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More Predecessors:
Recovering Writings from Photographs of Palimpsests (between 1895 and 1920)

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Prelude:

This paper continues the instant tradition established by my last Club presentation in 2013, which considered the efforts of Scottish twin sisters, Agnes Smith Lewis and Margaret Dunlop Smith Gibson, to photographically document historical and religious texts at St. Catherine's Monastery in Sinai in the 1890s. One of their primary interests was the photographic recording of *palimpsests*, which are parchments that have been deliberately erased and overwritten to reuse the writing surface. The efforts of the Smith Sisters foreshadowed my own work as a member of the imaging team that is using modern imaging technology to accomplish the same end at the same location.

Since presenting that talk, I learned, almost accidentally, of nearly contemporaneous efforts by others that used clever and very painstaking analog photographic methods to enhance the erased texts in palimpsests, and then to incorporate ultraviolet photography to improve the results several years later. This paper is my attempt to give due credit to these precursors, three Germans whose efforts have largely been forgotten: The first two were accomplished colleagues from Breslau: Ernst Pringsheim, an experimental physicist, and Otto Gradenwitz, a professor of religion and philosophy. The third contributor was a Benedictine monk with the religious name of Fr. Raphael Kögel, who later left the order and became a researcher in forensic imaging at Karlsruhe after reclaiming his birth name of Gustav. Kögel was by far was the most intriguing of the three, though aspects of his later life were, shall we say, "questionable."

The single most obvious fruit of the efforts, both direct and indirect, of these men is before us: a copy of a 1913 book of processed photographs of a palimpsest from the library at the Abbey of Saint Gall in Switzerland. At my suggestion and due to the efforts of Steve Galbraith, the curator of the Cary Graphic Arts Collection, this book is now in the collection of the Wallace Center at RIT. This book was located through the website of the American Book Exchange. Also of interest is a 1917 book that includes the transcription of this manuscript made by Fr. Alban Dold of the Benedictine community in Beuron, Germany from these photographs; the Archabbey of Beuron is located only about 90km from Saint Gallen. This book also was obtained from a bookstore in Germany through the AbeBooks.com website. These two acquisitions supply evidence that, as was true of my last paper, that this talk would not have been possible without the ready (and often free) online access to literature in the sciences and humanities that is now available, most often from the Internet Archive, Google books, JSTOR.com, and the HathiTrust digital library, but also from other smaller collections (one of the more significant references in this talk is a free download from the website of the University of Weimar). I also was pleasantly shocked to find that I could instantly download 100-year-old German patents at no cost. These online resources have developed to the state where I now *expect* documents to be available quickly and at no cost and feel rather put out if they are not.

Palimpsests: the Reason

Though it was the primary writing surface used during the Middle Ages, parchment was difficult to make and the skins of many sheep and/or goats were needed to create sufficient surface area for transcribing a typical book. For this reason, parchment manuscripts were often recycled by soaking and scraping off the ink before overwriting new texts. The overwritten parchments are called *palimpsests* from the Greek words for "scraped again." The original intent certainly was to recycle duplicated codices to augment the library collection, but the inevitable migration of books meant that the duplicated texts often disappeared, leaving the original text only in palimpsested form. As a general rule, the population of palimpsests tends to increase the farther east one travels in Eurasia, because parchment was less available there. This is certainly part of the reason for the large collection of palimpsests in the library of the Monastery of St. Catherine's; pilgrims probably sold manuscripts to the monks, who reused the parchments for locally produced manuscripts. It also is the reason for the current plans of my colleagues in the humanities to explore palimpsest collections in Tbilisi, Georgia.

The palimpsested manuscripts to which I have been closest are the works of Archimedes. The original sources for Archimedes' writings consist entirely of three volumes, which go by the rather boring names of Codex "A," Codex "B," and Codex "C." The first two were both transcribed in the 9th century and were in the Pope's library in 1311, but both had disappeared by 1564. Codex "C" had been copied in the mid-10th century, probably in Constantinople, but was in Jerusalem at the time of the Sixth Crusade in 1229, when it was erased and overwritten with the *Euchologion*, a Christian prayer book. It was used in services at the Monastery of Mar Saba near Jerusalem for hundreds of years. This book is now known as the *Archimedes Palimpsest*, and includes partial copies of seven treatises, including the only known existing copies of *On Floating Bodies* in the original Greek, one leaf of the only known copy of the first treatise on combinatorics, the *Stomachion*, and only copy of the *Method of Mechanical Theorems*. This is a letter from Archimedes to Eratosthenes that describes the former's use of mechanical analogies to prove mathematical theorems. Other leaves in the *Euchologion* are erased leaves that include works of importance in history and philosophy: parts of two lost speeches by the Greek orator Hypereides (*Against Timandros* and *Against Diondas*) that include important historical references, and a commentary on Aristotle's *Categories* by Alexander of Aphrodisias.

Figure 1: Image of Archimedes Palimpsest f. 88v under ultraviolet illumination; text at beginning of "*Method of Mechanical Theorems*" runs horizontally and later text from *Euchologion* prayer book oriented vertically ("The Archimedes Palimpsest" Auction Catalog from Christies, 29 October 1998," p. 35)

Chemical Methods to Recover Text from Palimpsests – The Alchemy of Reagents

Fortunately for scholars, the original writing was not completely removed by the efforts to erase; traces of ink are left, and these will be found to have been preserved the best where the older writing had been only washed off, or slightly rubbed off with pumice. Because of this observation, scholars over the last 200+ years have avidly sought methods to enhance the erased text for transcription. The first enhancement efforts used chemical reagents applied to the parchments to enhance the visibility of the erased ink. The first reference of chemical application to manuscripts was made by Pliny the Elder in the first century in his *Natural History* (Volume XXXIV p.11), where he described the use of a papyrus treated with gallnuts for the detection of iron in verdigris. The lack of mention of reagents in succeeding classical references suggests that the recipes may have been quietly handed down in the alchemy or religious networks. The next "public" mention of reagents may have been by Pietro Maria Canepario, a physician and philosopher who practiced in Venice who lists the recipe for a chemical reagent used on manuscripts on p. 179 of *De atramentis* ("On Inks" 1619). The perceived importance of this book at the time is suggested by the fact that Isaac Newton had a copy in his personal library. In his "Geschichte der Chemie" ("History of Chemistry, 1843), Hermann Kopp commented that "*The first reagent was generated from gallnuts, and by means of their preparations were also the first reagent paper.*" These two books are is other examples of once-rare historical writings that are now readily available online.

An obscure note by the historical scholar René-Prosper Tassin, from the Benedictine Congregation of St. Maur, may be the oldest documentation of the use of chemicals to recover writings from palimpsested manuscripts. In Volume 4 of the six-volume *Nouveau Traité de Diplomatique* published in 1759 (and also available online), Tassin gave a recipe for a tincture used to recover faded writings in iron-gall ink:

> *Crush some nut galls, place them in a vial of white wine, stopper the vial tightly and leave it one whole day in a warm place. Then distill by means of an an alembic and from the water that comes out, gently wet the parchment or paper that one wants to read.*
>
> *(English translation by Gregory Heyworth, University of Mississippi)*

Apparently, the recipe for nutgall reagent had been a tightly kept secret among the Benedictines for many years. Its value arises from the fact that the most common writing fluid at the time was iron gall ink, also made from nut galls. Though this was not the only reagent eventually available, the fact that it was documented probably means that it was widely used. Immediately following Tassin's publication, scholars (and others with less benevolent goals) trekked across Europe in search of manuscripts to treat, transcribe, and often to abandon, because the application of the reagent generally left the manuscript in unreadable condition. Cardinal Angelo Mai (1782-1854) is probably the best-known single person to have used the reagent weapon to read the text, but the action of the chemical was very quick and the text was readable for only a short time (sometimes only for a few seconds). Mai made a career of rediscovering and transcribing palimpsests from the Middle Ages. He is probably best known for discovering many fragments of Cicero's *De re publica* in 1819 (now preserved in the Vatican Library, Vat. Lat. 5757). This is a 4^{th}-century manuscript that was palimpsested 3-4 centuries later. The overtext is a commentary on the psalms by St. Augustine. Mai edited and published the original Cicero writings in 1822.

Modern scholars generally consider Mai to have been short-sighted because of the damage to the manuscripts left behind by his efforts. He is described as "hasty and uncritical and not over-scrupulous" in **Scribes and Scholars** by Reynolds, Wilson, and Wilson (Oxford University Press, 2013, p.195). That being said, he was arguably the first to demonstrate the valuable texts hidden in palimpsests, and widespread efforts to retrieve the original texts from these manuscripts started in earnest roughly around 1750 and ran for 100-150 years. In fact, my last paper showed a photograph of Agnes Smith Lewis painting reagent upon a manuscript at St. Catherines, which is reproduced below:

Figure 2: Agnes Smith Lewis painting reagent on palimpsest at St. Catherine's Monastery in 1893.

Damage from reagents to the *Vercelli Book* (Vercelli Biblioteca Capitolare MS 117), a compilation of poems, homilies, and the biography of a saint in Old English prose that dates to late 10th century, has led Ira Rabin of the University of Berlin to suggest that nutgall reagent was used deliberately to cause damage to leaves of the book. In 1833, a young scholar named Christian Maier travelled to Vercelli to study the book. He is known to have applied reagent and his transcript of the text records is unique, as it is the only source of readings now invisible due to the damage. Rabin believes that Maier did this deliberately to prevent other scholars from questioning his reading.

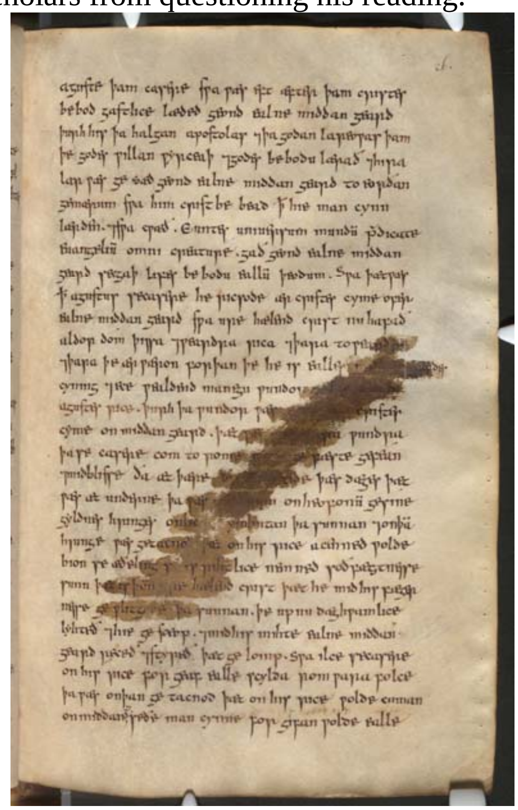


Figure 3: f. 26r of the *Vercelli Book*, showing the damage rendered by application of reagent

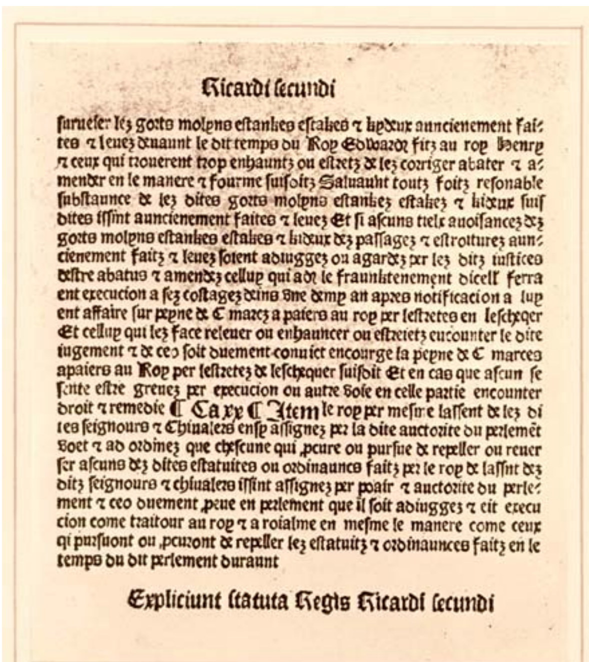
The damage to manuscripts became widely known to the point where custodians would, with complete justification, deny the application of reagents to any of their charges. The value of the erased writings was such that scholars remained desperate to read them, which stimulated efforts to develop nondestructive technical means for enhancing the texts. This is the true beginning of our story.

Photographic Imaging of Manuscripts

The invention of photography led rather quickly to its use to document manuscripts, though its use to enhance writings came much later. It seems likely that the first photographs of historical documents were collected by the first true giant of imaging science, William Henry Fox Talbot. His correspondence on the subject with the physicist Jean-Baptiste Biot (himself famous for the "Biot-Savart law" that specifies the force of the electric field generated by an electron current in a conductor) is preserved online. Biot's letter to Talbot dated 11 February 1840 reports that Biot's account of Talbot's imagery of "*reproductions of a Hebrew psalm, a Persian newspaper and a Latin document from 1279*" … "*will be reproduced next Saturday in our* ***Compte Rendu***," (which also is available online). This letter from Biot includes a short explanatory note in which "I point out the scientific selflessness which prompts you not to wait for a more favourable time of year to announce the process and to show the effects from which others could usefully benefit."

In six installments from 1844-1846, Talbot published *The Pencil of Nature* (available online from Project Gutenberg). This is the first commercially published book illustrated entirely with Calotype photographs (exposures directly onto paper coated with silver chloride). Among the 24 plates was a photograph of "a facsimile of an old printed page" that included statutes of Richard II written in old French (Figure 4). Though this was from a printed book not a leaf from a manuscript, Talbot clearly understood the value of photographic documentation of writings, as shown by his comment for this image:

> "*To the Antiquarian, this application of the photographic art seems destined to be of great advantage.*"



Ricardi secundi

surueier lez gorts molyns estankes estakes ⁊ kydeux auncienement faites ⁊ leuez deuaunt le dit temps du Roy Edward fitz au roy Henry ⁊ ceux qui trouerent trop enhauntz ou estretz de lez corriger abater ⁊ amender en le manere ⁊ fourme suisditz Sauuaunt toutz foitz resonable substaunce de lez dites gorts molyns estankez estakez ⁊ kideux suisdites issint auncienement faites ⁊ leuez Et si ascuns tiels auoisancez dez gorts molyns estankes estakes ⁊ kideux dez passagez ⁊ estroiturez auncienement faitz ⁊ leuez soient adiuggez ou agardez per lez ditz iustices destre abatus ⁊ amendez cellup qui ad le fraunktenement dicell ferra ent execucion a sez costagez deins vne temp an apres notificacion a luy ent affaire sur peyne de C marcz a paiers au roy per lestretes en lescheqer Et cellup qui lez face releuer ou enhauncer ou estreietz encounter le dite iugement ⁊ de ceo soit duement conuict encourge la peyne de C marces apaiers au Roy per lestretez de lescheqer suisdit Et en cas que ascun se sente estre greuez per execucion ou autre vole en celle partie encounter droit ⁊ remedie ¶ Ca xx ¶ Item le roy per mesme lassent de lez dites seignours ⁊ Chiualers ensy assignez per la dite auctorite du perlement voet ⁊ ad ordinez que chescune qui procure ou pursue de repeller ou reuerser ascuns dez dites estatuites ou ordinaunces faitz per le roy de lassent dez ditz seignours ⁊ chiualers issint assignez per poair ⁊ auctorite du perlement ⁊ ceo duement proue en perlement que il soit adiuggez ⁊ eit execucion come traitour au roy ⁊ a roialme en mesme le manere come ceux qi pursuont ou procuront de repeller lez estatuitz ⁊ ordinaunces faitz en le temps du dit perlement duraunt

Explicitiunt statuta Regis Ricardi secundi

Figure 4: Image of printed page from Talbot's *The Pencil of Nature* (Plate IX, p.31)

Photographic recording of historical writings apparently was in a rather dormant state until the maturation of photography in the 1880s, driven (of course) in large part by George Eastman's company. Shortly thereafter, the Smith sisters took their cameras to Sinai to record the palimpsests at St. Catherine's Monastery. An example of a photograph of an important palimpsest taken from the

Frontispiece of Agnes Smith Lewis' 1893 book *How the Codex was Found* (Macmillan and Bowes, Cambridge, available online) is in Figure 5, where the thumb of Galaktéon, the librarian of St. Catherine's at the time, is quite visible. The work of the Smith sisters was the subject of my paper to the Club two years ago.

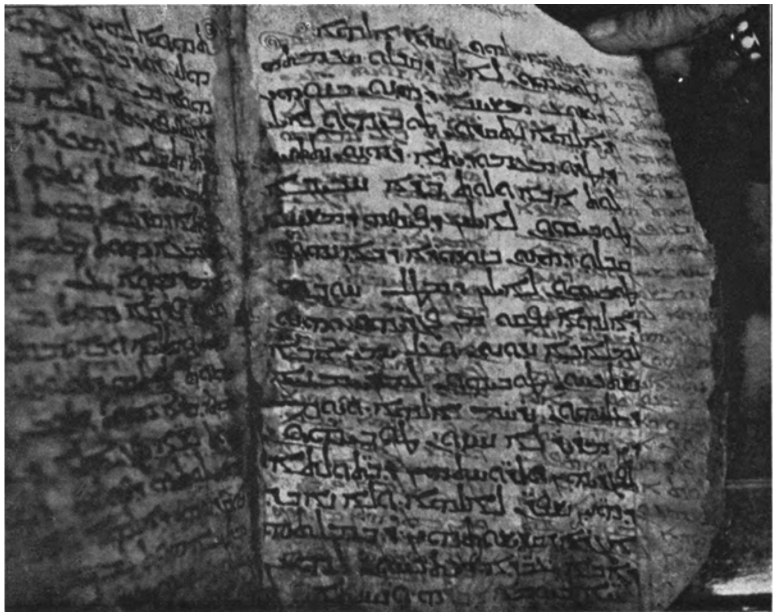


Figure 5: Palimpsest imaged by Agnes Smith Lewis during visit to Sinai in 1892-1893
***Codex Sinaiticus Syriacus*, original writing probably from 5th Century**

Photographic Image Processing

At about the same time as the travels of the Smith Sisters to the holy lands, Dr. Ernst Pringsheim presented a paper to the *Physical Society of Berlin* in 1893 with the title "*Photographische Reconstruction von Palimpsesten*" ("*Photographic Reconstruction of Palimpsests*"). The subject of the paper was Pringsheim's work with Dr. Otto Gradenwitz, a scholar also from Breslau who had trained as a lawyer.

Pringsheim was born in 1859 in Breslau, studied at Heidelberg, Breslau, and Berlin between 1877 and 1882; his doctoral advisor was Hermann von Helmholtz (1821-1894), who was one of the most productive of physicists of the later half of the 19th century. Pringsheim became an unsalaried lecturer at the University of Berlin in 1886 and Professor in 1896. He moved back to Breslau in 1905 as full professor of theoretical physics, and passed on in 1917. Otto Gradenwitz was born in Breslau in 1860 and studied law at Berlin, Heidelberg, and Leipzig. He was Professor of German Civil Law at the University of Heidelberg from 1905-1928. He lived in Berlin after retirement and died July 7, 1935.

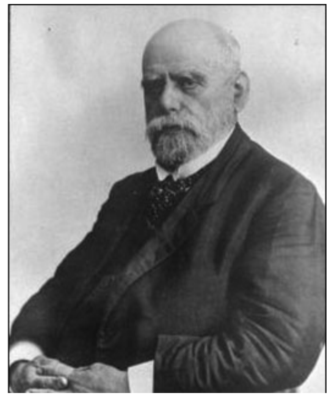



Figure 6: Portraits of Ernst Pringsheim (left) and Otto Gradenwitz (right)

The lecture delivered by Pringsheim was published as a paper of fewer than 700 words in *Verhandlungen der Physikalischen Gesellschaft zu Berlin im Jahre 1893* ("Proceedings of the Physical Society in Berlin in the year 1893," available online). At the time, Pringsheim had a position at the University of Breslau (now Wroclaw, in southwest Poland), where he was truly an accomplished experimental scientist. He became well known in the physics world over the next decade as a result of his collaboration with Otto Lummer to measure the spectrum of radiation emitted from a "blackbody" at wavelengths longer than the visible range and well into the infrared region (wavelengths out to $\lambda = 18\mu m$, well beyond the visible range). These measurements disagreed with the contemporary theory of light and eventually led Max Planck to make the hypothesis in 1900 that light is emitted in "packets" or "quanta" rather than in a continuous stream. In other words, the measurements of Pringsheim and Lummer were responsible in significant part for the development of quantum theory, which is one of the great revolutions in physics. Incidentally, there is evidence that Pringsheim and Lummer were better scientists than judges of individual potential. Max Born worked in their laboratory in Breslau and hoped to complete his degree in physics under their tutelage. A minor accident involving Born's blackbody experiment, a ruptured cooling water hose, and a flooded laboratory, led to Lummer's advice that Born would never become a physicist. Of course, Max Born won the Nobel Prize in Physics in 1954 for his contributions to the development of quantum mechanics.

Though the work of Pringsheim and Gradenwitz is not well remembered in the imaging world (with my own experience providing evidence of the fact), it received significant attention at the time. It was presented at the international conference on the conservation of manuscripts at St. Gallen in 1898 and as a paper in "*Jahrbuch für Photographie und Reproduktionstechnik für das Jahr 1901*," ("*Yearbook of Photography and Graphic Technology for 1901*"). Herman Schnauss, who was a pioneer in flash techniques in photography, published a paper in English, "Photography as an Aid to Paleography," in *The American Amateur Photographer* in 1900 that is largely an English translation of Pringsheim and Gradenwitz's 1898 presentation at St. Gallen (all three papers are available online). I contend that their work encompassed the same basic principles utilized by modern imaging teams, though we are blessed with more sophisticated tools.

Pringsheim and Gradenwitz must have made a significant experimental effort to produce a purely analog photographic method that attenuates the visibility of the later "overtext" while enhancing the faded original text in images of palimpsests. Their technique used two sandwiched photographic transparencies that had been collected under different illumination and processing conditions. Their goal is simple to verbalize and difficult to implement; they wanted to "subtract" the dense "overtext" to make the fainter recorded "undertext" more visible. However, their toolbox of analog photographic technology was quite limited because the sandwich of transparencies produces the arithmetic product of the transmittances of two transparencies (which is equivalent to adding the photographic densities), rather than adding or subtracting the transmittances. For this reason, Pringsheim and Gradenwitz could only approximate the desired operation. The technology of digital processing makes it possible to implement virtually any mathematical operation, so modern methods should give much better results for that reason alone.

In their paper, the two transparencies are (again boringly) labeled "A" and "B." The image "A" is collected through a yellow filter on an "eosin silver plate" and processed to display the older "undertext" as dark as possible (the transparency is opaque at those locations) and to display the later "overtext" as transparent as possible. The transparency "B" is a negative produced upon an ordinary silver bromide plate that was normally exposed and developed to obtain high contrast and to display both texts as transparent as possible. A transparency "B'" was made from "B" by contact printing with a short exposure and overdevelopment to increase the contrast of the faded text as much as possible. As Gradenwitz said in their paper published in 1901, "*The correct density of the positive B' was found through many tests. With very great difficulty the second requirement was fulfilled, namely the geometrical congruence of the two exposures,*" which is probably a significant understatement (English translation courtesy of Barry Knight, retired from the British Library).

The two transparencies "A" and "B'" are sandwiched in contact and imaged onto photographic paper in an enlarger. The goal may be easier to understand from the English translation of the table of possible outcomes in the original 1894 paper:

	Background	**Undertext**	**Overtext**
Negative A	dark	dark	light
Transparency B'	light	dark	dark
Transmitted light	dark + light = gray	dark + dark = black	light + dark = gray

The physics of the interactions of the light with the sandwich of transparencies indicates that better descriptions of the different cases for the transmitted light would be as arithmetic products: "dark × light = gray" and "dark × dark = black." Regardless of the notation and interpretation, the original "undertext" appears dark in the result, while the "overtext" and background areas both appear with approximately equal gray values. The end result is a visual separation of the undertext from the other features.

This analog operation is far easier to describe than to implement because the two transparencies must have the same dimensions (identical magnifications) and must be perfectly aligned ("in register"). My limited experience with photographic emulsions suggests that this had to be extraordinarily difficult, since almost imperceptible errors in rotation and scale completely defeat the beneficial effect of the combination. The effort required is indicated from the English translation of the penultimate paragraph of their 1893 paper:

> *Far greater difficulties apply to the fulfillment of the condition to register the two images. The required stable apparatus for this purpose was kindly provided by Mr. H. C. (Hermann Carl) Vogel of the Astrophysical Observatory at Potsdam.*
>
> *In this apparatus, the object and the camera were fixed immovably on the same iron tripod, and care is taken to ensure that the plate in the cassette and in the camera perfectly align. Nevertheless, a good result was not obtained until the recording B was made on a colorless glass plate with exactly the same thickness as that used to hold the filtered plate A.*

Even with this additional tool, the process likely still was very difficult because of differential swelling of the emulsions on the glass plates. It was not until they used plates of exactly the same thickness and imaged the combination at a large distance that all problems were overcome. The result, described by Schnauss in his 1900 paper, was judged as quite successful:

> *By a proper systematic application of photographic methods, by the use of orthochromatic plates with yellow filters, by controlling the lighting and the development properly, by enlarging to some extent the image, and by suitable intensification of the negatives, results will undoubtedly be obtained that are unattainable by any other method.*
>
> *"Photography as an Aid to Paleography," Hermann Schnauss,*
> **TheAmerican Amateur Photographer XII**, p. 504, 1900.

The comparison of the three images taken from the proceedings of the 1898 St. Gallen Conference show the success of the result for a Greek palimpsest from the Königliche Bibliothek (Royal Library) in Berlin (Berol. gr. quart. 65), now preserved in the Biblioteka Jagiellonska Krakow.

Figure 7: positive transparency A showing both texts (left); image B showing overtext "only" (center); combination of A+B' to reconstruct original text (right). From the Proceedings of St. Gallens Conference by Otto Posse, 1898.

Though this example provides evidence that the results could be "spectacular," the success of the method of Pringsheim and Gradenwitz clearly was limited by the capability to produce transparency B that shows the both over- and undertext with similar densities. This fact provides the opening for the third and most interesting character (by far) in this dramatic play: Gustav (Fr. Raphael) Kögel, who came up with methods for improving this image. Though Kögel's papers are referenced repeatedly in the early literature of manuscript imaging, I became aware of his contributions through the four references (two listed as by Gustav and two by Raphael) in the book *Scientific Aids for the Study of Manuscripts*, published in 1935 by R. B. Haselden of the Huntington Library. Parenthetically, also had an important connection to the Archimedes Palimpsest, having identified a photograph of one leaf in 1932 as belonging to the manuscript. I first saw a copy of Haselden's book probably 8-10 years ago and have purchased several used copies since. The most recent copy came from a used bookstore out west (Montana?); I was very surprised to see that this volume had been a discard from the library of SUNY-Geneseo, so it has, in a sense, "returned home."

Kögel's technical efforts towards manuscript imaging were primarily directed at the use of ultraviolet light to enhance the visibility of the undertext in image "B." These are documented rather widely in journals and patents from that time and the British Library website published a blog post in February 2014 by Barry Knight about Kögel's contributions.

In 1913-1914, Kögel filed three submissions (using his given first name of Gustav) at the Imperial Patent Office. On 30 October 1913, he filed for "*Method for illuminating of photographically recorded palimpsests*" (which contains the drawing of the illuminator reproduced below, #274030 granted on 19 June 1914). On 7 July 1914, he filed for "*Process for the preparation of palimpsest photographs with two superimposed photographic positives of palimpsest, one of which is the other contains the primary and secondary writing, transparency as only the secondary writing*," (#285154 granted on 21 June 1915). On 11 October 1914, he filed for "*Process for the photographic recording of palimpsests*" (#288327 granted on 23 October 1915). The second of these references the work of Pringsheim and Gradenwitz, so Kögel clearly was well acquainted with their work. The dedication page of his 1920 monograph, *Die Palimpsestphotographie*, emphasizes his appreciation for their contributions The English translation of the dedication reads:

Dedicated to
Dr. Otto Gradenwitz,
A well-deserved promoter of palimpsest research of outstanding merit,
Full professor of Roman law at the University of Heidelberg,

and dedicated to the memory of his friend and colleague
Dr. Ernst. Pringsheim,
formerly a full professor of Theoretical Physics at the University of Wroclaw,
in their honor, with adoration/with respect

The Author

(English translation courtesy of Dr. Jana Grusková, Austrian Academy of Sciences)

Parenthetically, this is the best single reference to Kögel's work, in part because of its extensive set of illustrations. Of course, this book also is available online.

The dedication, combined with the fact that both Pringsheim and Gradenwitz were Jewish, suggests that Kögel's later life had to have been burdened with some ambiguity.

Despite the fairly wide variety of references about Kögel's technical contributions, I have found very few published items that consider his personal life. The Technical University of Karlsruhe does have a collection of several boxes of his correspondence, including doctoral theses he advised, but I have not been able to access that material. For that reason, this paper leans quite heavily on a single narrative of Kögel's life, with the acknowledged risk of drawing conclusions based upon the judgments of one person. This reference, *Über P. Raphael Kögel und die Anfänge der Palimpsestforschung in Beuron* (*About Fr. Raphael Kögel and the beginnings of palimpsest research in Beuron*) was published (in German, of course) in 1997 by Johannes Werner, and is one of the very few documents obtained through interlibrary loan. One of my goals for this paper was to include a photograph of Kögel, but I have only found reference to one image in a local interest magazine published in Germany in 1997, which I have not as yet located.

Kögel was an illegitimate child born in Munich in 1882, but it was not until 1898 that his mother married, to Josef Bindei, the owner of a "butter shipping business." Kögel had applied to enter the order of Benedictines several times around 1898, but apparently was repeatedly rejected. In a letter written on August 29 of that year, he said, "*I have long time eagerly sought after to dedicate myself to the sacred religious life as a Benedictine, but several times (. ..) was rejected,*" namely because "*I have not yet completed the prescribed period of study and I am poor*" (English from Google "Translate"). He finally received his habit on 3 May 1899 and sent to the Abbey of São Bento de Olinda in Brazil that September, though he returned ill shortly thereafter. He was sent to Wessobrunn late in 1907, where technical interests apparently surpassed his religious training. In fact, he negotiated in 1909 and 1910 with a certain James Kerry in London, who in turn negotiated with the

Eastman Kodak Company (among others) for the establishment of a “Benedictine Reflexo-Copy machine.” Werner quotes from Kögel’s letters that he mentioned inventions of an electric clock, a compass, an advance in wireless telegraphy a “device for recording of electric waves with Morse telegraph.” Werner says that the Imperial Patent Office in Berlin gave Kögel a patent for the last on 23 September 1912 (though the fact that I cannot find a record of this patent makes me a bit suspicious). His other efforts in the first decade of the twentieth century were not documented in any references that I located.

Werner states that Kögel “hung out a sign in 1910 at the Abbey in Wessobrunn for the ‘Institut für Palimpsestphotographie’” for which “an electric power station was built specifically.” He was summoned to Beuron and the Palimpsest Institute apparently was transferred there in 1912. Over the next several years, Kögel apparently investigated how ultraviolet light can improve the visibility of erased or faded ink on manuscripts. The ultraviolet light causes the parchment to “glow” by fluorescence where the energetic photons in the ultraviolet light force some electrons in the parchment to be ionized. Other electrons take the place of those that were ionized while releasing light energy to make the glow. Since the emitted light comes from within the parchment, the faint ink traces absorb both on incidence and on emission, enhancing their visibility. The diagram from Kögel’s patent DE274030 for his illumination system used to project ultraviolet light onto a manuscript is reproduced as Figure 8 amply demonstrates the technical problems that Kögel had to solve with the crude technology of the time. Broadband radiation (including ultraviolet light) emitted by two mercury arc lamps at bottom was dispersed into the constituent spectra by quartz prisms that are transparent to ultraviolet light (which glass is not). Kogel used this to project overlapping spectra ranging from blue through ultraviolet onto the manuscript at right from both sides. In this way, he obtained at least “some” ultraviolet illumination over the entire leaf.

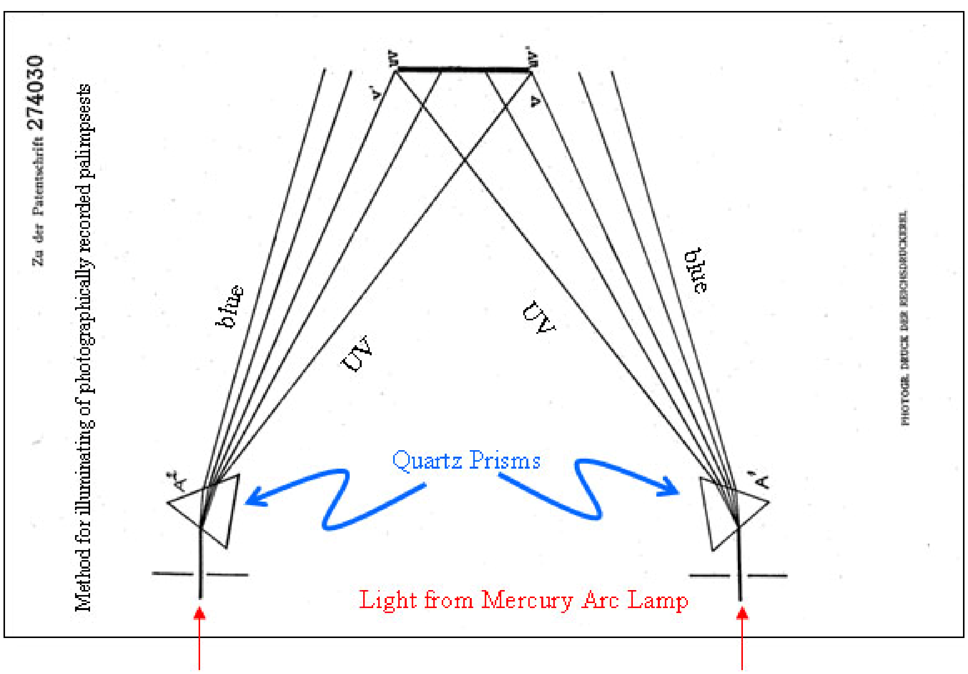


Figure 8: Diagram from patent DRP 274030 (granted 1914) showing use of quartz prisms to disperse spectrum of broadband radiation (including ultraviolet light) emitted by the mercury arc lamps at bottom.

Besides this makeshift illumination system, Kögel had to develop means to filter the light into the camera. Since the selection of colored filters common now were not available to him, he used *liquids* to filter the light – the liquids filled glass cuvettes placed over the camera lens, as shown in Figure 9. In the commentary in Kögel's 1920 monograph *Die Palimpsestphotographie*, he states:

> *The light filter is either solid or liquid, such as the famous yellow filters. In the latter case, the dye is dissolved with water or alcohol and fills a glass cuvette, which is placed immediately in front of the camera lens. If high demands are placed on the sharpness of the image, the cuvettes must be made of "optical" glass (with parallel sides). Mirror glass usually suffices for personal use when the internal distance between the parallel walls is not more than 5mm.*
>
> *Die Palimpsestphotographie*, Figure 4, p. 66
> (*translation from German to English by Google*)

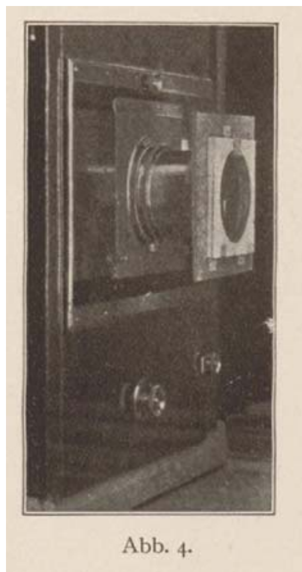


Figure 9: Glass cuvette for liquid bandpass filter positioned in front of lens.

With these crude lighting and the photographic emulsions of the day, the process was very difficult to implement. In his 1920 monograph, Kögel quotes exposure times of 1-2 ***hours*** for ultraviolet light with wavelengths λ = 313nm and 2 ***hours*** at λ = 365nm. Parenthetically, I mention that the ultraviolet lights used in the modern system have the same wavelength of λ = 365nm, and our exposure times are of the order of 10 seconds, and we have the advantage of seeing our results "instantly," which none of these men could do.

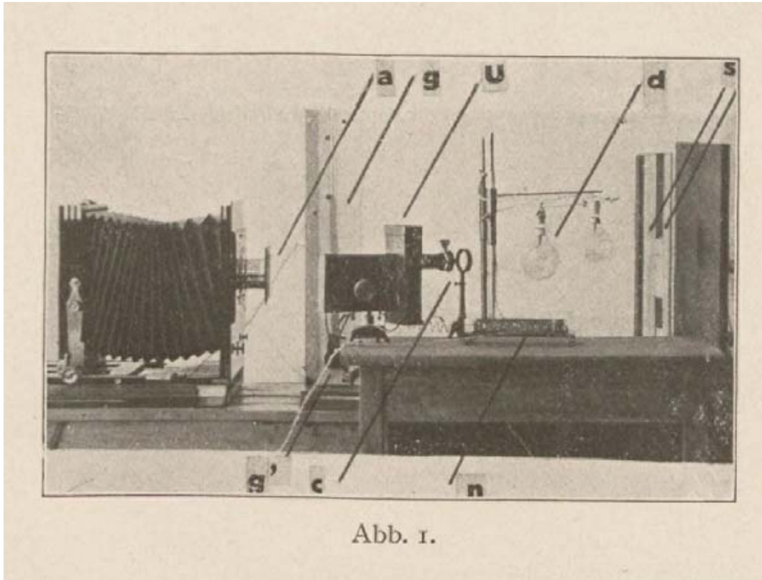


Figure 10: Kögel's camera system from 1920 monograph: Ultraviolet absorbing filter at a, condensing lens at c, metal filament lamps at d, Mercury vapor lamp is g-g', visible absorbing filter at u.

The Book:

Figure 11: Spicilegium Palimpsestorum, Volume I: Codex Sangallensis 193

The one volume of palimpsest images processed using the analog method is the **Spicilegium Palimpsestorum arte photographica paratum per S. Benedicti monachos Archiabbatiae Beuronensis**, **Volume I**: **Codex Sangallensis 193** ("Gleanings from Palimpsests, art photographs prepared by the monks of the Archabbey of St. Benedict in Beuron, Volume 1: Codex Sangallensis"). The overtext on this book includes a collection of homilies of St. Caesarius of Arles, and fragments of St. Augustine, St. Jerome and St. Maximus. Paleographic studies indicate that the later text is early ninth century CE. The undertext is composed of texts from several books of the Old Testament, the last chapter of Ezekiel, Daniel, and many pieces of the minor prophets, probably copied in the fifth century CE. The few "technical notes" are very sketchy, but some of the comments are instructive. The motivation for the photographic process is highlighted by "it must be specially emphasized that this method is a purely optical and excludes any use of reagents." The only indication of the actual method used is only implied, "…the original text was highlighted … partly by the well-known Gradenwitz-Pringsheim process, partly by an original process." The "original" aspect must refer to the ultraviolet illumination and the adjective "well-known" must be taken with a grain of salt, as it likely was that only in the narrow community of manuscript scholars. The comment that "the diversity of parchment and ink had been the cause of many technical difficulties, which manifest themselves in the inequality of individual panels" acknowledges the painstaking nature of the work.

Despite the challenges, Kögel was able to produce very good images of the erased texts of palimpsests, including the 152 plates of *Codex Sangallensis 193* in the book here on display. As is plain to see from its title, this was to be the first of a series of volumes of palimpsest imagery, an effort that was, of course, delayed (and eventually cancelled) by the outbreak of the Great War. Of parenthetical interest might be the original cost of the volume of 80 Marks, corresponding approximately to nineteen contemporary American dollars.

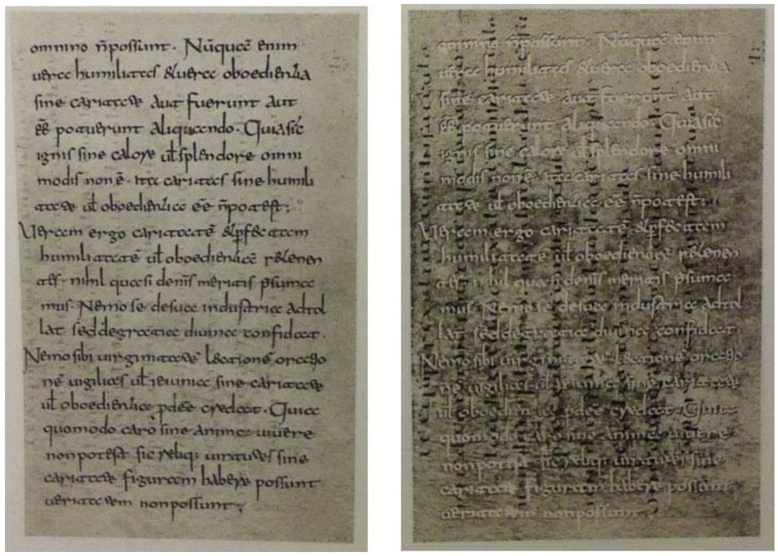


Figure 12: Comparison of original appearance (left) and after analog processing of photographs (right)

The contemporary reviews of the book were quite complimentary, including comments by Hans von Soden in Theologische Literaturzeitung (1914, N. 12), that "An unspecified photographic process (employs) color differentiation without the use of chemical reagents (to make) the lower writing visible again. The procedure shows new information very distinctly that is not available in a common photographic recording." Henri Omont, had a close connection to the Archimedes Palimpsest, (icons from his 1929 Book of Greek manuscripts in the Bibliothèque Nationale were copied and painted over four leaves of the palimpsest after 1938), commented that the book was "an excellent example of the very satisfactory results that may be obtained, without causing any damage to manuscripts, for reading and reproducing palimpsests, thanks to the direct application of advanced photographic processes by Fr. Raphael Kögel." (**Bibliothèque de l'école des chartes**, **75**, 360,1915).

Contemporary efforts of other researchers

It is interesting to see how these methods affected the works by other researchers in the same time period. In 1915, Louis Pampaloni at the Institute of Microscopy in Florence published similar results to those of Pringsheim and Gradenwitz and and of Kögel, though he did not document his method. One example was reported by Enrico Rostagno, Conservator of Manuscripts in Laurenziana, in a paper published in Rivista Delle Biblioteche in 1915 (V. 26, pp. 58-67, available online from Hathitrust). Though improvements over Kögel's method are claimed, the single result is difficult to assess:

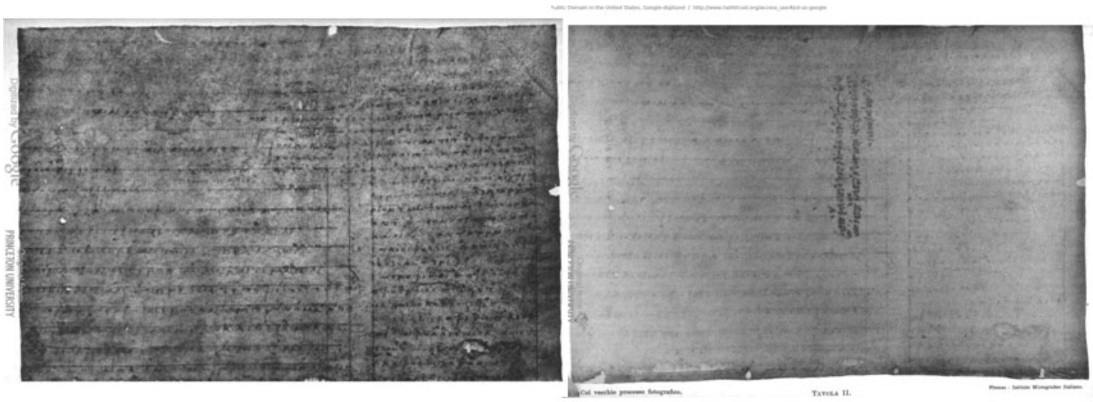


Figure 13: Comparison of images of Codex Laureuziano Plut. 60, 9, "Aristide's Oration" before and after processing by Louis Pampaloni: (left) visual appearance, (right) result of analog processing. The undertext was identified as by Aristophanes

In 1921, Giuseppe Perugi of Viterbo used a technique similar to that of Pringsheim that adjusted the intensity of the light on the photographic plate with the intention of avoiding the exposing the parchments to ultraviolet light. He put the method at the disposal of the "Contardo Ferreni Institute of Palimpsests," then just founded in Rome. I have found no examples of his results, so I cannot assess their value, and the only other references I have found to his work is a short item in "La Bibliofilia" (V.24 for 1922-1923, pp. 385-386, available from archive.org), where Perugi is quoted about the "principles" of his method (though he evidently is blowing a lot of smoke):

> *"The photographic plate is composed of layers is not divisible by the means which we possess, nor visible to the human eye. The light strikes the photographic plate, but the human eye can see only the surface of the objects. The photographic plate sees many layers in the object. Just to make myself understood* (sic!)*, these operations are added together so that the first shot reproduces the outside, the second reproduces the image photographed is the layer immediately posterior to the outer surface, etc. The layers of the plate are composed of molecules; because the radius distance to the second layer is not necessary that between the first and the second there is an imperceptible space because the light, unlike sound, spreads. The speed of light is immense, about 300,000 km per second. From here we need to measure the strength of the action of light on the photographic plate. What happens to molecules forming the first layer of the slab? What happens to those of the second? How do you form the so-called latent image? Can it grow? The latent image is a physical phenomenon or chemical? Many questions, it is true, the answer to which apparently difficult, instead of an ease that makes us smile."*
>
> *(translation from Italian to English by Google)*

Perugi then devotes several lines to the phenomenon of optical interference, which has nothing to do with the method. His work is largely forgotten (and probably for good reason). I did locate one article dated 10 September 1949 from "The Age" newspaper published in Melbourne, Australia (available from "news.google.com") that claims that Perugi "*applied new principles of photography, based partly on the theory that colors are produced by waves of varying lengths and partly on stereoscopic laws. He realized that the old erased letters would lie in different places on the surface of the parchment from the new ones … These effects could be produced on hypersensitive film, although they were almost imperceptible to the human eye.*" My assessment is that this is hyperbolic balderdash with just a bit of fact used to obscure the actual physics.

As one last example of contemporary work comes from Haselden's 1935 book, which includes a sequence of three photos as Figure III in the book and shown here in Figure 12: (a) the image in visible light, (b) the image under ultraviolet light, and (c) the result of sandwiching the positive of (a) and the negative of (b), so that the undertext in (b) is more visible. This method closely parallels that of Kögel.

Kögel's Later Years

Despite the war, Kögel apparently continued his efforts with the support of Fr. Alban Dold (1882-1960), who had been a chaplain on the Western Front, but was appointed Director of the Palimpsest Institute at the Archabbey of Beuron in 1918. In 1917, Dold published the second book shown here, the transcription of the *Codex Sangallensis* 193 from the photographs. In the foreword, Dold references Kögel's contributions in complimentary terms:

> *With grateful joy we congratulate (...) the brilliant master of palimpsest photography, P. Raphael Kögel, to the great successes that were granted to him. (. ..) At his suggestion and with his active and consultative actions, the Palimpsest Institute of Beuron Archabbey has been established in 1912. Due to a number of circumstances during the following years, he* (Kögel) *was not able to dedicate his time this institute. During wartime, our venerated brother came back as a guest to Beuron and worked for the Palimpsest-Institute. Meanwhile the first volume of Spicilegium Palimpsestorum (Gleanings from Palimpsests) had been published. The description of the way the texts of CSG.193 were photographed, the way of introducing the reader into the newest technique of fluorescence-palimpsest-photography – as already done for texts of CSG.567 – nobody could have described in a more competent and qualified way than the master himself.*
>
> *(English translation courtesy of Sandra Hodecek, National Library of Austria)*

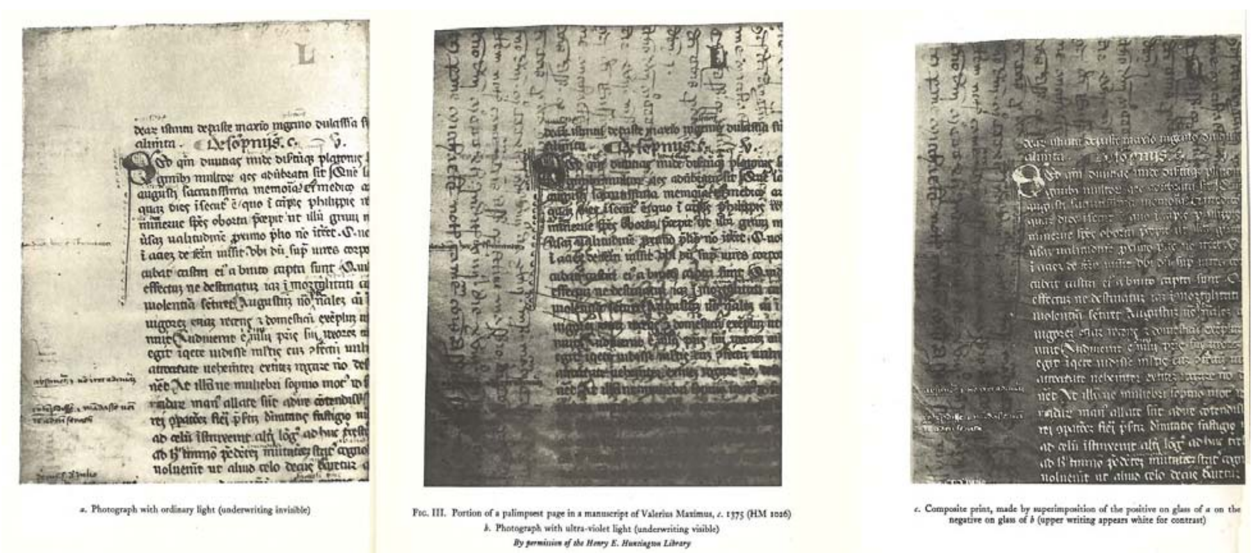


Figure 14: Sequence of three images from the Huntington Library (Figure III in *Scientific Aids for the Study of Manuscripts* by R.B. Haselden, 1935), using an adaptation of the technique of Kögel with ultraviolet illumination.

Dold also assessed the value of the photographic method in producing transcriptions with a "quick" turnaround:

> *All texts of 166 scroll palimpsests (except for vanishingly small parts) - were recovered, of course without any use of harmful reagents.* ***In less than half a year****, this succeeded*

> *in affecting the reading of the texts and the transcription." This outcome in such a short time would have been quite impossible earlier. For example, palimpsest researchers such as Mark G. Sobell have stated that he required fifteen years to decipher the Würzburg Pentateuch and Prophetenpalimpseste (139 palimpsested leaves).*
>
> (*emphasis added, translation by Google*)

Dold's book also includes a very interesting advertisement for the Beuron Palimpsest Institute on its last page. The Institute offers imaging services to owners of palimpsests for two different sizes of images: 90mm × 120mm images for 3.5 Marks (~$0.64 at 5.53 Marks of 100 pfennigs per dollar) and 120mm × 180mm for 5.5 Marks (~$1).

PALIMPSEST-INSTITUT
DER ERZABTEI BEURON IN HOHENZOLLERN.

„Privaten Besitzern von schwer leserlichen Palimpsesten oder öffentlichen Bibliotheken bietet das Institut seine Dienste an, um ohne Anwendung chemischer Reagentien und daher ohne Schädigung der kostbaren Exemplare die Texte der wissenschaftlichen Forschung zu erschließen. Mit Zustimmung des Besitzers wird gegebenenfalls in Aussicht gestellt, ohne neue Kosten für ihn die photographischen Aufnahmen durch ein Reproduktionsverfahren als Tafelwerk weiteren Kreisen von Interessenten zugänglich zu machen. Es ist nur zu wünschen, daß sich möglichst viele Palimpsestbesitzer dieses Angebot zu Nutzen machen werden und, was bisher schwer oder gar nicht zu entziffern war, für eine ausgedehntere wissenschaftliche Ausbeute nutzbar machen."

(Aus dem Artikel: „Handschriftenforschung und photographische Kunst" in de „Theologischen Revue", 1915, Nr. 1/2, von Universitäts-Professor J. Göttsberger, München.)

• • •

In obigem Sinn erneuert das Palimpsest-Institut Beuron sein Anerbieten, Aufträge auf palimpsest-photographische Arbeiten auf jeweilige schriftliche Anfrage und Zusage hin zu übernehmen.

In Format 9×12 cm werden Photogramme zu M. 3.50, in Format 12×18 zu M. 5.50 mit Fluoreszenzverfahren ausgeführt. Erfordert das Größenverhältnis der Handschrift größere Formate oder der Zustand der Primärschrift Überexpositionen mit Extra-Stromverbrauch, so tritt entsprechende Preiserhöhung ein.

Günstige Resultate sind zu erwarten, wenn noch etwas Primärschrift vorhanden ist und die Palimpsestblätter nicht mit Gallustinktur oder einem anderen hindernden Reagens behandelt wurden.

Die Codices bleiben unangetastet, werden keinen chemischen Reagentien irgendwelcher Art unterworfen und feuer- und diebessicher geborgen.

Probeaufnahmen zu gleichen Preisen; Probetafeln zu Diensten.

COLLIGERE
FRAGMENTA
NE PEREANT

Figure 15: Advertisement for services by the Palimpsest Institute on the last page of Dold's 1917 book

In 1920, Kögel applied for a lecturer's position at the Technische Hochschule in Karlsruhe (now the Karlsruhe Institute of Technology) and left the Benedictine order in 1924. At that time, he retook his given name of Gustav and married Katharina Winkler from Zwickau on 11 October. She bore him a daughter in 1926 and a son in 1929. During this time, he seemingly pursued the disposal of his past in a systematic fashion. According to Johannes Werner, at this time Kogel started to rewrite his own history to appear qualified for academic positions. The irony of this effort is palpable: Kogel's research life had been directed at recovering lost or erased writings from manuscripts, but his personal life became an effort at erasing his own "writings." In his application to Karlsruhe, he apparently claimed that he had studied experimental physics and chemistry, had completed a full course for bacteriological health investigations, and that he had been a professor of biblical studies while in Brazil. His biography in the 1930 "*Reichshandbuch der deutschen Gesellschaft, Das Handbuch der Persönlichkeiten in Wort und Bild*" (*Empire Handbook of German society, Handbook of personalities in words and pictures*) claims that he had studied at the Technical University of Munich, although the record "*maintains with certainty that Kögel was at no time an enrolled student there.*" Werner quotes on of Kogel's colleagues that "*he had more sociability with books and bottles than with people*." That said, Kogel started an *Institute of Technical Photochemistry and Scientific Photography* at the University of Karlsruhe, where he worked in the areas of imaging, including forensic imaging, microscopy, X-ray fluorescence, and cinematography.

From Werner's findings, Kögel's history gets far worse and very creepy from this point forward. He sent an unsolicited note in 1933 to the "Ministry" that on 31 July 1932, the day after the national election, "*that I was the <u>first</u> and so far as I know, the <u>only</u> lecturer at the university who hoisted the Hitler flag on the house legal institution building.*" (p.144, emphasis in original, English translation by Google). He joined the National Socialist German Workers Party (NSDAP) on 1 May 1933 and the National Socialist Teachers League (NSLB) on 18 July 1934. Though I found no indications about Kögel's attitude with respect to the official attitude towards Jews, it seems clear that he had to have followed the party line, which suggests that his dedication to Pringsheim and Gradenwitz must have been forgotten.

I found no information about Kogel's life from this point to the end of the war, and only a small amount thereafter. Apparently Kögel was so worried that the Spruchkammer (Denazification Courts) would have sufficient reason to "classify him in the group of the "Main Culprits" or "Major Offenders," which was the worst of the five categories of criminal recognized by the German committees; the others were "Offenders," including activists, militarists, and beneficiaries, "Lesser Offenders," "Followers," and "Exonerated"). Penalties for those in each category included imprisonment for up to ten years (or worse) for "Major Offenders," imprisonment for up to five years for "Offenders," fines of up to 10,000 marks for Lesser Offenders, and for 1000 marks for Followers. Note that fines were to be paid in inflated currency because the value of the Reichsmark dropped from about one per dollar in 1945 to 270 per dollar in 1947.

Kögel's fear of the Spruchkammer apparently was sufficient to drive him to suicide by hanging on 27 November 1945 near Petersthal in Allgäu, where he had been relocated with his family. This note in Werner's paper shocked and depressed me, as the final outcome did not fit with my vision of Kögel as a scientist working to recover important texts that would have otherwise been lost. Werner elucidated Kögel's end by quoting lines from Bertold Brecht's "Threepenny Opera," which seems to be an appropriate ending to this paper:

"*There are some who are in darkness*
And the others are in light.
And you see the ones in the light
Those in darkness drop from sight."

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