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Nadja Lenz

The Hidden Image:
Latency in Photography and Cryptography in the 19th Century

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Cover illustration:
Adam Diston, *untitled*,
Leven/England, ca. 1855, Gelatin silver print.
Museum Ludwig Köln,
Fotografische Sammlung SL 866/72
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The Hidden Image: Latency in Photography and Cryptography in the 19th Century

Nadja Lenz

The fact that a latent image – in the form of a latent script image –exists in early analogue photography as well as in early cryptography encourages a comparative study.[1]

The blackening of silver salts with light and the reaction of gallic acid with metallic salts causing a latent script image were already known in cryptography centuries before the discovery of photography. Recipes for so-called sympathetic scripts[2] were based on these chemical processes. But, to which extent did the inventors of photography deal with cryptography? What kind of relationship exists between cryptography and photography and how are these two processes similar to each other?

History of concepts

The term 'latency' comes from the Latin word 'latens', and means 'hidden'. Only since the beginning of the 19th century, has the adjective 'latent' – in connection with a term describing a condition such as 'latent warmth', 'latent heat' and 'latent illnesses' – characterized a scientific phenomenon. The term was formerly mainly used in a religious or philosophical context.[3]

The metaphor 'image latente' (latent image) was already used in the French daily newspaper *Le Constitutionnel* in connection with the announcement of the daguerreotype process in the year 1839[4] and was taken over by the British press shortly thereafter.

As far as the pioneers and advocates of photography are concerned, the said term still had to be established. In contrast to Henry Fox Talbot, who frequently mentions the term 'latent image' in his records, the scientists John Herschel and François Arago talk of the 'dormant picture' and 'image dormante' respectively.[5] Further terms used by Henry Fox Talbot are: 'latent picture',[6] 'latent representation',[7] 'invisible picture',[8] and 'invisible impression',[9] as well as the circumscription '[the] image was impressed in a short period, but invisible ...'.[10] All these explain the invisible state of the photographic picture after exposure but before developing.

The term 'cryptography' comes from the Greek κρυπτός, kryptós, 'hidden' and γράφειν, gráphein "to write". The objective of cryptography is to guarantee four different characteristics for the content to be communicated: 1) Confidentiality: only authorized persons are able

1. This is the subject of my thesis *Das latente Bild in den Anfängen der Fotografie. Entdeckung des Unsichtbaren, Verschlüsselung des Sichtbaren* under the guidance of Prof. Herta Wolf, Institute of Art History at the University of Cologne. An earlier version of this article was presented on 16 April 2009 as part of Prof. Dr. Herta Wolf's graduate colloquium on *Conceptualisations in the Early Days of Photography* organised by the University of Duisburg-Essen, in Cologne in 2009.
2. From the Greek "Sympatheia" – "Sympathy", because the inks were mainly used for writing love-letters. Invisible inks are normally clear fluids, which become colourless when dry and visible again under the influence of warmth (with cobalt salts) or by the chemical gassing with hydrogen sulphide (with lead salts).
3. Sabine Müller, 'Diesseits des Diskurses', in: Franz X. Eder (ed.), *Historische Diskursanalysen: Genealogie, Theorie, Anwendungen*, Wiesbaden: Verlag für Sozialanalysen 2006, 138.
4. *Le Constitutionnel*, August 21, 1839. The reference can be found in: R. Derek Wood, 'The Daguerreotype and Development of the Latent Image: Une Analogie Remarquable', in: *Journal of Photographic Science*, September/October 1996, 44 (5), 165 – 167.
5. 'Papier photogénique, dit amphitype, He M. Herschell [sic]', in: Edmond de Valicourt (ed.), *Nouveau manuel complet de photographie sur métal, sur papier et sur verre albumine et collodion*, vol. 2, Paris 1862, 308.
6. Larry John Schaaf, *Records of the Dawn of Photography: Talbot's Notebooks P & Q*, Cambridge University Press 1996, Q 41.
7. Schaaf 1996 (reference 6), Q 43.
8. Schaaf 1996 (reference 6), Q 55.
9. Schaaf 1996 (reference 6), Q 77.
10. Concept of a letter, William Henry Fox Talbot to Alfred François Bouard, October 22, 1847, http://foxtalbot.dmu.ac.uk/letters/letters.html (20/12/2011), *The correspondence of William Henry Fox Talbot*, Project Director: Professor Larry J. Schaaf, Document number: 6021.

Figure 1
Julia Margaret Cameron, *J.F.W. Herschel*, Hawkhurst, Kent April 1867, albumen silver print, 35.4 x 27.3 cm. The J. Paul Getty Museum, Los Angeles.

to understand the contents of a message; 2) Authenticity (authorship): The sender of a message is unambiguously identifiable; 3) Integrity: The recipient is able to determine whether the contents of a message have been changed without authorization, and 4) Commitment: It is not possible for the sender of a message to deny its authorship.

When comparing photography and cryptography from the aspect of latency, it is helpful to consider the nature and the value of the latent condition.

The nature of latency

Basically, a distinction can be made between two individual kinds of latency:

Material latency stands for hiddenness through the lack of contrast. The latent image of analogue photography and of early cryptography – the script image of sympathetic inks – represents this kind of latency of chemical-physical processes. Moreover, latency and visibility describe a chronological order – a before and after; form and contents are hidden.

Immaterial latency means hiddenness by abstraction: Something hidden, which reveals its contents only after being decoded and understood. Latency and visibility can exist simultaneously; the form is visible but the contents are not revealed.

Material Latency in Cryptography

In cryptography, latency is generated by coating the carrier material, normally paper, with sympathetic ink. Recipes for sympathetic inks, with which the written vanishes when dry, were developed from the 14th to the 16th century, the period of individual handwritten ciphers and fantasy signs. Until the end of the 19th century, innovative recipes for secret writings were still published in scientific journals (figs. 1 and 2).

Six categories of sympathetic scripts based on different processes are known in the area of cryptography: Secret writings which have to be 1) sprinkled with powder, 2) scraped or rubbed, 3) warmed or heated, 4) exposed to the air, 5) moistened or immersed into another liquid or 6) exposed to vapours in order to make them readable again.

Figure 2
J.F.W. Herschel, *"Slough. April 22. 1839. Hyposulphite fixing. To be read transparent or a reflecting eye piece" (Secret writing).* National Media Museum, Bradford, BD1 1 NQ.

An analysis of the categories 5) and 6) is especially interesting when making a comparison. In early photography, the latent image was made visible by immersing it in gallic acid (Calotype method) or by vaporization with mercury vapour (Daguerreotype method).

Material Latency in Photography

In order to analyse the processes that play a role in the production of a latent image, it was necessary to understand the nature of the light, which was still a completely mysterious electromagnetic phenomenon in 1839. The theories of that time regarding the development of a latent image can be roughly summarized in three directions: Physical processes, chemical reactions or a combination of both were used[13] for explanation. All research was based on studies of silver halides. It was commonly assumed that the substances silver iodide, silver bromide and, consequently, silver chloride react in a similar way.[14]

Louis Mandé Daguerre, as well as Alexandre Edmond Becquerel, Joseph Henry and John Draper, assumed that electricity played a role in the image forming process. If electricity produces light, light should be able to produce electricity.

But only the quantum theory led to an exact understanding of the processes that have an effect on the development of the latent image. Contemporary science created a relationship between the two main variables: the amount of the effective radiation to the amount of the physically and chemically changed matter. The latent image is generated by the exposure of the light-sensitive film on a carrier material. During this process, a rather small number of the silver ions in the silver salt crystals are reduced to metallic silver atoms. These silver nuclei generate the latent image. In early photography, the carrier material also partly had the function of the light-sensitive layer (e.g. with the Daguerreotype, a process in which silver-plated and polished copper-plates had been sensitized with iodine or bromine vapour).

Before the diagnosis of the latent image in the process of photography, the light-sensitive image carriers had been exposed to the sun and one waited until a motif became visible (photogenic drawing). Exposure and development were all the same, the sunlight functioned as the developer.

Since the start of the use the latent image in analogue photography, the small silver crystals on the exposed parts have been auto-catalytically enlarged by a developer fluid (e.g. with the silver-bromide gelatine print). In this way, the silver ions of the silver bromide in

13. E. P. Wightman, 'Theories of the Latent Image and Reversal', in: *The journal of physical chemistry*, 1915, 19 (7), 571–588.
14. William Jerome Harrison, *The Chemistry of Photography*, New York 1892, 182.

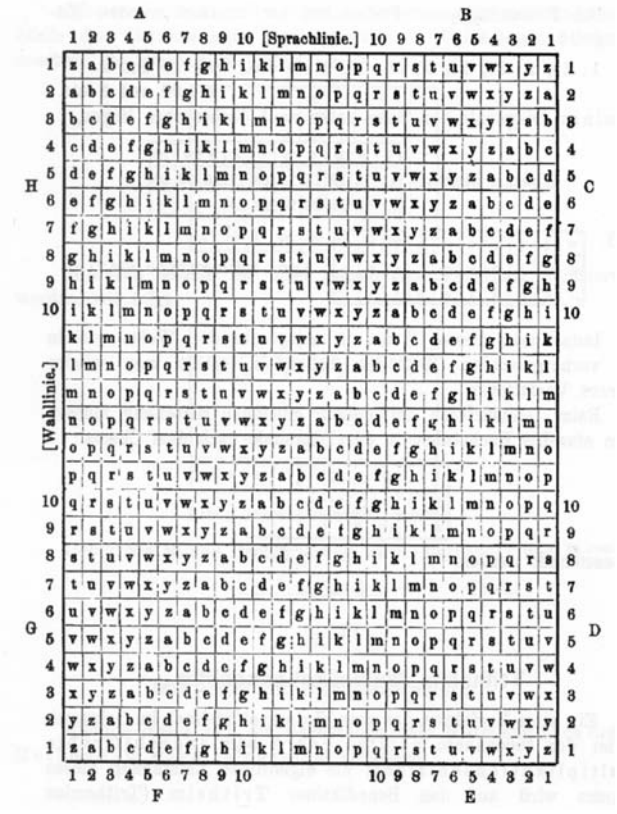

Figure 3
Hans Schneikert, *Moderne Darstellung der gebräuchlichsten und nützlichsten Geheimschriften mit besonderer Berücksichtigung der Graphologie als Hilfsmittel zur Dechiffrierung, Verbesserung und Neubildung von Geheimschriften*, Mannheim 1908, 12.

direct proximity to the silver nuclei are reduced to silver as well and appear black.

As already during the process of generation, the picture carrier can also influence the development (visualization) of a latent image. Thomas Wedgwood noticed that an image becomes visible more quickly on light-sensitive coated leather than on paper with the same coating.[15] Leather contains tannic acid (tannins), a derivation of gallic acid.

As R. Derek Wood explains in his article: *The Daguerreotype and Development of the Latent Image: Une Analogie Remarquable*[16], the first announcements concerning the photographic process assumed that the reading public was already aware of the sympathetic reaction of gallic acid with metal salts.[17] Early alchemists knew of the image intensifying potential of the oak-apple. According to Wood, knowledge of the process probably explains why some scientists had already experimented with gallic acid before 1839 – and therefore, before Henry Fox Talbot. In a letter to Talbot dated February 28, 1839, John Herschel mentioned the reaction of gallic acid with silver nitrate and he also refers officially to its relevance for the photographic process in an article written for the Royal Society dated March 14, 1839.

Immaterial Latency in Cryptography

The latency of cryptography has been mainly immaterial since the time of Gutenberg. Typographical coding with moveable letters, encrypting and decoding moved away from the chemical "handicraft" method in favour of semantic letters and juggling numbers: through sublimation/transposition or masking with irrelevant issues (confusion).[18] (fig. 3) In cryptography, a change from the material to the immaterial latency appeared.

Immaterial Latency in Photography

Immaterial latency in photography has existed only since the onset of digitalization in the middle of the 20th century and is therefore not the subject of this essay.[19]

15. Humphry Davy, 'An Account of a Method of copying Paintings upon Glass, and of making Profiles, by the agency of Light upon Nitrate of Silver. Invented by T. Wedgwood, Esq. With observations by H. Davy', in: *Journals of the Royal Institution of London*, vol. 1, no. 9 (22/6/1802), 170-74.
16. R. Derek Wood, 'The Daguerreotype and Development of the Latent Image: Une Analogie Remarquable', in: *Journal of Photographic Science*, September/October 1996, 44 (5), 165 - 167.
17. R. Derek Wood, 'Latent Developments from Gallic Acid 1839', in: *Journal of Photographic Science*, January/February 1980, 36 – 41.
18. Precisely speaking, cryptography uses a "manifold" immaterial latency: The recipient of an encrypted message needs to not only know the key but also to have knowledge of the language in which the contents is written – if it has not been semantically encrypted (e.g. by using metaphors). The same holds true for the decryption of visual contents. Understanding a picture needs more cognitive processes than "simply" seeing and understanding.
19. The immaterial aspects hidden in photography have only existed since it became possible to transform light sources into digital signals. Accordingly, a "latent image" is generated by exposure and encoding. This process is reversible – under the presumption that the corresponding hard- and software is available. The decoding is done by the re-conversion of the digital signals into light waves. A mathematical key stands for the developer fluid, which processes digital signals to be reproduced in an image output device. Besides the encoded pure image information, data concerning the development process (diaphragm, length of exposure, type of camera, etc.), the originator and the rights of use (with commercial utilization) can also be part of the encryption and can be transferred together with the transmission. Even in the case of later processing, this information will not necessarily get lost. These additional data are normally not visible on the decoded picture.

Figure 4
Charles Richard Meade,
Portrait of Louis-Jacques-Mandé Daguerre,
Brie-sur-Marne 1848, Daguerreotype,
hand-colored, image: 15.7 x 11.5 cm,
object (whole): 22.1 x 17.8 cm.
The J. Paul Getty Museum, Los Angeles.

The use of latency

Hiding for the sake of secrecy is the point of departure of cryptography. Here, latency is the mandatory means to an end. This does not hold true for photography: The visible image as the result of the exposure is important. A latent image is rather a labile part of the photographic process. Appreciation of the practical use of this "image in a state of suspension" as well as its ability to inspire creativity and experimentation, only came at a later date. Contrary to this, hiding for the sake of secrecy was the starting point of cryptography.

Apparently, the latent image, together with the photographic developer, was discovered accidentally as a side effect of the photographic process. It is not known why Daguerre (fig. 4) decided to use mercury for the development of his plates. There is a persistent story about the cupboard in which he stored his chemicals. He put an exposed silver iodide plate into the cupboard and later discovered that the developed image had become visible. Daguerre traced the development back to the mercury vapour which had formed inside the cupboard. The sources do not agree on the extent to which mercury has contributed to the development of the photographic plate: Some mention a bowl with mercury,[20] some a broken thermometer[21] and others refer to mercury which had been deposited in the cracks and joints of the cupboard.[22]

Mercury has a low vapour pressure; thus, a drop will be sufficient to produce mercury vapour inside a cabinet for chemicals. Whether this vapour is, however, sufficient to develop the AgBr-free particles of the crystals and silver clusters, is answered by the physicist, Ludger Wöste:

I believe it is possible that the side-by-side storage of exposed photo-sensitive plates and an open mercury source can lead to the emergence of an image on the plates. If stored in an unrefrigerated and sheltered place such as a cupboard, the vapour pressure of mercury in the air is sufficiently high as to cause the silver halide crystals on the plate (regardless of exposure) to come into contact with mercury atoms. This is enough to stabilize the latent image, i.e. the reduction of the exposed crystals to metallic silver.[23]

20. Josef Maria Eder, *Ausführliches Handbuch der Photographie, Erster Teil – Erste Hälfte,* Halle an der Saale 1891, 125. William Jerome Harrison, *The Chemistry of Photography*, New York 1892, 207.
21. Heinz Haberkorn, *Anfänge der Fotografie: Entstehungsbedingungen eines neuen Mediums*, Reinbek: Rowolth 1981, 73.
22. Wilhelm Schmidt, 'Die Photographie, ihre Entstehung und Entwicklung', Berlin 1886, in: *Sammlung wissenschaftlicher Vorträge*, Berlin 1870, (8) 248.
23. Dr. Ludger Wöste, Freie Universität Berlin and Nadja Lenz, personal communication, March 2009.

It is said that Talbot also accidentally discovered the potential of a latent photographic image in 1841. When he exposed some photographically treated sheets of paper for only a short time to prove their sensitivity, he put one sheet aside. He picked it up again later and discovered that it showed a negative image.[24] Later photographic research confirms, however, that Talbot's use of gallic acid can be traced back to a conversation with a seller of optical instruments (Andrew Ross & Co, Regent Street, London), who told him about the experiments Joseph Bancroft Reade had performed.[25] As Reade stated in 1865, he had also discovered the existence of the latent photographic image by chance. Regarding the use of gallic acid, however, he referred to the experiments carried out by Wedgwood[26].

In photography, latency was felt as being mystic because one was not able to explain the exact procedures leading to the development of a latent image. In a letter to the French scientist Biot, Talbot writes that:

I offer it as a new method of secret writing, which offers a great deal of security. Should a letter which has been thus written invisibly, falls into foreign hands, when he opens it, he will find nothing more than blank paper. But, by thus exposing it to daylight, he will have destroyed it, and the writing will thus become forever indecipherable. I recommend this experiment to diplomats, and to lovers of mystery.[27]

And, detection of the latent image in 1839 also considerably increased the suitability of photography for everyday use. It became possible to interrupt the transition-free process from exposure to development by storing the latent image in darkness. This resulted in an enormous gain in time and mobility for the early photographers. Complex equipment for the purpose of immediately developing and conserving the motif directly after being photographed was no longer necessary. In addition, the length of exposure could be considerably shortened through knowledge of the different 'reaction accelerating' components in the developer fluid.

Early photography and cryptography – differences and similarities

The reasons which led to the origin of photography and cryptography are different. In photography, it was the desire to portrait the moment; in cryptography, the safe transmission of confidential messages. The generation of a latent image in secret writing is the mandatory means to an end, whereas it is only an intermediate step in photography.

The opposite motives – making something visible or hiding it – however, led early photographers and cryptographers to use similar means and to the development of similar processes. Whether the different goals in the past were the only reason for the different rate of development of the two media is another question.

24. Josef Maria Eder, *Der Collodion- und Daguerreotyp-Process und ältere Negativ-Processe*, Halle/Saale 1884, 78.
25. R. Derek Wood, 'Latent Developments from Gallic Acid, 1839', in: *Journal of Photographic Science*, January/February 1980, 36 - 41.
26. J. B. Reade, 'The Early History of Photography', Letter 'From the Rev. J. B. Reade to Lyndon Smith Esq ... Dec. 16, 1859', *British Journal of Photography*, 1 March 1862, vol. 9, 79–80 (where he said "My use of gallate of silver was the result of an inference from Wedgwood's experiments with white leather"). Also reprinted almost in full (without its source being cited) in John Werge's influential *Evolution of Photography*, London: 1890, 15–21.
27. Concept of a letter, William Henry Fox Talbot to Jean-Baptiste Biot, January 17, 1841, http://foxtalbot.dmu.ac.uk/letters/letters.html (20/12/2011), *The Correspondence of William Henry Fox Talbot*, Project Director: Professor Larry J. Schaaf, Document number: 4556. Original in French language.

The moment in which an image is in a latent condition is different in photography and cryptography: In early cryptography, the image was formed by writing that became latent when it dried and visible once again after being developed. In photography, the image is generated by exposure and development after which the image becomes visible for the first time.

But there are many commonalities between photography and cryptography, especially in connection with the chemical relationships affecting latency. It is no coincidence that photography is based on ingredients of chemical-based secret writings. In the 19th century, in the early days of scientific chemistry, alchemy was still regarded seriously although some considered it out of date and not precise from a scientific point of view.[28] One of the substances alchemists discovered in their search for the "philosopher's stone" was named Luna Cornea or horn silver. They recognized that this substance blackened when exposed to light.[29]

Johann Heinrich Schulze (1687–1744), who – in 1720 – attempted to refine an earlier experiment by Christian Adolph Balduin, should also be mentioned. He did not discover the "philosopher's stone" but phosphorus. Just as accidentally, Schulze discovered the property of light to blacken silver nitrate.

Later, Jean Hellot made paper light-sensitive by using silver nitrate. He was interested in the possibilities of the art of secret writing and detected that a weak silver nitrate solution in water could function as invisible ink. He had written on a white sheet of paper with diluted silver nitrate solution – as long as he kept this paper in darkness, it remained white. Exposed to the sunlight, what he had written became legible in a kind of blue-grey colour within one hour. However, Hellot assumed this blackening to be a result of the impurity of the nitric acid, in which he suspected sulphur.[30]

Joseph Nicéphore Niépce, the discoverer of heliography, who was afraid that his work could fall into the wrong hands, used a numerical secret writing in his written conversation with Daguerre. He replaced key terms by numbers. In February 1830, Daguerre sent a letter to Niépce drawing his attention to the fact that their common attempts to improve the heliographic process may have been successful:

This is the breakthrough of promptitude. The same happens to 53 [distillation] as to 14 [day]. The remains of 53 [distillation] after 55 [evaporation] do not corrode after applying 21 [solvent]. The parts which received during 14 [day], facilitate (sic!) 55 [evaporation]. What remains on the plate is equally uncorrodible by 21 [solvent]. So 14 [day] seems to have a similar effect as 24 [fire], which proves that the principle applies to both processes.[31]

28. Russell Roberts, Michael Gray, *Specimens and Marvels: William Henry Fox Talbot and the Invention of Photography*, New York: Aperture 2000, 9-10.
29. Hermann W. Vogel, Hans Spörl (eds.), P*hotographie. Ein kurzes Lehrbuch für Liebhaber und Fachleute*, Braunschweig 1909, 1.
30. 'Histoire de l'Académie Royale des Sciences, année 1727. Avec des Mémoires de Mathématique et pour Physique pour la même Année. Sur une nouvelle encre sympathétique', in: Josef Maria Eder (ed.), *Quellenschriften zu den frühesten Anfängen der Photographie bis zum XVIII. Jahrhundert*, Halle/Saale 1913, 103 –116.
31. Letter from Daguerre to Niépce, February 1830. Jean-Louis Marignier, 'Experimenteller Nachvollzug der Forschungsarbeiten von Nicéphore Niépce', in: *Spektrum der Wissenschaft*, February 2, 1997, 57.

Figure 5
Joseph Nicéphore Niépce, *Un Clair de Lune*, c. 1827, photograph on pewter. The Royal Photographic Society Collection at National Media Museum/SSPL.

Some publications on photography mention Niépce as the discoverer of the latent photographic image.[32] This assumption is due to a misunderstanding in descriptions of his heliographic process. In his "Notice sur l'héliographie", Niépce does mention a hidden image that he made visible with the help of a solvent.[33] However, this was not actually a latent photographic image: The colouration of the bitumen covered the image after exposure. It was washed out in a further stage of development and, in this way, became visible.[34]

However, investigations carried out on his photograph – *Un Claire de Lune* (fig. 5) – by the Getty Conservation Institute (GCI) in 2010 show that Niépce was already practising a photographic process described by the Institute as "Physautotype" in 1827. To achieve this, the CHI illuminated the image medium with a special Fourier Transform Infrared Spectrometer

32. Cf. G. C. Hermann Halleur, Franz Schubert, Gustave Louis Maurice Strauss, *The Art of Photography: Instructions in the Art of Producing Photographic Pictures in Any Color, and on Any Material: for the Use of Beginners, and Also of Persons who Have Already Attained Some Proficiency in the Art, and of Engravers on Copper, Stone, Wood, Etc.*, J. Weale 1854, 4. John Sartain, Caroline Matilda Kirkland, J. S. Hart, 'Photography – its origin, progress, and present state', in: *Sartain's Union Magazine of Literature and Art*, vol. 10, Philadelphia 1852, 447.
33. 'Notice sur l'héliographie', in: M. L'Abbé Migne, *Nouvelle encyclopédie théologique*, Paris 1860, 738. 34. Jacques Roquencourt, 'Daguerre et l'optique', in: *Études photographiques*, vol. 5, November 1998, 26-49.
34. Jacques Roquencourt, 'Daguerre et l'optique', in: *Études photographiques*, vol. 5, November 1998, 26-49.

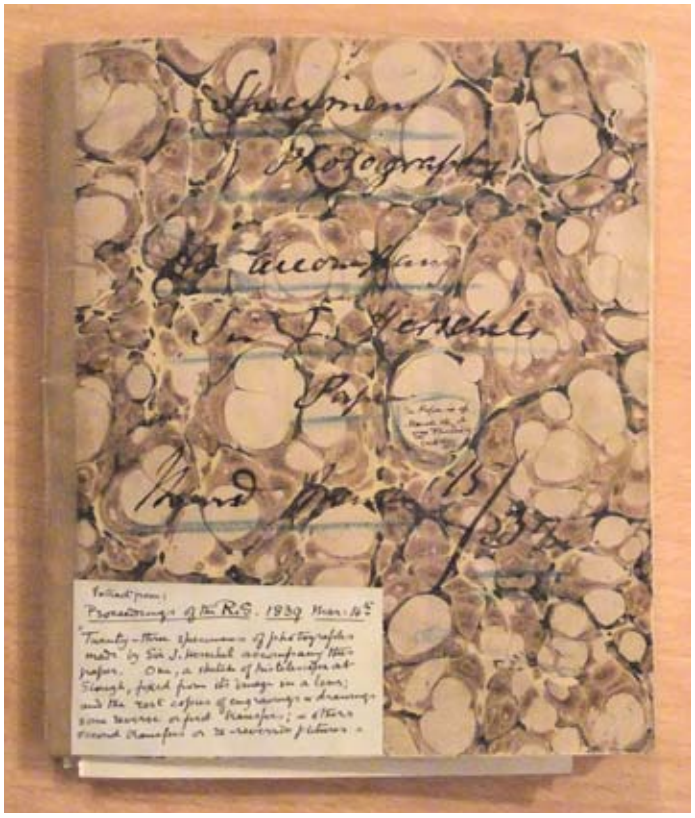

Figure 6
Cover of Herschel's notebook, *Specimens of photography. Extract from: Proceedings of the R. S. 1839 Mars 14th. Twenty-three specimens of photographs made by Sir J. Herschel accompany his paper. One a sketch of his telescope at Slough, fixed from its image in a lens; and the rest copies of engravings or drawings some reverse or first transfers; & others second transfers or re-reversed pictures.* National Media Museum, Bradford, BD1 1 NQ.

to obtain information on the substances used. Heated lavender oil was discovered on the pewter medium. Bitumen, as used in the process of heliography, was missing. A more exact analysis has, so far, not been carried out. Although the CGI has classified *Un Claire de Lune* as the first photograph, it appears certain that no strengthening of the picture occurred at a later time seeing that the Getty Institute was unable to detect any other chemical substances.[35]
In the book *Kryptographik. Lehrbuch der Geheimschreibekunst (Chiffrir- und Dechiffrirkunst) in Staats- und Privatgeschäften* by Johann Ludwig Klüber, dated 1809, a process of cryptography which comes remarkably close to the production of a Daguerreotype and the substances needed for it is described.

Solubilize lead (II) oxide in distilled vinegar. Filter it and allow to rest until it becomes clearer. Store the liquid in a bottle of glass. Then start writing, but make sure you do not dry what is written with fire. If the writing is to become visible, one must only bring it into contact with sulphurated hydrogen gas, which is done in the following way. Pour half a pint of pure water over a lot (= 1/30 of a pound) of potassium sulphide (available from pharmacies), shake it well, allow to rest for a quarter of an hour, then pour the liquid into a glass container and seal it with a cork stopper. The writing must be placed just above the opening of the glass and the letters will emerge in a brownish red colour. If a few drops of any kind of acid are added, the letters should get a metallic lustre.[36]

The physician Ludger Wöste[37] elaborated that:

At least in association with silver lustre the description contains all essential ingredients of the silver photography, so that I can well imagine that the author produced with his secret writing a quite robust latent image, which he then developed with the procedure according to his description.

A paper with secret writing dated 22 April 1839 was found in Herschel's estate with a note by Herschel on the upper edge stating that he had fixed this with hyposulfite.
Seeing that he had been working on his first photo-chemical pictures, which he presented to the Royal Society as part of his lecture entitled *Note on the Art of Photography, or the application of*

35. Cf.: Nadja Lenz, 'Neue wissenschaftliche Erkenntnisse zu den ältesten fotografischen Bildern der Welt', in: Rundbrief Fotografie, vol. 18 (2011), no. 1 / N.F. 69, 41-42. In his work: 'Première reconstitution du deuxième procédé photographique du monde'published in: *Le photographe*, November 1992, 26-33, Jean–Louis Margnier drew attention to an earlier process used by Daguerre and Niépce in 1832 that he described as 'Physautotype'.

36. Johann Ludwig Klüber, Kryptographik: *Lehrbuch der Geheimschreibekunst (Chiffrir- und Dechiffrirkunst) in Staats- und Privatgeschäften*, Tübingen 1809, 408-409.

37. Dr. Ludger Wöste, Freie Universität Berlin and Nadja Lenz, personal communication, March 2009.

Figure 7
Pill box and nitrate of mercury which Herschel used for his chemical experiments. National Maritime Museum, Greenwich.

the Chemical Rays of Light to the purposes of Pictorial Representation on 14 March 1839, shortly before this and that he mentions hyposulfite being used as a fixing agent for the first time, it still remains to be clarified if photo-chemical parallels exist between the objects going beyond the substance. (Figs. 6 and 7)
Herschel made the Royal Society aware of the (playful?) image-intensifying effect of mercury chloride (mercury(I)chloride) ($HgCl_2$) in his 1840 report.[38] The process – later called magic photographs or Indian-ink outlines – made it possible to make paper photographs invisible by applying mercury chloride and make them visible again by applying neutral hyposulfite. With the publication of this process, Herschel refers to the existing parallels to the latent (script)-image of secret writing.

By far the most remarkable fixing process with which I am acquainted, however, consists in washing over the picture with a weak solution of corrosive sublimate, and then laying it for a few moments in water. This at once and completely obliterates the picture, reducing it to the state of perfectly white paper, on which the nicest examination [if the process be perfectly executed] can detect no trace, and in which it can be used for any other purpose, as drawing, writing, etc., being completely insensible to light. Nevertheless, the picture, though invisible, is only dormant, and may be instantly revived in all its force by merely brushing it over with a solution of a neutral hyposulphite, after which it remains as insensible as before to the action of light. And thus it may be successively obliterated and revived as often as we please. It hardly requires mention that the property in question furnishes a means of painting in mezzotinto [i.e. of commencing on black paper and working in the lights], as also a mode of secret writing, and a variety of similar applications.[39]

Dealing with secret writings also contributed to cross-process changes and optimizations: In the same year, in which John Herschel announced the magic-photographs process, 1840, Robert Hunt used his experience for optimizing Daguerreotypes: After the latent image had been made visible, it became even clearer by the treatment with mercury chloride.
Talbot also gives some hints regarding chemical experiments with secret writings in his notebooks between 1833 and 1836. The first, in notebook Q in March 1831, states that:

38. J. F. W. Herschel, 'On the chemical action of the rays of the solar spectrum on preparations of silver and other substances, both metallic and non-metallic, and on some photographic processes', in: *Philosophical Transactions of the Royal Society of London*, 1840, 1–59.
39. J.F.W. Herschel 1840 (reference 38). With regard to further investigations in respect of Herschel's work with secret writings, see also: R. S. Schultze, 'Photographic Researches of Sir John F.W. Herschel. Rediscovery and Description of Original.
Material on the Photographic Researches of Sir John F.W. Herschel, 1839 – 1844', in: *Journal of Photographic Science*, The Royal Photographic Society of Great Britain, March 1965, vol. 13, 1965, 57 – 68.

letters written with Sul Chrome when heated are slightly greenish sulph Nickel. They become raised white and fused sulph Iron. Brownish black it requires great to heat to develop it. Common salt & Sulph Copper mixed [tho' both dry and slightly damp] immed/y turn green owing to the form/n of muriate of copper [chloride][40]

Conclusion

Early photographers dealt extensively with the findings of cryptography, both in their search for suitable substances to produce light-sensitive layers as well as in experimental research into suitable developers to visualise a latent image or document. Mercury and gallic acid played a key role. It comes as no surprise that gallic acid, in particular, received special attention seeing that it was a component of the ink used for documents of a diplomatic character. Hyposulfite, on the other hand, was suitable for use as a fixing agent for both cryptographic and photographic documents.

Photographically and cryptographically motivated experiments on material latency were always useful in the scientific classification of the chemical substances employed. Whether almost by chance – as in the case of Jean Hellot – or exactingly scientific – in John Herschel's case – this made it possible to arrive at new conclusions on chemical and chemical-physical effects.

Cryptography not only made a major contribution to the discovery of photography, it still plays a pioneer role. Long before the discovery of photography, cryptography used immaterial latency to store and transmit information. Photography has only made use of immaterial latency for the same purpose since the middle of the 20th century.

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40. Michael Gray, 'Secret Writing', in: Mike Weaver (ed.), *Henry Fox Talbot: Selected Texts and Bibliography*, vol. 3, Oxford 1992, 71 – 73.