, Velotyp, and Velotyp Carbon brands manufactured by Mimosa.³⁴ *Chrysanthemum segetum* data overlap with Velotyp Carbon as well, while data for *Adiantum pedatum* is similar to that of a photograph by El Lissitzky printed on Satrap, a German paper. Collecting data on paper samples of known origin or date in more reference collections and comparing it to the fiber analysis of specific prints will increase this precision.

In addition, XRF analysis was conducted on the prints in order to evaluate the inorganic elements of each layer of the photographic paper (emulsion with suspended image material, baryta, and paper base).³⁵ The system of analysis developed at The Museum of Modern Art examines elements from both the recto and verso of the print, as this has been shown to yield specific data on each layer (fig. 14). The analysis confirmed that the prints each have a baryta layer, based on the presence of barium, sulfur, and

strontium. Both *Chrysanthemum segetum* and *Adiantum pedatum* appear distinct. The spectrum from the recto of the latter shows less barium and sulfur but a stronger strontium peak. With the exception of *Chrysanthemum*, all six other prints show high contents of aluminum, silicon, potassium, and iron, which is probably indicative of the presence of organic filler in the paper. *Chrysanthemum* indicates practically no silicon, potassium, or iron but does contain aluminum and phosphorus. A summary comparison of the seven prints based on the five material paper characteristics examined is presented in figure 15.

What does such a thorough examination of a photographer's material choices add to our knowledge about a body of work? In this case we uncover details that enhance our understanding and further heighten our esteem for works that have come to be regarded as among the finest examples of early-twentieth-century photography. That Blossfeldt was a systematic and meticulous photographer can be readily observed by even the most casual review of his work, yet it is not until we look more closely that we can fully appreciate the extraordinary precision he brought to every stage of the photographic process. Blossfeldt's remarkable images may appear simple, reflective in a way of the often small, humble plant forms they depict. But if the photographer brought these forms to a grander scale in the service of making visible what many of his students might otherwise overlook, he also produced stunning images whose elegant simplicity nevertheless was the product of painstaking effort. The analysis undertaken here reminds us of the material essence of Blossfeldt's images, that even those photographs produced from the same negative are each unique, and that each is an individually conceived, expertly crafted, and masterfully executed material *object*—that is to say, an object of art.

NOTES

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Fotothek at the Staats- und Universitätsbibliothek Dresden (SLUB).

1. The institute merged with Berlin's Hochschule für die Bildenden Künste in 1924, and together they would ultimately become the Universität der Künste Berlin. Rajka Knipper, "Die Sammlung Karl Blossfeldt in der Universität der Künste Berlin: Lehrmittel für den Kunstgewerblichen Unterricht" (Cologne: SK Stiftung Kultur, Die Photographische Sammlung, 2009), p. 2.

2. Karl Blossfeldt, "Aus der Werkstatt der Nature" (June/July 1929), quoted in Jürgen Wilde, "Karl Blossfeldt: A Photographer's Life," in *Karl Blossfeldt: Photography* (Ostfildern: Cantz, 1998), pp. 5–6, 10 n.1.

3. This was not the first time Blossfeldt worked to use photography to such purpose. In the early 1890s in Italy, he served as an assistant to the artist and teacher Moritz Meurer, using specially designed magnifying glasses to photograph plant specimens for use as teaching material. Claudia Schubert,

Karl Blossfeldt—Studienzeit und Lehrtätigkeit: Quellen und Nachweise aus dem Archiv der Universität Berlin (Cologne: SK Stiftung, Die Photographische Sammlung, 2009), pp. 3, 5–6. Meurer also credited Blossfeldt as the photographer in his two publications: *Die Ursprungsformen des Griechischen Akanthusornaments und ihre Natürlichen Vorbilder* (Berlin: Druck und Verlag von Georg Reimer, 1896); and *Vergleichende Formenlehre des Ornamentes und der Pflanze* (Dresden: Verlag von Gerhard Kühtmann, 1909). Knipper, "Die Sammlung Karl Blossfeldt," p. 9.

4. Blossfeldt, quoted in Wilde, "Karl Blossfeldt: A Photographer's Life," pp. 6, 10 n.1.
5. In a letter of 1906, Blossfeldt wrote that his photographs were the product of "considerable material sacrifice," suggesting that he purchased the glass-plate negatives at his own expense. It would not be until 1907 that, according to archival records, Blossfeldt would receive fees for "the management and maintenance of the preserved and prepared botanical and photographic materials provided for the Institute by Blossfeldt." Schubert, "Karl Blossfeldt," p. 9.
6. Blossfeldt noted that he used a "self-built camera" in technical information he submitted to *Das Deutsche Lichtbild* (Berlin: Robert & Bruno Schultz, 1930), section DDL20, n.p.
7. Paul Wedepohl, introduction to *Karl Blossfeldt 1865-1932, Pflanzenfotografien* (Berlin: Galerie Taube, 1984), n.p.
8. Blossfeldt, letter of 1906, quoted in Schubert, "Karl Blossfeldt," pp. 8-9, 27-28.
9. The invoice shows the university paid 600 marks total, or 20 marks per print. *Ibid.*, p. 11. It is interesting to note that these prints are the same size as six of the prints in the Walther Collection.
10. Wilde, "Karl Blossfeldt: A Photographer's Life," p. 8, and Schubert, "Karl Blossfeldt," p. 11.
11. Installation images of *Film und Foto*, which were studied by Olivier Lugon, show that Blossfeldt's prints were exhibited at both venues. See Lugon, "Photography and Exhibition in Germany around 1930," in Mitra Abbaspour, Lee Ann Daffner, and Maria Morris Hambourg, eds., *Object:Photo. Modern Photographs: The Thomas Walther Collection 1909-1949* (New York: The Museum of Modern Art, 2014), pp. 366-75. Four prints by Blossfeldt are also listed in the catalogue for the Vienna venue of the exhibition in 1930. Lugon, e-mail correspondence with the author, June 10, 2014.
12. Wilde, "Karl Blossfeldt: A Photographer's Life," p. 9.
13. In addition to the seven prints in the Walther Collection, this research also included comparative study conducted between 2011 and 2013 of a number of Blossfeldt's negatives and prints in the collections of the Deutsche Fotothek; the Universität der Künste Berlin; The Metropolitan Museum of Art, New York; the Museum of Fine Arts, Houston; and the Sprengel Museum, Hannover, as well as prints and Blossfeldt's "working collages" accessible at the time in the Ann and Jürgen Wilde Collection at the Pinakothek der Moderne, Munich. A broader survey of both print and negative size as well as inscriptions was conducted using data gathered from each institution above and the online databases of the Universität der Künste Berlin (hereafter "UdK Berlin Archive"), www.photographie-sk-kultur.de/karl-blossfeldt/werke/, and the Blossfeldt collection of the Deutsche Fotothek, www.deutschefotothek.de/.
14. A total of six photographs by Blossfeldt were published in the annual *Das Deutsche Lichtbild* along with their respective technical and material information: 1930 (plates 6, 7, and section DDL20, n.p.); 1931 (plates 134, 135, and section DDL29, n.p.); 1933 (plate 153 and section DDL27, T73); and 1935 (plate 38 and section DDL22, T41). The technical entries record that Blossfeldt used the Aplanat lens for all six images, with an exposure time of eight minutes for one of the images published in 1931 and twelve minutes for the other, as well as twelve minutes for the images published in 1933 and 1935. Blossfeldt also recorded that he used three brands of glass-plate negatives from two manufacturers: "Flavin" plates made by J. Hauff & Co. and "Braunschicht" and "Braunsiegel" plates made by Satrap.
15. Metric measurements will be given first in discussions of paper and negative size, where metric was the original unit of measurement. Elsewhere, imperial measurements will be given first, followed by their metric equivalents in parentheses.
16. The exact retouch medium used remains unidentified, even after technical analysis. The current assessment is based on visual examination through stereomicroscope. The colorant of the wash is likely composed of finely divided pigments or dyes, such as those used in watercolors.
17. These negatives, which were in the possession of Frederick Löchner, Blossfeldt's nephew-in-law, were used by Leipzig-based publisher Fotokinoverlag for the 1990 book *Karl Blossfeldt: Fotografien zwischen Natur und Kunst*, by Andreas Hüneke and Gerhard Ihrke, after which they passed into the collection of the Deutsche Fotothek. Through T. O. Immish, curator of the collection of photographs at Stiftung Moritzburg Halle in Saale, Ihrke recalls that Fotokinoverlag did not perform any retouching on the negatives prior to publishing the book. Immish, e-mail correspondence with the author, April 25, 2013.
18. While the retouching may have been the work of someone else, its distinctive and consistent manner suggests the work of one individual, most likely Blossfeldt himself. For example, when the use of pencil was compared on both Blossfeldt's negatives and prints, the technique was strikingly similar. The material barely grazed the surface, resulting in a slightly granular distribution of the colorant.
19. As part of their significant photography collection, Jürgen Wilde and his wife, Ann, built the largest collection of Blossfeldt prints, negatives, and other related materials, which is now housed at Munich's Pinakothek der Moderne. I would like to thank Dr. Inka Graeve-Ingelmann for her critical assistance in distinguishing between the handwriting of Blossfeldt and Jürgen Wilde, as well as Rajka Knipper, research associate and registrar of Die Photographische Sammlung/SK Stiftung Kultur der Sparkasse KölnBonn, August Sander Archiv, for answering my questions on Blossfeldt's inscriptions.
20. Knipper, "Die Sammlung Karl Blossfeldt," pp. 5-6, 11.
21. *Das Deutsche Lichtbild*, 1930, plates 6, 7, and section DDL20, n.p.; 1931, plate 135 and section DDL29, n.p.; 1933, plate 153 and section DDL27, T73.
22. Despite Blossfeldt's own stated intention that he was making his photographs for classroom instruction, there is speculation as to just how many prints he actually displayed in the classroom. Although some do show surface dirt, many of his prints are in excellent condition, which does not suggest repeated handling and display, and while some prints exhibit multiple pinholes, implying a number of pinnings, many show but a single set of holes from when the photographic paper was mounted as part of the original enlargement process.
23. For additional insights on Blossfeldt's inscriptions, see Knipper, "Die Sammlung Karl Blossfeldt," p. 18; and Graeve-Ingelmann, "Karl Blossfeldt: eine Einführung," in *Patrimonia* 354 (2012):22-23.
24. Knipper suggests that *abgeschn* may be interpreted as *abgeschnitten*, or "trimmed." Knipper, "Die Sammlung Karl Blossfeldt," p. 18.

25. Neue Photographische Gesellschaft, A.G., leaflet and brochure for Lenta-Gaslichtpapier, n.d., "Photographic Paper Samples, Tech Sheets" box, Fritz Wentzel Collection, Richard and Ronay Menschel Library, George Eastman House International Museum of Photography and Film, Rochester, N.Y.
26. Knipper, "Die Sammlung Karl Blossfeldt," p. 11. There are sixty-one known working collages, gray cardboard sheets that contain more than a thousand contact prints made from Blossfeldt's negatives. See Ann and Jürgen Wilde, eds., *Karl Blossfeldt: Working Collages* (Cambridge, Mass.: MIT Press, 2001); and also figure 7 of this essay.
27. Standard photographic paper formats available at the time were determined based on contemporary price lists from major German paper manufacturers. Mimoso, A.G., "Preisliste" no. 286 (January 1925), p. 2; and Satrap, "Brutto und Netto preise aus der Satrap Fachfotografen Leste [F./5. 1925]," Technology Collection, Richard and Ronay Menschel Library, George Eastman House International Museum of Photography and Film, Rochester, N.Y.
28. For example, semireflective sheen is often described as "semi-matte" or "luster." For a more thorough discussion, see Paul Messier, "Image Isn't Everything: Revealing Affinities across Collections through the Language of the Photographic Print," on this website.
29. Metric measurements will be given in discussions of precise scientific data, where metric is the scientific standard.
30. The bottom edge of *Passiflora* is thicker than the top, and there is no flat surface over the measurable area due to the four curling edges, with the result that the print's thickness measured .178 millimeters and .192 millimeters.
31. These studies were conducted internally by the Department of Conservation of The Museum of Modern Art between 2006 and 2014. For further discussion see A. Martins, L. Daffner, A. Fenech, C. McGlinchey, and M. Strlič, "Non-Destructive Dating of Fiber-Based Gelatin Silver Prints Using Near-Infrared Spectroscopy and Multivariate Analysis," *Analytical & Bioanalytical Chemistry* 402, no. 4 (2012):1459-69; Lee Ann Daffner and Messier, "Abstract: New Applications for Paper Fiber Analysis in Characterizing Gelatin Silver Prints," in *Topics in Photographic Preservation 13* (Washington, D.C.: AIC/PMG, 2009), pp. 83-85; and Kit Funderburk, *A Guide to the Surface Characteristics, Kodak Fiber-Based Black and White Papers*, 2nd ed. (Rochester, N.Y.: Eastman Kodak Company, 2009), p. 42.
32. Fiber analysis for The Museum of Modern Art was conducted by Walter Rantenan of Integrated Paper Services in Appleton, Wisc., between 2010 and 2013. The forensic method employed was TAPPI Test Method T 401 om-03 "Fiber Analysis of Paper and Paperboard." The species percentage determination is an internal method of IPS. According to the report, the samples that show only cotton and bast fiber are potentially the earliest, from 1900 to 1935. The mixes that show cotton, bast, and chemical wood pulp typically range from 1915 to the early 1930s. The samples with virtually all sulfite pulp typically range from 1929 to the 1970s. According to Messier, "In the mid-1920s, paper manufacturers were transitioning away from papers containing a high percentage of rag fiber (cotton and flax/bast) in favor of increasing amounts of wood pulp. Papers from the later 1920s show significantly less rag fiber. The transition to wood pulp and away from rag fiber was more or less complete by the mid-1930s, at which point most photographic paper was made exclusively with wood pulp." Messier, "A Technical Analysis of Le Violon d'Ingres," in *The Long Arm of Coincidence: Selections from the Rosalind and Melvin Jacobs Collection* (Göttingen: Steidl, and New York: Pace/MacGill Gallery, 2009), n.p.
33. See Daffner, "Dive: A Materialist History of the Photographic Industry in Germany and the Soviet Union between the Wars," in Abbaspour, Daffner, Hambourg, *Object:Photo*, pp. 51-69. The year 1932 in the date range for all seven prints reflects the year of Blossfeldt's death, in consideration of the fact that the prints also exhibit Blossfeldt's known handwriting.
34. Georg Heinrich Emmerich, *Mimosa Handbuch: ein Führer durch die Gesamt-Fabrikation der Mimosa*, A.-G. Dresden-A. 21 (Dresden: Mimosa, A.G., 1922).
35. XRF analysis and the data examination were performed at The Museum of Modern Art by Ana Martins, conservation associate research scientist, with Marc Vermeulen and James Newhouse, conservation science interns, during three separate sessions between 2011 and 2013. The papers all have very similar thicknesses and thus no correction of the XRF was attempted. Spectra were collected at 40 kV and 20 µA for 300 seconds for each spot using a Bruker Tracer III-SD0 handheld XRF instrument with a Rhodium excitation source, silicon drift detector, and helium purge. Spectra from the recto were acquired in non-contact mode. Spectra from the verso were acquired in contact with the print. For analysis, the print was placed on a sheet of Plexiglas lined with Japanese paper, MMN-1 Tengucho 5g/m² of Hiromi Paper Company; this support was used as the background spectrum.

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