



The Platinum Print Technology of the Austrian Pictorialist Heinrich Kühn

Andreas Gruber

In more than fifty years of artistic production, Heinrich Kühn (1866–1944) consciously used materials and techniques to portray the pictorial details of his photographs while imparting a certain softness to his images and exquisite surfaces to his prints. Nonsilver processes, especially prints made in gum dichromate and oil pigment transfer, fulfilled many of Kühn's aesthetic demands for his paper positives, but he experimented with platinum printing for about two decades of his career as a photographer, modifying the process to suit his creative requirements. In the early 1890s he used platinum, and then, after years of printing exclusively in gum dichromate, in 1902 he saw platinum prints by the American Pictorialists and Photo-Secessionists at an international exhibition in Germany. These inspired Kühn to return to platinum printing.

Kühn's writings on platinum printing, including his correspondence, laboratory journals, articles, and books, along with examinations of his photographs, provide extraordinarily detailed information about his materials and working methods. This essay provides an overview of the periods in Kühn's career during which he made platinum prints, the key recipes and paper supports he used, and descriptions of his methods for preparing his papers for printing. Finally, Kühn's work is discussed within the context of the platinum printing practices, products, and materials available in the German-speaking countries in the first decade of the twentieth century.

Kühn's Platinum Prints

Visual examination alone makes it clear that Heinrich Kühn experimented extensively with various materials and methods. His prints' image hues span the spectrum from neutral gray-black to reddish-brown; his papers vary from heavyweight stocks to very thin tissues, and highly textured to smooth; and the surface sheen of his photographs ranges from matte to glossy. Close observation with a microscope reveals that, in many cases, the paper fibers on the recto differ from those on the verso, indicating that Kühn laminated different types of papers to each other. Some papers have distinct coatings that make the print semitranslucent or completely alter the color of the substrate. Some platinum prints do not have the characteristics commonly associated with platinum photographs; rather, they bear a closer resemblance to carbon or gum dichromate prints, a process Kühn used in conjunction with platinum to expand his aesthetic possibilities. It is only by examination with x-ray fluorescence spectroscopy (XRF) that the presence of platinum is revealed. These observations correlate with Kühn's published papers as well as with entries in his laboratory journals.

Kühn printed in a variety of formats, ranging from approximately 10 × 15 cm to 35 × 40 cm. The most common image sizes from 1904–7 range from 25 × 30 cm to 35 × 40 cm. His later platinum prints tend to be smaller (18 × 24 cm to no larger than 25 × 30 cm). Kühn used paper or glass-plate negatives to contact-print his photographs, including the larger prints that he made from enlarged negatives. He used the platinum process for landscapes, genre, nudes, still life, and intimate portraits of his family, as well as portraiture work (fig. 1).

Figure 1. Heinrich Kühn, *Edward Steichen*, 1907. Platinum print with mercury on Japanese tissue paper sized with chrome-alum gelatin, 28.5 × 22.5 cm. Stiftung Bonartes Vaduz/Vienna.



Figure 2. Giuseppe Pizzighelli, *View of a Square with a Church*, 1887. Platinum print, 12.6 × 7.9 cm. Albertina, Permanent Loan of the Höhere Graphische Bundes-Lehr- und Versuchsanstalt, Vienna. This print is from a series of first samples of Pizzighelli's printing-out process.

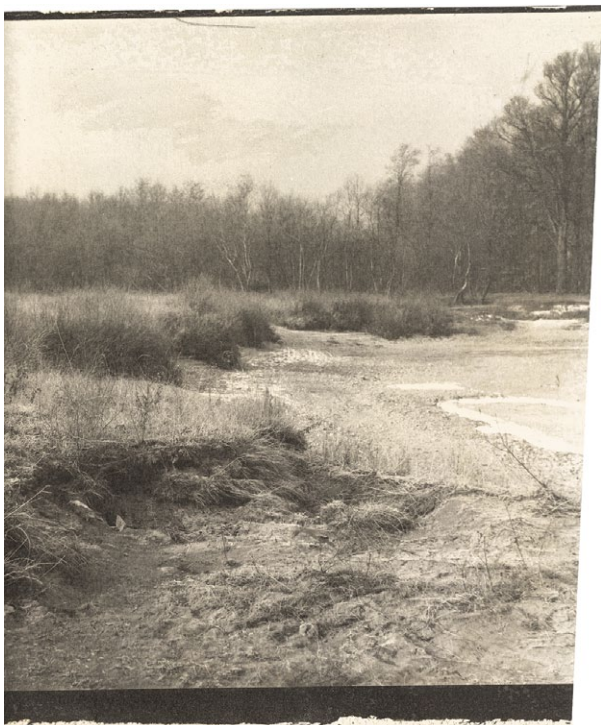


Figure 3. Heinrich Kühn, *Landscape, Innsbruck*, December 1894. Platinum print on textured paper, 19.8 × 15.3 cm. Stiftung Bonartes Vaduz/Vienna.

Kühn's Periods of Platinum Printing

Kühn produced platinum prints from the early 1890s until around 1914. Within this time frame he used and experimented with platinum printing during two distinct periods: 1890–96 and 1904–13.

Kühn's Platinum Prints, 1890–1896

In the early 1890s Kühn undertook a two-month photography expedition through Dalmatia and Herzegovina, then part of the Austrian monarchy. In Ragusa (now Dubrovnik) he met with the inventor of the platinum print-out process, the Austrian army officer Giuseppe Pizzighelli (1849–1912),¹ who most certainly taught Kühn how to make platinum prints using this method (fig. 2).² During this trip Kühn almost exclusively captured landscapes as his subject matter, most of which featured mountain views. Only a very few images had figurative elements.

Kühn exhibited his photographs for the first time in 1894. Little is known about his printing methods from this period, but Kühn's prints were described in an exhibition catalog as "self-prepared platinum-papers."³ In an 1895 exhibition he presented prints made in carbon, platinum, and palladium.⁴ The prints from this period were frequently made on a highly textured, heavy paper stock with both warm and cold image tones (fig. 3). Some of the platinum prints even resemble pigment prints with a slight surface sheen, printed on papers with strong surface sizings.

Kühn discontinued platinum printing in the latter half of 1896, possibly due to the influence of his artist friends Hugo Henneberg and Hans Watzek. In September 1896 Watzek wrote to Kühn, "I was very pleased to hear you gave up the platinum process."⁵ A review of a photograph exhibition of the Vienna Camera Club that opened in late 1896 states that "Henneberg, Watzek and Kühn put aside iron, platinum and palladium salts to surrender entirely to gum Arabic, dichromates and, most significantly, to watercolor pigments. Color!"⁶

Kühn's Platinum Prints, 1904–1913

The platinum prints by American Photo-Secessionists at 1903 international exhibitions in Hamburg and Wiesbaden made a deep impression on Kühn.⁷ Most of all he admired the work and techniques of Edward Steichen (1879–1973) and Gertrude Käsebier (1852–1934). In 1905 Kühn co-organized an international photography exhibition in Vienna, inviting Alfred Stieglitz (1864–1946) to select the American entries. Stieglitz, with whom Kühn corresponded for more than thirty years,⁸ visited him in 1904 and 1907 in Tyrol. In 1905 Kühn wrote to Stieglitz, "Your visit

has accelerated a certain shift in my thinking. The photographs of the Photo Secession showed me that these wonderfully delicate tonal gradations could be achieved in photography. And since then, many of my gum dichromate prints strike me as raw.” After almost ten years of printing in gum, Kühn returned to platinum printing with Stieglitz having “personally hypnotized” him.⁹

Kühn used the platinum process almost continuously from 1904 until the end of 1913. However, his laboratory journal entries record intervals during this time in which he became obsessed with other processes, experimenting with the Autochrome, gum gravure, and the oil-transfer process. By the middle of 1913, the essential platinum salts were no longer readily available and became prohibitively expensive, so Kühn gradually shifted to oil-transfer printing, which would become his process of choice until the end of his life in 1944.

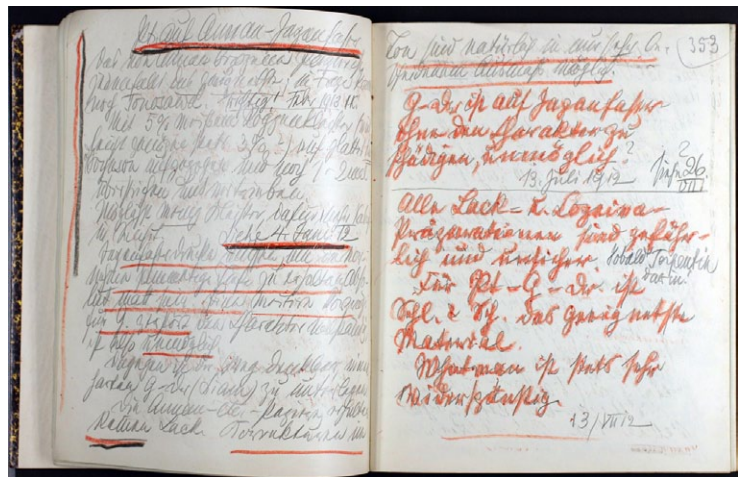


Figure 4. Heinrich Kühn, laboratory journal, July 13, 1912, 352–53. Private collection. In these pages Kühn refers to platinum printing on Annan Japanese tissue paper, gum dichromate printing on Japanese tissue paper, copaiba coatings, and gum dichromate over platinum printing.

Kühn's Writings on Platinum Printing

Scientifically trained through his study of medicine, Kühn recorded his trials and experiments in laboratory notebooks as no other photographer of the time is known

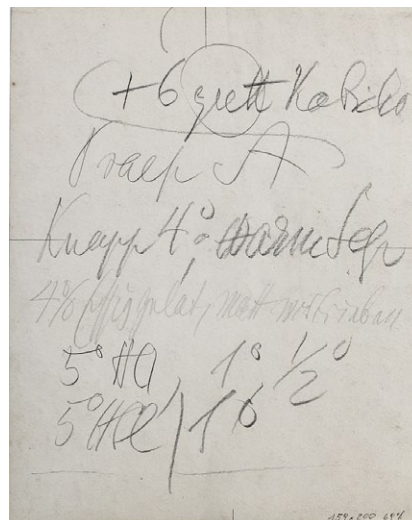
to have done. These notebooks, the earliest of which dates from 1899, provide detailed information on Kühn's materials, processes, and working methods and tell a comprehensive story about how he mastered the platinum process.¹⁰ The entries reveal his enthusiasm and endurance as well as some setbacks and failures. They are sometimes difficult to decipher, as Kühn revised many notations, added comments in later years, and underscored some remarks or crossed them out completely (fig. 4).

Another important source of information regarding Kühn's working methods is the inscriptions found on the verso of many of his prints, where he carefully noted in abbreviations the sizings, chemicals, and/or exposure times he used. The abbreviations can be interpreted with the aid of the laboratory journals (fig. 5).

Kühn's publications also provide a wealth of information about his work. In 1917–19 Kühn shared his experiences of almost two decades of platinum printing, among other



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5a

Figure 5. Heinrich Kühn, *Walther at the Door*, October 1911. Gum dichromate over platinum print with mercury, printed on Japanese tissue paper that was pasted onto a secondary heavy paper support, 28.9 × 23 cm. Private collection.

5a. Verso, showing registration marks in pencil for multiple printing and pencil notes that refer to the production of the image:

- “+6 gutt KaBichr”: addition of six drops potassium dichromate to the developer
- “Praep A”: Preparation A, a term used in the journals referring to the paper preparation before printing, meaning pasting Japanese tissue paper to the secondary paper support with a 2% gelatin and 1.5% arrowroot paste
- “Knapp 4°”: barely 4° exposure of the platinum print; ° is the unit of his exposure meter
- “Warm Sep”: Jacoby Sepia Developer
- “4% Essiggelat, matt vertrieben”: a coating of 4% vinegar gelatin on the finished platinum print as preparation for the superimposed gum prints, buffed matte
- “5° HCl, 1°, ½°, 5° HCl, 1°”: 5 exposure units for five layers of gum on top of the platinum print, two of which involved HCl (hydrochloric acid) in the development

335 Andreas Gruber, “The Platinum Print Technology of the Austrian Pictorialist Heinrich Kühn,” in *Platinum and Palladium Photographs: Technical History, Connoisseurship, and Preservation*, ed. Constance McCabe (Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 2017), 332–347.



Figure 6. Title page of Heinrich Kühn, *Technik der Lichtbildnererei* (Halle a. d. Saale: Wilhelm Knapp, 1921).

processes, in a series of articles entitled “Einführung in die Technik der bildmäßigen Photographie” (Introduction to the Technique of Pictorial Photography).¹¹ These essays were reissued in 1921 as a book entitled *Technik der Lichtbildnererei* (Photographic Techniques) (fig. 6).¹² Kühn did not give detailed recipes for platinum printing but instead referred to the methods and writings of Baron Arthur von Hübl (1853–1932).¹³ This retrospective summary provides insight regarding Kühn’s approaches to the study of tonal values. Notably, he also stressed that he could no longer recommend the practice of platinum printing due to the enormous costs of time and money and the health risks posed by poisonous ingredients such as oxalates and mercury.

Kühn’s Platinum Technology

Kühn technology involved commercial and noncommercial platinum papers of various surface qualities, printed with printing-out and developing-out processes, very frequently with additional chemistry both to influence the image color and to improve the printing process.

Prämiirt: Fabrik photographischer Papiere Prämiirt:
WIEN, WIEN,
PARIS, PARIS,
MELBOURNE. MELBOURNE.
Dr. E. A. JUST

WIEN, Fünfhaus, Märzstrasse Nr. 33,
empfiehlt ihre genau nach Angabe der Herren Hauptmann
Pizzighelli und Oberleutenant Baron Hübl angefertigten
Papiere für Platinotypie.

	Dimension in Ctm. nur gelatinirt sensibilisirt		
Röder	Papiersorte „glatt“ 49×65	per Buch fl. 2.— fl. 12.—	
	per 1/4	n n —.60 n 3.50	
	„rauh“ 49×65	per n n 2.— n 13.—	
	per 1/4	n n —.60 n 3.70	
Rives	„glatt“ 46×58	per n n 2.50 n 12.—	
	per 1/4	n n —.70 n 3.50	

Bei grösserer Abnahme Rabatt nach Uebereinkunft.

Figure 7. Dr. E. A. Just, Vienna, advertisement for platinum papers, offering Röder and Rives papers sensitized with Pizzighelli and Hübl’s recipes or custom sensitized to order. From Arthur Freiherr von Hübl and Giuseppe Pizzighelli, *Die Platinotypie* (Halle a. d. Saale: Wilhelm Knapp, 1882), 88.

Commercial Platinum Papers Available in Austria and Germany

Commercial platinum papers were readily available in Austria and Germany in the mid-1880s. William Willis Jr.’s (1841–1923) Platinotype Company papers were sold by every major photographic material supplier.¹⁴ Ilford’s Platona, another British paper for cold development, was available from 1899.¹⁵ In addition to these English products, a large selection of German and Austrian platinum papers were also marketed.¹⁶ Unlike Willis, Pizzighelli and Hübl did not require a license to use their recipes, so their process became particularly popular. Various companies began to produce and sell their own “Pizzighelli platinum papers.” The earliest Austrian papers were produced beginning in 1882 by Dr. E. A. Just of Vienna (fig. 7). These were sensitized on Röder and Rives paper stock using Hübl’s and Pizzighelli’s recipes.¹⁷ The Viennese photographic supply house Eisenschiml & Wachtl provided detailed instructions for Hübl and Pizzighelli’s hot-development paper in its circa 1885 catalog. The catalog also offered papers presized with gelatin, arrowroot, and *algein* (sodium alginate) to be sensitized by the photographer, as well as ready-to-print sensitized papers, chemicals, and metal containers with calcium chloride desiccant packets for the storage of sensitized paper.¹⁸ In 1887 the Bernhard Wachtl Company in Vienna, sold the same products and specified Röder and Rives papers for use as substrates for platinum prints.¹⁹ In July 1895 Wachtl sold materials for both the 1882 and 1887 Pizzighelli processes, a ready-sensitized cold-bath platinum paper, and an iron-sensitized paper for the “platinum-in-the-developer” method.²⁰ By October 1895 Wachtl’s catalog offered the “most recent” English platinum papers for hot and cold development, Pizzighelli’s Direktes Kopierpapier” (contact printing-out paper), and a printing-out Korn Papier (grained paper).²¹ In 1897 Wachtl also marketed Berlin-based Dr. Krebs’²² palladium paper and platinum toner for palladium papers

Dr. Krebs’ Palladium-Papier
weiss — (matt) — weiss.
Vollständiger Ersatz für Platin-Papier.
Viel leichter und einfacher zu behandeln als Platinpapier. Gleichmässige Copien
Einfache Tönung.
Prachtvolle Weiss- und tiefschwarze Ton der Bilder.

Centimeter	6×9	7×10	9×12	10×13	10×15	12×16	13×18	18×24
per Packet 24 Blatt fl.	—55	—66	—90	1.20	1.32	1.56	2.22	3.78
per Bogen Centimeter	50×62		40×50					
fl.	—90		—66					

Gebrauchsanweisung Neuheits-Berichte Januar-April 1896, Seite 50.137.

Dr. Krebs’ concentrirtes Platinonbad.
Für Aluminium- und Palladium-Papier.

Figure 8. Dr. Krebs advertisement for palladium paper and platinum toner for palladium paper. From Bernhard Wachtl, *Photographische Neuheits-Berichte* 6 (April–July 1897): 204.

as novelties (fig. 8), as well as sensitized fabrics (muslin, linen, satin, and silk) for platinum printing.²³

Drs. Adolf Hesekei and Richard Jacoby in Berlin produced and sold Pizzighelli's printing-out paper in 1888.²⁴ From April 1890 Hesekei and Jacoby operated separate businesses, at which time Hesekei marketed products including his proprietary Hesekei's Silver-Platinum Paper, a printing-out paper that offered rich black and bluish-black tones but was substantially cheaper than platinum paper (fig. 9). Advertisements in 1891 mentioned that Hesekei produced platinum papers sensitized on Whatman paper stock.²⁵ Dr. Richard Jacoby's company, which existed from 1890 until about 1930,²⁶ offered Jacoby's Platinum Paper no. 1 in 1891, which contained palladium salts as additives to produce brown image tones,²⁷ and from January 1897 also sold postcards that were sensitized partially or overall with platinum.²⁸ Jacoby offered printing-out platinum



Figure 9. Dr. Adolf Hesekei advertisement for “Silber-Platinpapier.” From *Photographische Correspondenz* 27, no. 361 (October 1890): n.p.

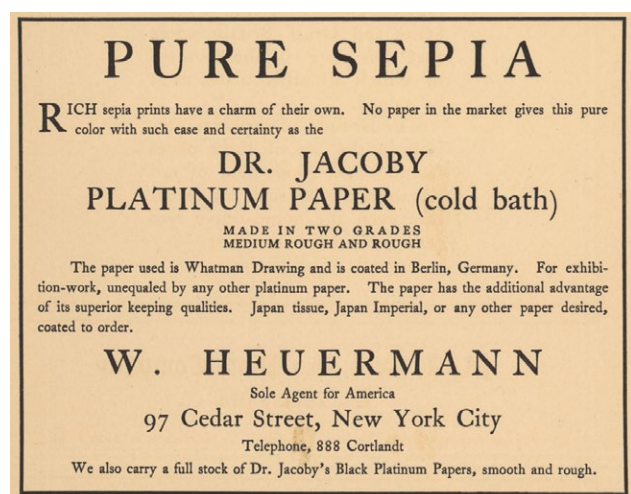


Figure 10. W. Heuermann advertisement for “Dr. Jacoby Platinum Paper” on Whatman or Japanese paper stocks, “or any other paper desired.” From *Camera Work: A Photographic Quarterly* 13 (January 1906): 61.



Figure 11. Sigmund Bondy, Vienna, advertisement for platinum enlargements using papers by Wilh. & M. L. Winter. From *Photographische Correspondenz* 30, no. 389 (February 1893): n.p.

papers, developing-out platinum papers, and a palladium paper that he marketed in 1918.²⁹ More than fifteen different paper types were used to produce these products, including Rives, Whatman, and Gustav Schaeuffelen's Pyramidenkornpapier (pyramid-textured paper). Richard Jacoby's products were also advertised in *Camera Work* (fig. 10) and other American journals by the New York photographic supplies importer W. Heuermann as the sole agent for Jacoby papers in the United States, offering sepia papers for cold development without mercury,³⁰ both sepia- and black-tone papers with superior keeping properties, and custom sensitization of Japanese and other papers.

Additional producers and dealers included Andreas Lurz & Company of Vienna and Franzensbad in 1902,³¹ HELIOS Company in Berlin,³² Unger & Hoffmann Company in Dresden,³³ and the Romain Talbot Company in Berlin, which sold a Pizzighelli platinum paper for hot development and a “New!” Willis platinum-in-the-developer paper in 1889.³⁴ All these papers were made for contact printing. A few photography studios and retailers also offered to print enlarged platinum prints as a special service, including Türkel & Steiner in Vienna, which used and sold platinum enlargement papers made by Josef Kosak in Temesvár.³⁵ Sigmund Bondy in Vienna (fig. 11) and Franz Kühn in Berlin offered platinum enlargements using papers produced by Wilh. & M. L. Winter in Vienna.³⁶

Kühn's Use of Commercial Platinum Papers

Kühn's journals demonstrate that he was in frequent contact with Dr. Richard Jacoby, who became Kühn's key supplier of presized papers for use with platinum and sensitized platinum papers. Jacoby offered custom-sensitized paper stocks from suppliers such as Whatman and Rives

337 Andreas Gruber, “The Platinum Print Technology of the Austrian Pictorialist Heinrich Kühn,” in *Platinum and Palladium Photographs: Technical History, Connoisseurship, and Preservation*, ed. Constance McCabe (Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 2017), 332–347.



Figure 12. Heinrich Kühn, *Descent*, c. 1912. Cold-developed platinum print with mercury on Japanese tissue paper coated with arrowroot, 16.2 × 20.1 cm. Stiftung Bonartes Vaduz/Vienna.

and specialized in sensitized Japanese papers of various thicknesses that Kühn found highly attractive.

In general, Kühn was not fond of commercial platinum papers because they were “not made according to the photographer’s needs; rather, the photographic negatives had to be manipulated by means of intensification and/or localized development to suit the given platinum papers.”³⁷ Moreover, it displeased him that commercial papers had to be kept in metal containers with a calcium chloride desiccant due to the paper’s very short shelf life. Regarding a February–March 1905 exhibition, he noted in his journal that “Jacoby’s Imperial Japanese Sepia papers print rather contrasty and the brown tone achieved was not homogeneous. On the white walls of Gallery Miethke my prints looked rather soiled.”³⁸ These issues may have triggered Kühn to once again sensitize his own platinum papers after a 1904–5 interlude of experimenting with commercial papers.

Kühn’s Self-Prepared Platinum Papers

The advantage of sensitizing his own papers was obvious to Kühn: it gave him full freedom to choose the raw paper stock from smooth, lightweight tissue papers to rough-textured extra-heavyweight watercolor papers. His journals and surviving paper samples demonstrate that Kühn used papers from Zanders, Rives, Whatman, Dambri-court Frères, Van Gelder, Joynson, and, most frequently, the German Schleicher & Schüll Company, which was known for its high-quality paper raw stock used for by photographic paper manufacturers.³⁹

Kühn discovered that the biggest obstacle in the choice of suitable papers for platinum printing was the presence of gelatin “animal glue” sizing. At the time, the gelatin that was used to size watercolor papers was not as highly

Figure 13. Heinrich Kühn’s unused specimens of coated papers for gum dichromate over platinum printing. Private collection.

13a. Japanese tissue paper coated with a matte lacquer for negatives of unknown composition (recto) and vinegar-gelatin (verso).

13b. Japanese tissue paper coated with mastic gum.

13c. Annan Japanese tissue paper coated with dammar gum.

13d. Japanese tissue paper coated with copaiba balsam.

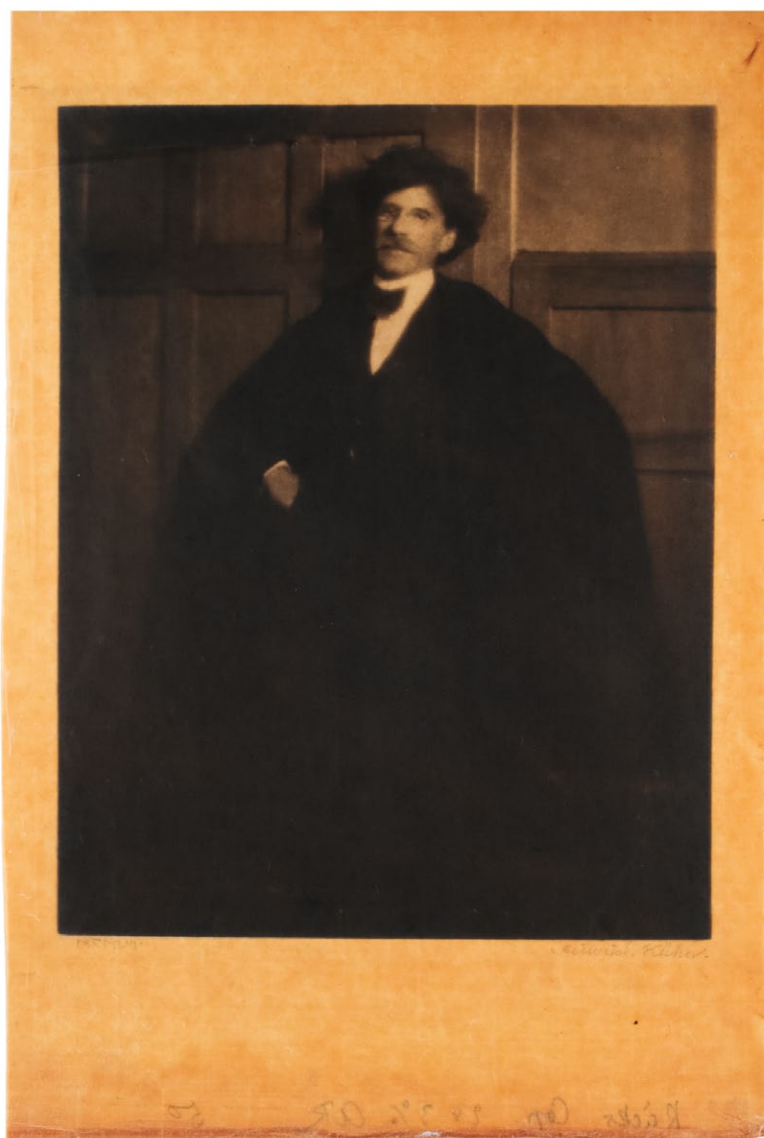


338 Andreas Gruber, “The Platinum Print Technology of the Austrian Pictorialist Heinrich Kühn,” in *Platinum and Palladium Photographs: Technical History, Connoisseurship, and Preservation*, ed. Constance McCabe (Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 2017), 332–347.

Figure 14. Heinrich Kühn, *Alfred Stieglitz*, 1907. Platinum print with mercury on Japanese tissue paper pasted on heavier paper support, 28.8 × 22.7 cm. National Gallery of Art, Gift in memory of Harry H. Lunn Jr. from his friends and family, 1999.76.1. This is an example of a platinum print on paper impregnated with a natural resin consistent with copaiba balsam.

purified as that required for gelatin silver emulsions. He found that “platinum prints could not be obtained on gelatin-sized watercolor papers with standard methods” but that “with hot development and the addition of mercury salts to the developer these papers worked without problem.”⁴⁰ Kühn was able to use the available gelatin-sized papers, frequently by adding a superficial sizing made from arrowroot, rye flower, or wheat starch. The most effective way of surface sizing was by dipping the papers in a hot, dilute starch solution. According to Kühn, the gelatin-sized papers of the Schleicher & Schüll Company worked flawlessly with this additional sizing.⁴¹ Kühn also noticed that the different vegetable coatings had effects on the final platinum print: arrowroot-sized papers created a more light-sensitive platinum paper than one sized with rye starch, which produced warmer image tones.⁴²

After a very short period of using tracing paper,⁴³ Kühn began in March 1905 to experiment with Japanese tissue papers of various thicknesses.⁴⁴ He favored the stunning matte surface and transparency of Japanese tissue papers, especially in the works he had seen from Gertrude Käsebier, and soon began experimenting with them when he returned to platinum printing (fig. 12). According to surviving receipts and correspondence, his key suppliers for Japanese tissue papers were H. Saenger in Hamburg, the largest importer of Japanese tissue papers in Germany, and Craig Annan in Glasgow. Kühn observed that the thin Japanese papers allowed the image to form throughout the whole mat of fibers rather than resting on the uppermost surface of the paper, and that when white Japanese papers were used, unequalled depths of the shadow areas could be achieved. The thin, absorbent papers were not easy to



manipulate and abraded easily, so he sometimes placed them on glass plates to facilitate the sensitization process. They also absorbed large amounts of the expensive sensitizing solution, sometimes resulting in weak images with dull or fogged highlights. “Large amounts of oxidizing agents, such as potassium dichromate,” Kühn wrote in his journal, “have to be added to the sensitizer in order to achieve strong images and bright highlights.”⁴⁵ To inhibit the sensitizing solutions from penetrating all the way into the tissue papers, he very frequently precoated the papers with resins and varnishes, such as copaiba balsam, mastic, dammar, commercial negative lacquers, and mixtures of these coating materials (figs. 13, 14).⁴⁶ However, Kühn recognized that the appeal of thin Japanese tissue papers lay in their transparent softness and completely matte surface, and these qualities were lost once coated with lacquer or when laminated to an additional support.⁴⁷

Kühn's Paper Sensitizing and Development

Of the three major platinum processes—hot- and cold-developing-out processes (fig. 15), platinum-in-the-developer processes, and printing-out processes—Kühn mainly used the hot- and cold-developing methods and printing-out processes.

Kühn's Use of Developing-Out Papers

Kühn wrote that:

Hot and cold development processes shared very similar chemical composition, preparation steps, and working procedures, the only difference being the developer was at room temperature for the cold-bath process, and in the case of the hot-bath process the developer was quite warm or even boiling hot. . . . The temperature of the developer, however, resulted in a tremendous difference in the final prints: cold-developed prints tended to have cool or neutral color nuances, and produced contrasty images with little highlight information and compressed middle tones and shadow details. . . . The hot-developed image distinguished itself with a long and soft tonal range, and warm image tones. However, the development action took place rapidly and was therefore difficult to control, but from a technical point of view it was the easiest process to carry out.

According to Kühn, "The platinum-in-the-developer method was the least popular of the commonly used platinum processes."⁴⁸

It had a brief commercial life due to its expense and the short shelf life of the developer.⁴⁹

A recipe used frequently by Kühn around 1905 serves well to illustrate the complexity of the chemistry involved:

sensitizer

- 9 ml lead-iron solution (Hübl)
- 6 ml potassium chloroplatinite solution
- 2 ml water
- 8 drops of potassium dichromate 1%

developer (30°C)

- 100 ml potassium oxalate
- 500 ml water
- with the addition of 10 ml zinc oxalate
- or 25 ml zinc sulfate.⁵⁰

Kühn frequently used Jacoby's Sepia Developer, a proprietary product used primarily for the cold-development method. Jacoby's Sepia Developer recipes with and without mercury can be found in Kühn's journals.⁵¹

Kühn modified his recipes as needed, depending on which paper substrate he used. For example, if the image was too high in contrast, the developer's temperature was raised; if too low, he recommended boosting the contrast by adding potassium dichromate to the developer (1–2 drops of a 1% solution).⁵² The prints were fixed in hydrochloric acid and finally rinsed in water.



15a



15b

Figure 15. Photographer unknown, *Visionary Female Figure*, n.d.

15a. Platinum print, hot developed, 13.3 × 9.3 cm. Albertina, permanent Loan of the Höhere Graphische Bundes-Lehr- und Versuchsanstalt, Vienna.

15b. Platinum print, cold developed, 13.3 × 9.3 cm. Albertina, Permanent Loan of the Höhere Graphische Bundes-Lehr- und Versuchsanstalt, Vienna.

Kühn's Use of Printing-Out Papers

Pizzighelli's printing-out process, introduced in 1887, combines the developer with the sensitizer.⁵³ The difficulty with printing-out papers was they needed to be slightly damp to allow for the reduction of platinum image metal. When the slightly dampened sensitized paper was exposed to light through a negative, the image appeared without the need for chemical development. The papers could be humidified before use by putting them into a printing frame that was stored in a dampening chamber. If the image did not completely print out, the print could be intensified or "developed" by exposure to hot water vapor. Kühn wrote, "The contact-copy frame should be stored in a damp environment. Additions of small amounts of mercury salts to the sensitizer boosted the print-out process. The image tones were influenced only slightly by adding mercury, but the particle formation process occurred much faster."⁵⁴ Kühn also stressed that printing out had to be performed in high-noon sun.⁵⁵ A printing-out formula after Hans Watzek is found in an entry for May 1910 in Kühn's laboratory journal:

sensitizing

- 6 ml potassium ferrioxalate
- 4 ml potassium chloroplatinite
- 1 ml mercury citrate.⁵⁶

According to Kühn, the image would form instantaneously in a hot vapor stream. Like the developed-out prints, the printed-out prints were cleared in a hydrochloric acid bath and washed in water.⁵⁷

Kühn's Use of Additional Chemicals

Kühn's writings about the printing-out platinum process indicate that to achieve an acceptable image "metal salts, such as lead, palladium, or mercury, had to be introduced, otherwise the platinum reduction took a long time and the image appeared grainy."⁵⁸ Indeed, XRF examination of Kühn's platinum prints very frequently reveal that in addition to platinum and iron, metals including mercury, lead, and/or zinc are often found.

Mercury served as a key element in Kühn's formulas for his platinum sensitizers and developers. Nearly all his platinum prints that have been examined with XRF in museums worldwide exhibit the presence of mercury, including both warm- and cold-toned images (fig. 16).⁵⁹ Kühn added "corrosive sublimate" (mercury(II) chloride) or mercury citrate to speed the printing-out process, to allow printing on gelatin-sized papers, and to achieve brown or warm image tones. In July 1912 he noted in his journal that his increasing sensitivity to mercury caused severe

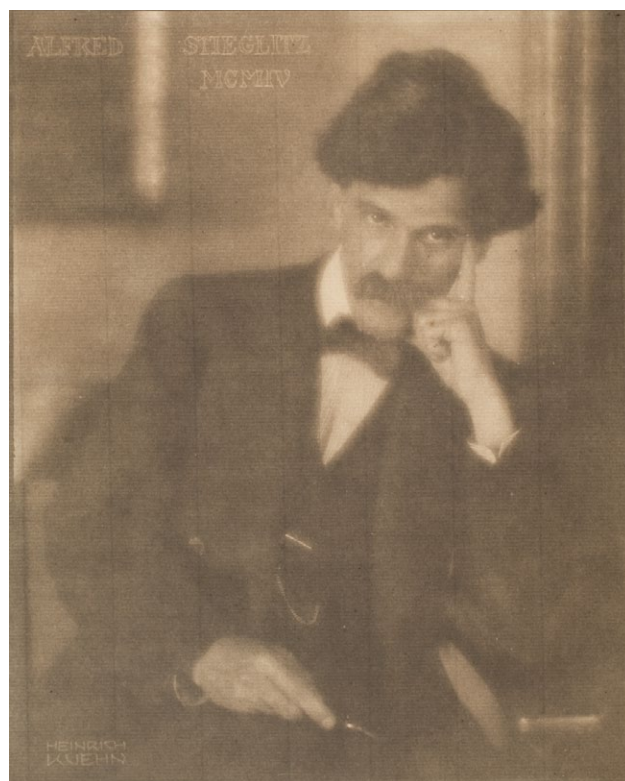


Figure 16. Heinrich Kühn, *Alfred Stieglitz*, 1904. Platinum print with mercury, image 25.4 × 2.2 cm. George Eastman Museum. XRF analysis detected platinum, mercury, and lead.

respiratory problems, preventing him from any further use of sublimate or similar mercury solutions: "I will give up mercury, at least in the sensitizer."⁶⁰ Apparently he deduced that the mercury compounds in the developer were evaporating less than they did in the sensitizer. After a period of mercury-free experiments, however, he came to realize that mercury citrate in the sensitizer was essential when using gelatin-sized printing-out papers.⁶¹

In 1896 Kühn described a recipe in which he partially or completely replaced the platinum salts in Watzek's recipe with palladium salts to achieve brown image tones.⁶² Years later he began experimenting with palladium again. In April 1910 he added palladium salts to the sensitizer.⁶³ However, he found in June 1912 that "palladium is altogether useless, soft character, bluish tones, very uncertain handling."⁶⁴ Still he kept utilizing palladium but only in addition to platinum, especially in 1913.

At the end of November 1904 Kühn described experiments with a copper developer, described by Jacoby for reddish-brown image tones, that incorporated copper oxalate or copper vitriol (copper(II) sulfate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)).⁶⁵

Further additions included oxidizing agents such as potassium dichromate, which was added to the sensitizing solution to enhance contrast and to achieve dense images



Figure 17. Heinrich Kühn, *Mary Warner with Black Hat*, c. 1910. Double-tone platinum print with warm midtones and neutral shadows, 22.9 × 17 cm. Museum Folkwang, Essen.



Figure 18. Heinrich Kühn, *Hofgarten im Herbst*, 1906. Reddish-brown platinum print with mercury, 16.5 × 29.3 cm. Stiftung Bonartes Vaduz/Vienna.

with clear highlights. Glycerine was sometimes added to the developer in substantial amounts as a retarding agent when developing at relatively low temperatures, but Kühn abandoned the practice because he found it caused the final image to become too high in contrast.⁶⁶

The Image Hues of Kühn's Platinum Prints

Kühn's prints are found in a large range of image hues, from neutral black (see fig. 12) to "double tones" (neutral black shadows and yellow-brown midtones) (fig. 17), from sepia to fox red (fig. 18). In general, Kühn preferred prints with warm black hues, free of double tones, and did not favor bluish-cold tone prints or prints with fox-red tones. In an 1896 paper entitled, "Brown Platinum Prints" he summarized ways to achieve a permanent brown image, which he described at that time as the preferred tone for platinum prints that claimed artistic value:⁶⁷ brown tones could be achieved by means of hot development, vapor development of dry printed-out images, or complete print out of humidified paper while in the printing frame. Kühn stated that in all circumstances, however, additives such as salts of mercury were needed to produce brown tones or the platinum sensitizer must be partially or completely replaced with a palladium sensitizer (potassium tetrachloropalladate(II)). Hot development of papers containing mercury in the

sensitizer gave the most reliable brown tones. "Tones can be pushed to a yellow-red, if the mercury chloride in the preparation-solution as well as in the 80°C hot developer is used in higher amounts."⁶⁸

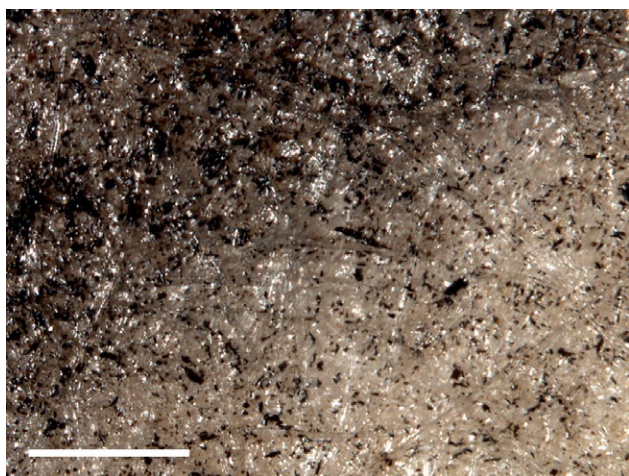


Figure 19. Heinrich Kühn, *Nude (Mary)*, 1908. Sepia tone gum dichromate over platinum print on vellum paper, image 29.8 × 23.7 cm. Stiftung Bonartes Vaduz/Vienna.

Figure 20. Heinrich Kühn, *Walther Kühn*, 1911. Gum dichromate over platinum print, sheet 29.7 × 23.7 cm. National Gallery of Art, Horace W. Goldsmith Foundation through Robert and Joyce Menschel, 2000.19.1.



20a. Photomacrograph detail showing pigment clusters from the gum dichromate print on top of the platinum-soaked paper fibers. Scale bar = 0.25 mm.



20a

The paper's sizing also influenced both image formation and color. Kühn used rough-textured watercolor papers without removing the gelatin sizing but added another coating of arrowroot starch size to produce warm final image tones without adding mercury. These were similar in appearance to printed-out images achieved by steam development.

Gum over Platinum Printing

The gum-over-platinum combination process was frequently and masterfully used by Kühn (figs. 19–21; see also fig. 5). By 1905 Kühn discovered that, despite the rich tonality of the platinum print, the process did not meet his aesthetic demands: "Platinum printing alone is not sufficient for me, it does not completely conform to my character," he wrote to Stieglitz.⁶⁹ Kühn believed that platinum prints could be displayed successfully only when shown on walls in brightly lit rooms without the distraction of nearby furniture and wallpaper. The frequent practice of trying to visually enhance the prints by mounting them on colored papers was not a satisfactory one for him.⁷⁰ The

problem with platinum prints for Kühn was the excess of midtones and lack of deep blacks. To achieve this aesthetic goal Kühn found that a corrective gum print was needed to compress platinum's wide midtone range and give strength and contrast to the print.

According to Kühn, this technique was most likely introduced by Würthle and Spinnhirn in Salzburg.⁷¹ The process for making platinum-gum dichromate combination prints began with a completely processed platinum print. The finished platinum print was coated with a 5% solution of gelatin with chrome-alum to provide the proper surface sizing for the gum printing. When dry, it was then coated with a pigmented gum Arabic solution, to which potassium dichromate had been added. Once dry, the print was once again light sensitive. The gum print was made with pigments that consisted of ground charcoal, ivory black, and sometimes traces of brown or gold ocher.⁷² A negative was placed in perfect register with the existing platinum image and exposed to light. The exposed print was "developed" with water, applied as a stream or by brushing, to remove the unhardened gum. According to Kühn, the platinum base print should be thin and weak in contrast. He applied a pigment-rich gum solution over the platinum print using thin coatings to enrich only the shadow areas while leaving the lower densities and midtones of the platinum image intact (see fig. 20).⁷³ Usually one layer was applied, but prints with up to five layers of gum on a platinum print can be found (see fig. 5).

Kühn achieved his first successful results with gum over platinum combination printing in November 1905,⁷⁴ and in 1907 he started to experiment with gum over platinum on Japanese tissue paper (see fig. 21).⁷⁵ Kühn found that when using this combination process proper registration



Figure 21. Heinrich Kühn, *The Kühn Children*, c. 1907. Gum dichromate over platinum print on heavyweight Japanese tissue paper coated with copaiba balsam, with creases, 29.8 × 39.7 cm. Private collection.



Figure 22. Detail of an unused Japanese tissue paper pasted on a secondary paper support prepared by Heinrich Kühn. Private collection. Kühn usually trimmed the borders of finished prints, so the different paper layers are not easy to detect.

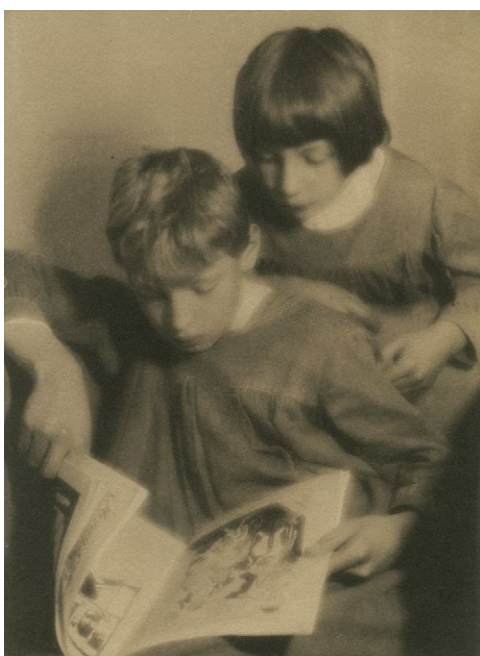
of the negative between printings was a challenge and that “while platinum sometimes required a vegetable sizing, gum printing required a strong gelatin sizing.”⁷⁶ The papers used for gum-over-platinum needed to be dimensionally stable prior to printing, so Kühn devised many different ways and materials to achieve this. His methods included dipping the papers several times in boiling hot starch size solutions, followed by rapid drying between the baths. The starch coating needed to be very thin; otherwise the platinum image, along with the starch coating, would float off the surface during processing.⁷⁷ Describing another method to create expansion-free supports in April 1910, Kühn tried combining Japanese

tissue paper with a heavier paper stock made by Schleicher & Schüll.⁷⁸ In one method he bonded the papers together with a 3% arrowroot paste, pressed them together with a squeegee, and coated them again on both the recto and verso with the same paste (fig. 22). Another example of combining two papers to achieve dimensional stability of the support dates from May 12, 1912, in which thin Whatman paper, sized with copaiba and dammar, was pasted onto a smooth Schleicher & Schüll paper with a combination of a 5% vinegar-gelatin and a 2% arrowroot paste (see also fig. 5 for slightly different proportions).⁷⁹ On June 4, 1912, he even devised a Japanese paper that could be stripped off a heavy support paper after processing in a warm water bath.⁸⁰

Preservation of Kühn’s Platinum Prints

Kühn’s aesthetic preferences may have changed over time and included a wide variety of image colors. In some cases, however, it is also possible that the appearance of his prints may have changed over the last one hundred years (fig. 23). Many of Kühn’s platinum prints exhibit significant yellowing, creases, and brittleness of the paper supports, a condition most frequently observed in those printed on Japanese tissue papers, in combination with gum, and with resin coatings (see fig. 21).

Kühn mentioned that the extra coating of sizing would soften substantially during processing,⁸¹ which increased the risk of damaging the image particles that were weakly bound to the uppermost paper fibers of such prints. Superficial arrowroot or rye starch sizes and pigmented gum layers might swell considerably upon any humidifi-



23a



23b

Figure 23. Heinrich Kühn, *Hans and Walther*, c. 1910.

23a. Platinum print with mercury on vellum paper, 24.1 × 18.2 cm. Private collection. This print might have undergone a color change in the mid-tones from neutral to a yellowish brown over time. According to the inscription on the verso, the paper support is Schleicher & Schüll, with no additional coating, cold-developed in Jacoby’s sublimate (mercury(II) chloride) developer.

23b. Platinum print on vellum paper, 24 × 18.2 cm. Private collection. According to the inscription on the verso, the developer contained zinc sulfate.

cation or wet treatment, and the surface might be prone to abrasion. Therefore, conservation treatments must be approached with caution.

Pure metallic platinum particles will remain unaffected by oxidation. While some platinum prints are in better condition than gelatin silver prints, the permanence of platinum prints produced with mercury compounds in the sensitizing or developing solutions has always been in doubt.⁸² Mercury, alone or in combination with certain support papers, where components may not have been compatible with platinum, could pose preservation problems.

Indeed, Kühn expressed concerns about the permanence of his platinum prints, but his passion for the aesthetic qualities of his photographs cannot be doubted. In 1923 he wrote to Stieglitz, saying, “By the way, [gelatin] silver prints disintegrate after a couple of years, same as platinum-mercury prints.”⁸³ In a 1928 letter to Stieglitz, Kühn stated, “Of all my platinum prints, only the black prints kept well. In my sepia copies the highlight details are not as delicate as they used to be. I am sure one reason is the raw paper stock, which is of too poor a quality. But the raw material of the development papers is appalling as well. Sometimes it all seems like a waste of time, since only few people can see the images as they were intended to be, and posterity will not get a clear concept of them anymore.”⁸⁴

Acknowledgments

I would like to thank Stiftung Bonartes Vaduz/Vienna for its financial support, especially Monika Faber, head of the Photoinstitut Bonartes in Vienna, for her permanent interest and encouragement. Furthermore, I thank all my colleagues from the various museums with Kühn holdings worldwide who supported this research by providing me with easy access to their collections and sharing their knowledge.

Notes

1. Hübl and Pizzighelli 1882; Pizzighelli 1887, 409–13; Pizzighelli 1892, 42–49.
2. Mahler 2010, 226.
3. Amateur Photographen Verein 1894. Kühn's entries were 154, *Ortler Tirol*; 155, *Trafoier Gletscher, Tirol*; 156, *Aus dem Kaiserthal, Tirol*; and 157, *Genrebild “Lesender Alter,”* all described as “Auf selbst präpariertem Platinpapier.”
4. Gesellschaft zu Förderung der Amateur Photographie 1895. Kühn's entries were 432, *Sommer*; 433, *Meraner Bauer (Kohleindruck)*; 434, *Obst Stilleben*; and 435, *Diana*.
5. Hans Watzek to Heinrich Kühn, September 14, 1896, private collection: “Es freute mich sehr, dass Sie das Platinverfahren aufgegeben haben.”

6. Buschbeck 1897, 34. The Vienna Camera Club's *Ausstellung künstlerischer Photographien* exhibited color gum dichromate prints: first series, [December?] 1896–January 1897; second series, February 1–mid-February 1897.

7. Heinrich Kühn, laboratory journal, November 1903, 64, Albertina, Vienna. More information on Kühn's relations with the U.S. Secessionists can be found Faber 2012. The international exhibitions were 10th International Annual Exhibition of Art-Photography in the Kunsthalle Hamburg, September 26–October 26, 1903, organized by the Gesellschaft zur Förderung der Amateurphotographie in Hamburg, and the First International Exhibition for Artistic Portraiture Photography in the Ceremonial Hall of the City Hall Wiesbaden, April–May 26, 1903.

8. Heinrich Kühn's correspondence (in German) is in the Alfred Stieglitz/Georgia O'Keeffe Archive, Yale Collection of American Literature, Beinecke Rare Book and Manuscript Library, New Haven, Conn.

9. Heinrich Kühn to Alfred Stieglitz, October 11, 1905, Alfred Stieglitz/Georgia O'Keeffe Archive.

10. Kühn's laboratory journals for 1900–1912 are in the Albertina; journals for 1912–13 are in a private collection.

11. Kühn 1917–19. The articles in this series pertaining to platinum printing were published in 1919.

12. Kühn 1921.

13. Hübl 1902.

14. See Romain Talbot, Berlin, product list including Willis platinum paper for cold development, *Photographische Rundschau* 2, no. 12 (1888): vii; Benque & Kindermann, Hamburg, advertisement in Gesellschaft zur Förderung der Amateur Photographie, *7th Internationale Ausstellung von Kunst Photographien, 1899*, exh. cat. (Hamburg: Verlagsanstalt und Druckerei A.-G. [vormals J. F. Richter], 1899), n.p.; R. Lechner advertisement as Photographischer Manufaktur, *Photographische Correspondenz* 27, no. 353 (February 1890), n.p.; Langer 1910, 210–13; A. Moll, Vienna, advertisement for Platinotype Company papers for hot and cold development, *Photographische Correspondenz* 32, no. 417 (June 1895): n.p. This listing and similar lists in this essay may not be complete as I had access mainly to the photographic periodicals *Photographische Correspondenz* and *Photographische Rundschau* and to available catalogs of photographic materials suppliers.

15. Eder and Valenta 1900, 541.

16. A. Moll, Vienna, advertisement for “Pizzighelli's Platinpapier,” *Photographische Rundschau* 2, no. 5 (1888): ix, and *Photographische Rundschau* 3, no. 13 (1889): i; Charles Scolik, photographer and photographic materials dealer, advertisement for the latest Pizzighelli platinum paper of Heseke & Jacoby for the Austro-Hungarian monarchy, *Photographische Rundschau* 2 (1888), no. 8, xiii; no. 9, xiii; no. 10, xiv; no. 11, iv; no. 12, iv; and *Photographische Rundschau* 3, no. 13 (1889): iv; Charles Scolik advertisement for “Dr. Richard Jacoby's neu verbessertem, direct copierendem Platinpapier (ohne Entwicklung)” and “Dr. Jacoby's Entwicklungs—Platinpapier,” *Photographische Correspondenz* 28, no. 365 (February 1891): n.p.

17. Papers usually prepared according to recipe no. 2 on page 57 of Hübl and Pizzighelli 1882:

- 24 ml platinum solution (1 part $[K_2PtCl_4]$, 6 parts dist. H_2O)
- 18 ml iron solution (20 g ferric oxalate $[Fe_2(C_2O_4)_3]$ in 100 ml H_2O)
- 4 ml chlorate-iron solution (100 cm iron solution + 0.4 g potassium chlorate)
- 4 ml water.

18. Eisenschiml and Wachtl c. 1885, 205–10.

19. Bernhard Wachtl 1887, 204.
20. Bernhard Wachtl 1895a. See also Mike Ware, “The Technical History and Chemistry of Platinum and Palladium Printing,” and Sarah S. Wagner, “Manufactured Platinum and *Faux Platinum* Papers, 1880s–1920s,” in this volume.
21. Bernhard Wachtl 1895b, 50.196.
22. According to an advertisement from 1902, Dr. G. Krebs was or later became the owner of Photochemische Fabrik HELIOS in Offenbach a. M. See *Photographische Correspondenz* 39, no. 471 (August 1902): n.p.
23. Bernhard Wachtl 1897, 204. See also Ronel Namde, “Platinum Printing on Textiles,” in this volume.
24. See Hoffmann 1888, 236–39; Drs. Adolf Hesekei and Richard Jacoby advertisement for “Pizzighelli’s Platinpapier,” *Photographische Rundschau* 2, no. 5 (1888): xi.
25. Dr. Adolf Hesekei & Company advertisement for “Hauptspecialitäten: Wesentlich verbessertes Pizzighelli Platinpapier; Neu: Silber-Platin Papier,” *Photographische Correspondenz* 28, no. 364 (January 1891): n.p.
26. Confirmation of the date range for Dr. Richard Jacoby’s business is from a variety of sources. See Dr. Richard Jacoby advertisement for platinum papers, *Photographische Correspondenz* 27, no. 355 (April 1890): n.p.; Dr. Richard Jacoby detailed product and price list, *Photographische Correspondenz* 34, no. 446 (November 1897): n.p. See also two letters, Heinrich Kühn to Alfred Stieglitz, February 27, 1923 (“Jacoby still supplies with real platinum papers”) and December 9, 1927 (“Platinum paper is available again. From the Platinotype Company in London, as well as from Dr. Jacoby. The Platinum prices went down again, after having reached vertigo-inducing heights. Unaffordable for people like us. Having to support a family of four with \$40 a month is quite a feat.”), both Alfred Stieglitz/Georgia O’Keeffe Archive. Also see Dr. Richard Jacoby advertisement, *Photographische Correspondenz* 63, no. 752 (March 1927): xi.
27. Dr. Richard Jacoby advertisement for “Platinpapier Nr. 1,” *Photographische Nachrichten* 3 (1891): 708.
28. Dr. Richard Jacoby advertisement for postcards, *Photographische Correspondenz* 34, no. 436 (January 1897): n.p.
29. Dr. Richard Jacoby advertisement for palladium paper, *Photographische Rundschau* 55 (1918): n.p.
30. W. Heuermann advertisement for Jacoby sepia papers for cold development without mercury, *Camera Notes* 5, no. 4 (December 1902): n.p.
31. Andreas Lurz [1902].
32. HELIOS Company, Berlin, advertisement, *Photographische Correspondenz* 27, no. 354 (March 1890): n.p.
33. Unger & Hoffmann advertisement for platinum papers, *Photographische Correspondenz* 28, no. 364 (January 1891): n.p.; Eder and Trumm 1929, 123.
34. Romain Talbot 1889.
35. Türkel & Steiner, Vienna, advertisement for platinum enlargement papers by Josef Kossak (standard sizes up to 52 × 66 cm, larger prints upon request), *Photographische Correspondenz*, 30, no. 389 (February 1893): n.p.
36. Franz Kühn, Berlin, advertisement for platinum enlargements using papers by Wilh. & M. L. Winter, *Photographische Correspondenz* 30, no. 393 (June 1893): n.p.
37. Kühn 1921, 256–57.
38. Kühn, laboratory journal, March 1905, 76, Albertina.
39. Gruber 2011, 195–202.
40. Kühn 1921, 262. Impure gelatin can interfere with platinum reduction chemistry. This interference can be overcome by incorporating mercury in the developer and using it at elevated temperatures, thus promoting the formation of smaller image particles.
41. Kühn 1921, 262.
42. Kühn, laboratory journal, June 4, 1912, 307, private collection.
43. Kühn, laboratory journal, March 1905, 76, Albertina. The tracing paper was Schleicher & Schüll glassine (tracing) paper, roll.
44. Kühn, laboratory journal, March 29, 1905, 78, Albertina.
45. Kühn, laboratory journal, February 22, 1913, 390, private collection.
46. Christopher A. Maines, analysis report of Kühn, *Alfred Stieglitz*, NGA 1999.76.1, January 3, 2016, Scientific Research Department, National Gallery of Art, Washington, D.C. This analysis confirms the presence of a natural resin consistent with copaiba balsam.
47. Kühn, laboratory journal, February 22, 1913, 390–91, private collection.
48. Kühn 1921, 259–60.
49. See Ware, “Technical History and Chemistry,” in this volume.
50. Kühn, laboratory journal, March 1905, 77, Albertina.
51. The recipe with mercury is from Kühn, laboratory journal, July 15, 1907, 94–95, Albertina: a Jacoby Sepia Developer utilizes 400 [ml] water, 60 [g] potassium oxalate, 50 (-200) [ml] Sepia solution (containing mercury(II)chloride), to be used also at room temperature. The recipe without mercury is from Kühn, laboratory journal, November 15, 2004, 72, Albertina: Jacoby Sepia Developer (25°C): 50 ml potassium oxalate, 25 ml ammonium phosphate monobasic, 500 ml water.
52. Kühn 1921, 260.
53. Eder 1888, 335; also in Pizzighelli 1887, 409–13.
54. Kühn 1921, 261.
55. Kühn 1921, 261.
56. Kühn, laboratory journal, May 17, 1910, 184, Albertina.
57. Kühn, laboratory journal, May 17, 1910, 184, Albertina.
58. Kühn, laboratory journal, June 4, 1912, 306, private collection.
59. Cheryl Podsiki, analysis report of Kühn, *Alfred Stieglitz*, 1904, George Eastman Museum 1978.0565.0006, 2010. XRF analysis detected platinum, mercury, and lead.
60. Kühn, laboratory journal, July 24, 1912, 372, private collection.
61. Kühn, laboratory journal, February 27, 1913, 396, private collection.
62. Kühn 1896, 1–3.
63. Kühn, laboratory journal, April 23, 1910, 180, Albertina.
64. Kühn, laboratory journal, June 4, 1912, 306, private collection.
65. Kühn, laboratory journal, end of November–December 1, 1904, 72–74, Albertina. Vienna.
66. Kühn 1921, 260.
67. Sepia was favored due to the resemblance to etchings and rotogravures, which were in vogue at the time.
68. Kühn 1896, 1.

69. Kühn to Stieglitz, October 11, 1905, Alfred Stieglitz/Georgia O'Keeffe Archive.
70. Kühn 1921, 264.
71. Kühn 1921, 264. Kühn does not provide a date for the introduction of this method.
72. Kühn, laboratory journal, April 13, 1910, 169, Albertina.
73. Kühn 1921, 268.
74. Kühn, laboratory journal, November 28, 1905, 85, Albertina.
75. Kühn, laboratory journal, July 15, 1907, 93ff., Albertina.
76. Kühn 1921, 266.
77. Kühn 1921, 266.
78. Kühn, laboratory journal, April 1910, Albertina.
79. Kühn, laboratory journal, May 12, 1912, 303, private collection.
80. Kühn, laboratory journal, June 4, 1912, private collection.
81. Kühn 1921, 266.
82. Norris et al. 2013, 35.
83. Kühn to Stieglitz, September 19, 1923, Alfred Stieglitz/Georgia O'Keeffe Archive.
84. Kühn to Stieglitz, December 14, 1928, Alfred Stieglitz/Georgia O'Keeffe Archive.

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