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Janez A. Puhar (1814–1864) – The Forgotten Slovene Inventor of Photography on Glass and His Process – The Puharotype (1842)

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Abstract

This article highlights the importance of the Slovene photographer Janez Avguštin Puhar (1814–1864) and his photographic process – the puharotype. The process is fully described, as are Puhar's efforts to be recognized as the inventor of photography on glass. The article also presents an overview of the results of a preliminary study previously made using the proton-induced x-ray emission (PIXE) method on Puhar's surviving photographic materials.

Introduction

It is generally acknowledged that in 1848 Claude Félix Abel Niépce de Saint-Victor (1805–70) invented the first practical photographic process on a glass support (Gernsheim 1955, 148). Having used starch as a binder on a glass plate in the previous year, he then informed the Académie des sciences in Paris about the improvements to be obtained by changing the binder and coating glass plates with an emulsion of potassium iodide suspended in albumen (Whitman 2007, 9). He named the process after himself – the niepceotype.

But as in so many other developments in the history of photography, the full story is much more complicated. There are several others inventors/photographers from different countries who contributed experimentally to the evolution on glass-plate photography prior to 1848. The earliest experiments on glass as a support were carried out in France by Joseph Nicéphore Niépce (1765–1833). In 1822, while working on his heliograph process, he experimented with different supports for a layer of bitumen of Judea dissolved in lavender oil. In 1829, he started a partnership with Louis-Jacques-Mandé Daguerre (1798–1851) in order to improve his process; instead they invented a new one – the physautotype, in which images were produced by the use of lavender oil dissolved in alcohol as a photosensitive agent (Whitman 2007, 6).

Experiments continued in England; in 1839 Sir John Frederick William Herschel (1792–1871) invented a photographic process called the amphitype or allotype, as suggested by his colleague W. H. F. Talbot. Herschel combined highly diluted solutions of sodium chloride and silver nitrate on a clean glass plate to form a thin coating of silver chloride (Whitman 2007, 7). Once dry, the plate was given a second application of silver nitrate and exposed while still wet in a camera obscura (Osterman 2001, 1). One photograph survives and is kept in the National Media Museum at Bradford (England). It is the earliest surviving photograph on glass in the world (Whitman 2007, 7). A year later, William Henry Fox Talbot (1800–77) conducted some experiments involving albumen on glass fumed with iodine and sensitised with silver nitrate (Whitman 2007, 8).

In the United States, Alexander S. Wolcott (1804–44) and John Whipple (1823–91) carried out experiments in the early 1840s which were not published before 1848; their achievements became known only after Abel Niépce de Saint-Victor's announcement of the niepceotype. Both used albumen as a binder on a glass support. In 1843, Alexander S. Wolcott, from New York, wrote to his friend John Johnson about his experiments involving albumen on glass for making photographic lantern slides. Wolcott died three months later and his letter was published only in 1855 (Osterman 2001, 2). A year later, not knowing about the experiments made by Wolcott, John Whipple and his partner William Jones, from Boston, Massachusetts, started experiments with albumen as a binder on a glass support. Preoccupied with other experiments, Whipple patented the process known as a crystalotype in the United States in 1850 (Whitman 2007, 8).

Thus, there were several photographers from different countries who had experimented with the glass plate as a support for the photographic image before 1848. These involved both positives and negatives and used different binders, exposure times, fixing agents, etc.

The purpose of this paper is to add to the list of the above mentioned inventors an additional name – the Slovene photographer Janez A. Puhar (1814–64) and his invention, a photographic process which he named the heliotype or hyalotype or svitlopis. Today, it is commonly known as the puharotype, after its inventor.

Biographical Information, Photographic Process, and Related Literature

Janez Avguštin Puhar (also written Johann Pucher or Joannes Puhar) was born on 26 August 1814 in Kranj, in the Carniola region of Slovenia, which was then part of the Austrian Empire. After finishing grammar school in Kranj, he entered a seminary and was ordained into the priesthood in 1838. From 1839, he worked as a curate in various towns and villages: in Svibno, Metlika, Ljubno, Radovljica, Bled, Cerklje, Smlednik and Kamnik. He returned to Kranj in 1864 where he died on 7 August (Robežnik 2007, 12–21).

According to the records of Jurij Jarc, Puhar's first biographer, Puhar had already mastered the daguerreotype process by 1840 (Jarc 1859,136–138). Puhar is also mentioned as the first daguerreotypist in Carniola (Kambič 1989, 13). Since he found this process very expensive, he invented his own technique, using materials which were cheap and available. He used glass plates as the image support, sulfur as a binder, iodine and mercury vapours as light-sensitive agents, bromine vapours as an agent for enhancing the weak image on the plate and alcohol as a fixing agent. It was a completely dry process; he worked only with vapours.

Puhar presented his invention in an article entitled *Neu erfundenes Verfahren, transparente Heliotypen auf Glassplatten darzustellen* (Newly discovered process of representing transparent heliotypes on glass plates), published on 28 April 1843 in the newspaper *Carniolia* (Laibach) (Puhar 1843, 416). The same article, with the title *Transparente Heliotypen auf Glassplaten darzustellen* (Representing transparent heliotypes on glass plates), was reprinted a week later, on 3 May 1843, in a Graz newspaper, the *Innerösterreichisches Industrie und gewerbe Blatt* (140). Both articles were signed by J. P. Kaplan in Upper Carniola. Puhar's detailed report about his invention served as written proof of the originality of the process and proof of the year of his invention as well.

In this article, Puhar refers primarily to Dr Moser's theory of light and to Robert Hunt's thesis of thermoelectric changes induced on a smooth mirror surface when touched by a body. The contact results in an imprint, a latent image that becomes visible by means of certain vapours. Then Puhar continues as follows (Bassin 2001, 53):

> In the case of my invention, which is already a year old, the principle is that the light reflected from the illuminated object influences the molecules of the heated and cleaned glass plate in the camera obscura in the same way as a contiguous body can, that is to say, during the exposure, which in my judgment lasts approximately 15 seconds. The vapours I use, which bind a lot of heat, are caught at the last moment, in the flicker of an eyelid, in the places which have been reached by light as they condense or electrically attract; the glass remains clean, partially or completely consistent with the power of light tones, which means that they do not condense, but rebound. After this interplay of vapours the picture inside the camera obscura is fixed and thus we can see a motif fixed on the glass plate at a certain distance from a black plate if we hold the former in front of a window. It is transparent and has a blue tone and is not reversed, but in its natural position, although pictures can also come out well in such a way that you can look at them in incoming light like daguerreotype pictures, whose focus and light accuracy they have, although the latter to a lesser degree because they are not so light-receptive. Another circumstance here is that there are certain spots in which the picture seems to appear as in a haze due to inadequate procedure. To preserve such a picture for good, we varnish it and cover it with a glass plate to protect it from the damp and dust.

In 1848, Puhar found out about Abel Niépce de Saint-Victor's photographic process, which was recognized as the first practical photographic process on glass. Puhar began looking for a way to protect the precedence of his own invention. He asked the natural science experts in Ljubljana for help. He soon made contact with Schrötter von Cristelli, the secretary of the Academy of Sciences in Vienna. As a scientist who was primarily involved with problems concerning sulfur, he found Puhar's process with sulfur vapour interesting. After correspondence with Puhar, the members of the academy carefully examined Puhar's invention. In 1851, the academy published Puhar's report entitled *Die Transparentlichtbilder auf Glass* (Transparent light images on glass) in *Sitzungsberichte der mathematisch-naturwissenschaftlichen Klasse der kaiserlichen Akademie der Wissenschaften* (Reports of a mathematical and natural science character of the Academy of Sciences) (Puhar 1851, 43–46), and a year later the report was translated into French and published in the French journal *La Lumière* on 4 September 1852, entitled *Images transparentes sûr verre per Pucher, chimiste à Veldes (Oberkrain, Autriche)*" (160).

In his report Puhar states:

> Each invention […] even the most inconspicuous […] has to be examined with attention. […] This is even more necessary if a new chemical agent is used. The latter is true for my invention, already eight years old […] where sulfur is used for the production of transparent photographs on glass plates. […] I am going to explain my method […] We breathe on a flat window glass, or better on a polished mirror glass and rub the plate with a dry and soft linen cloth and warm up the plate. The light-sensitive material is applied to the plate using a sulfur candle, made especially for this purpose. The sulfur candle is inserted in a narrow tube and burned. The plate is kept at a distance of about three inches. After a very short time the plate is coated with a pearl white surface, which has a bluish

> red character under light. A sulfur candle is made from the pith of a rush, soaked in a mixture of sulfur and mastic. […] Then the sulfurized plate is, just for a few seconds, impregnated with iodine vapours. […]The plate is now light-sensitive. The plate is inserted in a camera[1] and exposed to light for one minute. […] On the bottom of the camera is a metal container, filled with mercury.[2] […] Then the plate is taken out of the camera. The mercury vapours produces a weak image. We use bromine vapour to develop the image and then fix the image in alcohol. The entire process lasts from five to eight minutes.

At the end, he varnished the image, put another glass plate on the top of the first and sealed the edges in order to protect the image from humidity and dust. Puharotypes are unique images which cannot be duplicated or reproduced.

In 17 June 1852, Puhar received the title of honorary member, and a diploma from the French Académie nationale agricole, manufacturière et commerciale, recognizing him as the inventor of photography on glass.[3]

From 1851 to 1855, he also displayed his puharotypes at several events: at the Great Exhibition of the Works of Industry of All Nations in London in 1851[4], at the World's Fair in New York in 1853[5], and at the Exposition Universelle in Paris in 1855 (Kambič 2006, 36–37).

Puhar is mentioned in only a few histories of photography. He is described in Wilhelm Mutschlechner's exhibition catalogue (1984, 10) as an "independent inventor of photography on glass". Wolfgang Baier (1965, 152–153) summarized the Vienna report about his process. Together with a short description of his process, and with some doubts, he was included among the pioneers of photography in Helmut Gernsheim's *History of Photography* (1955, 45–46).

Fig. 1. Janez Puhar, *Self-portrait*, 120 x 100 mm, puharotype. Image courtesy of the National Museum of Slovenia, photographed by Tomaž Lauko

Fig. 2. Janez Puhar, *Portrait of a Man (Portrait of Brother in Law)*, puharotype, 115 x 92 mm, ca. 1855. Image courtesy of the National Museum of Slovenia, photographed by Tomaž Lauko

Fig. 3. Janez Puhar, *Portrait of a Woman (possibly Sister),* puharotype, 115 x 92 mm. Image courtesy of the National Museum of Slovenia, photographed by Tomaž Lauko

Identification of Puharotypes

There are only five known surviving puharotypes. Three (figs. 1–3) are kept in the National Museum of Slovenia, one is in the Museum for Design and Architecture (a portrait of Andrej Vavken in Cerklje, circa 1860), and the other in a private collection (fig. 4).

Visual examination was made of the first three puharotypes from the National Museum of Slovenia. All of them are rather modest, small in size (120 x 100 mm), and of black, grey and bluish tonality. Much damage has occurred due to the fragility of the support material, which is glass, and because of inappropriate restoration and conservation methods. Some improper attempts at cleaning the images have also been made, most evident in Figure 1.

The only, preliminary, research involving chemical analysis of the puharotypes and associated hypotheses was made between 1999 and 2002 for the purpose of a documentary entitled *Izgubljena formula Janeza Puharja* (Janez Puhar's Lost Formula), which was broadcast at the Slovenian Film Festival in 2000.

The preliminary study was made on the puharotype *Portrait of the composer Andrej Vavken and painter Ivan Franke* (1861) (fig. 4.), and was led by Dr Miloš Budnar from the Microanalytical Centre (MIC) of the Jožef Stefan Institute Reactor Centre.

For the analysis of the Puharotype, the proton induced x-ray emission (PIXE) method was used. The PIXE method determines elemental concentrations in the sample on excitation by a proton beam with a typical strength of 1–3 MeV. On colliding with protons, atoms in the sample become ionised and excited. The excited electrons subsequently lose energy and return to the ground state by the emission of x-rays whose energy is characteristic of the given atom. The PIXE method is based mainly on the detection of the K-shell transitions in lighter, and the L-shell transitions in heavier atoms, because the characteristic energies of these transitions are well enough separated to resolve the contributions of different atoms in the spectra recorded by a typical semiconductor x-ray detector. The PIXE method is used for systematic studies of art and archeological objects. The measurements were executed at the Tandetron accelerator, using a proton beam in air, so the analysis was performed without sampling. The PIXE method is multi-elemental, fast, sensitive (ppm), precise (< 5%), and non-destructive.[6]

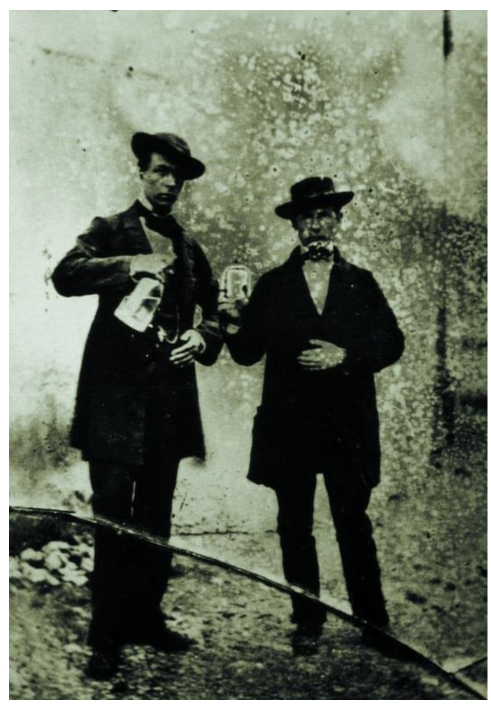

Fig. 4. Janez Puhar, *Portrait of the Composer Andrej Vavken and the Painter Ivan Franke*, ca. 1861, puharotype, 115 x 97 mm. Privately owned, reproduction sent for the purpose of this article by M. Budnar

The aim of the measurements in the pilot study was to investigate the method used in Puhar's process, particularly the materials used in this process. The analysis showed that Puhar used two elements during his process: mercury (Hg) and sulfur (S) (fig. 5.). This was the first preliminary scientific evidence confirming the originality of Puhar's process. The presence of other elements in the spectra, such as silicon (Si), potassium (K), calcium (Ca), manganese (Mn), titanium (Ti), and iron (Fe), could be attributed to impurities in the materials (Budnar 2013). The presence of iodine (I) or bromine (Br) was not found.

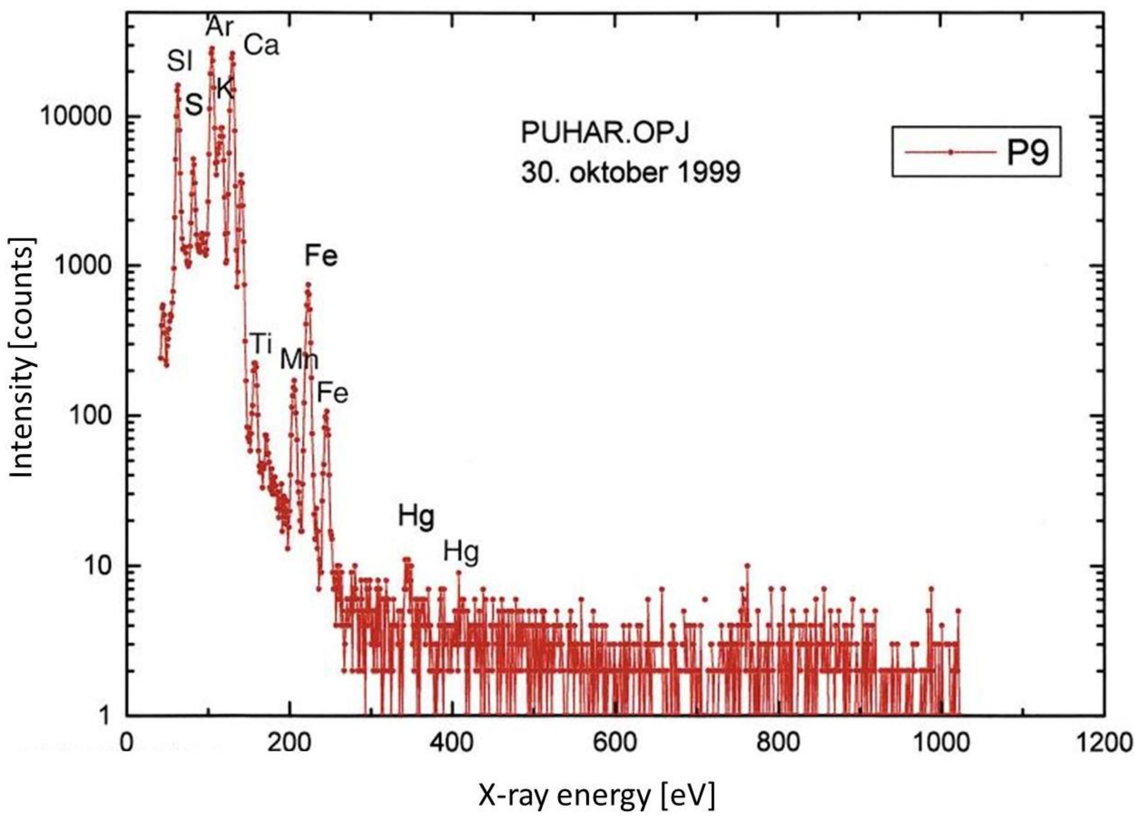

Fig. 5. Analaysis of a Puharotype (Figure 4) using the PIXE method.

Although the pilot study was suspended at this stage, its results are significant for identification of the process. In addition, in 2000 Dr Boris Orel (2000) from the National Institute of Chemistry summarized previous results and the correspondence between Igor Pediček and Dr Mike Ware, and also proposed a new hypothesis. In the first hypothesis, Ware claimed that Janez Puhar discovered the light sensitivity of sulfur thirty years before the generally recognized date.[7] He claimed that Puhar also discovered a previously unknown photographic process based on the light sensitivity of mercury sulfide (Orel 2000). In the second hypothesis, Orel claimed that light sensitivity was achieved due to the interaction of the three elements sulfur, iodine and mercury. He stated that sulfur is not the light-sensitive agent, but serves only as a matrix for the inclusion of iodine, even though its presence was not detected by the PIXE method (Orel 2000).

At this stage, the research performed during and after the shooting of the documentary came to a standstill. No further work was undertaken. The analysis by the PIXE method confirmed that Puhar had used sulfur during the process. Different hypotheses were then proposed: the first based on the results obtained by the PIXE method, by which iodine is not detected, and the second based on Puhar's original process in which the use of iodine is described. The correct answer can only be found by further scientific research into the characteristics of the procedure. This should be carried out by an interdisciplinary project team of chemists, in particular, and curators and art historians, and in cooperation with foreign experts who have many years of experience with analytical methods of identifying old photographic processes. To further this objective, all historical evidence about the process, as well as all unpublished analytical results are presented here together for the first time.

Conclusion

It is possible to claim with certainty that Janez Puhar belongs to the group of photographic inventors who experimented with different chemical substances on a glass support before 1848. This can be proved by the historical evidence presented in this paper. The preliminary research conducted in 1999 and 2000 is significant because it proves the use of sulfur and mercury in his method. However, it also raises some new questions about the chemical materials he actually used in his process, particularly iodine.

In 2014, Slovenia will celebrate the 200th anniversary of the birth of Janez Puhar by commemorating Puhar year. It will, therefore, be an appropriate opportunity to undertake further research in order to present the originality of his process to the Slovenian and the international professional public. Undoubtedly, the process was unique in his time. Unfortunately, Puhar was unable to promote it successfully in the same way as his contemporaries did.

Notes

1). He made his own camera.
2). He heated it and produced mercury vapors.
3). The original diploma is preserved in the National Museum of Slovenia.
4). See https://archive.org/stream/officialcatalog06unkngoog#page/n206/mode/1up.
5). See https://archive.org/stream/cu31924031227105#page/n182/mode/1up.
6). See http://www.rcp.ijs.si/mic/general/iba_pixe.php.
7). See http://www.biodiversitylibrary.org/item/122389.

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