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Cold light in the painting '*Group portrait in the Chemist's House*'

> 'Alchemists treated light as a symbol of the spirit and were particularly interested in the light imprisoned in matter'.[1]

(1) Introduction

In 2005 the Jagiellonian University Museum mounted the exhibition *Uczony i jego pracownia / The Scholar and His Study*, which was opened from 11th May to 28th August.

Among the paintings borrowed from numerous museums in Poland, and scientific instruments chiefly from the collections of the Jagiellonian University Museum, was a picture by a 17th century Dutch artist, Cornelis de Man. It is the property of the National Museum in Warsaw, on permanent display in the Gallery of Foreign Paintings.

The painting (see also http://www3.uj.edu.pl/Muzeum/angielski/images/16-cd.jpg) is a group portrait of five men. Two of them are sitting at the table. The boy, an assistant in the laboratory part of whose interior can be seen in the background, stands holding a glass bottle filled with light. He is demonstrating it to the onlooker rather than to the men gathered in the room. As one of the two assistants, he is

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[1] See: http://www.chemsoc.org/viselements/pages/alchemist/alc_phosphorus.htm — Website of the Royal Chemical Society.

staring at the beholder with a serious and content expression, at the same time communicating the importance of what is inside the glass vessel. The bottle, tilted towards the older man, sets the vector of the proceeding conversation (wordless, limited to the exchange of meaningful gestures). The man is pointing with his finger at the precious contents of the vessel, simultaneously turning his head towards the another man who appreciating the extraordinary nature of the substance, is making a gesture of approval and of recognition something really great. The remaining two figures — the other assistant, looking at the viewer and carrying "something" in a wicker basket, and the man in rich attire, standing behind the table, complete the scene. The last-mentioned man has put his left hand on his heart, thus emphasizing a solemn mood and the unusual character of the demonstration. On the table, whose form is markedly out of perspective (though it is of no particular importance to the reception of the painting), is an open book with drawings. Unfortunately, macrographs of the book did not make the drawings more legible. Perhaps they are only simulated.

The canvas attracted attention due to its subject matter, the manner of depiction, and a high artistic quality; nevertheless, the story depicted in it remained unknown. The curator of the Department of Painting of the Jagiellonian University Museum hoped that the presence of the painting in the exhibition, visited also by people pursuing exact sciences and those interested in the history of science, might bring the solution to this riddle, the more so because the picture had waited for it more than a hundred years (since its acquisition for the National Museum in Warsaw at the auction of J.P. Weyer's collection in Cologne in 1862[2]). This could not be achieved in the course of preparations, but during the exhibition the picture intrigued two chemists, co-authors of this paper, who proposed a thesis explaining the event depicted by Cornelis de Man. However, before describing the discovery, it is necessary to recount the history of the studies concerning the picture discussed here.

In 1988 an exhibition was organized in Brunswick. It was accompanied by a catalogue edited by J. Białostocki and R. Klessmann. The entry written by M. Monkiewicz[3] included the earlier literature referring to the painting. The entry in the catalogue of the exhibition *The Scholar and His Study*, by the same author, in principle repeats the information from the previous catalogue, except for one more item of bibliography, S. Krifka's *Erfindung, Erkenntnis, Konstruktion. Studien zur Bildgeschichte von Naturwissenschaften und Technik vom 16. bis zum 19. Jahrhundert*, Berlin, 2000. However, Krifka's article was not found to contain any reference to the painting of interest here. Thus from these entries we still learn nothing about the depicted figures or the content of the scene.

C. Hofstede de Groot described the picture as *Alchemists*, Cl. Brière-Misme called it the *Portrait of the Family of Apothecaries*, P. Starzyński and M. Walicki saw in the men *Three Chemists in the Laboratory*, while, according to J. Michałkowa, the scene shows scholars demonstrating their latest results to their patron.[4] M. Monkiewicz calls the depiction *Group Portrait in the Chemist's House*.[5]

As regards a more precise definition of the subject of the composition, only Michałkowa has described it as a scene in which the scholars are demonstrating the results of their investigations to their patron; however, no hypothesis has been advanced as to what kind of investigation this might be. The picture by Cornelis de Man is certainly connected with an event of great importance, which took place when chemistry was emerging from the mists of alchemy.

(2) Brandt and his discovery

Alchemists are generally known to have sought the philosopher's stone. They wanted to learn how to transmute base metals into gold. One of them was a German, Hennig Brandt (according to *Britannica Encyclopedia* — Hennig Brand, 1630–1692?), an ex-soldier, later a merchant, but primarily an indefatigable alchemist in search of the philosopher's stone, an object of all alchemists' dream, though Brandt would certainly have been satisfied with gold alone. According to the rumours circulating among scholars, it was possible to obtain a "liquor" from urine, that is, a liquid which turned silver

[2] M. Monkiewicz, a catalogue entry [in:] *Uczony i jego pracownia* (Kraków 2005), p. 132

[3] *Europäische Malerei des Barok aus dem Nationalmuseum Warschau*, ed. by J. Białostocki and R. Klessmann, a catalogue entry by M. Monkiewicz (Braunschweig–Utrecht–Köln–München 1988–1990), pp. 157–160 (with the earlier literature).

[4] *Ibid.*, p. 160, n. 1.

[5] M. Monkiewicz, op. cit., p. 132.

into gold. Brandt evaporated animal urine and next calcined the residue in anaerobic conditions. As a result of sustained efforts a white substance began to settle on the walls of the retort. One day, at dusk, when Brandt entered his workshop, he saw a mysterious radiance emanate from the retort. However, this was neither the philosopher's stone nor gold, but a yellowish-white waxy paste glowing in the dark. The light emitted by it was so bright that Brandt could read alchemic books by it in the evening.[6] Nevertheless, this was not an ordinary light. It was cold. Contemporary scholars — and this happened in 1669 — did not know such a phenomenon. It was not gold, but Brandt, once a merchant, resolved that his discovery must bring him heaps of gold.

The news about the extraordinary substance spread among alchemists and all who were interested in science, but Brandt well kept the secret of its production.

Ignacy Eichstaedt writes in his Księga pierwiastków [A Book of the Elements]:

> His laboratory was visited by the curious and enthusiasts — physicians, scholars, the rich and powerful, and eminent citizens. They all wanted to see the wonderful glowing substance, to acquire at least a pinch of it, to buy the secret. Brandt indeed sold small samples, but guarded the secret with his life.[7]

The fame of the new discovery was reaching ever-widening circles and more and more people desired to see it. The fortunes of the luminescent substance are the subject of numerous stories differing in details but all including two physician-alchemists: Johannes Daniel Kraft (or Krafft, and sometimes Crafft) and Johann Kunckel von Löwenstern. Eichstaedt writes that for a generous sum of money Kraft managed to buy from Brandt the method of obtaining the luminescent substance.[8] However, Morris writes in *The Last Sorcerers: The Path from Alchemy to the Periodic Table* that although Kraft bought it from Brandt, the latter did not betray to him the secret of its production.[9]

Kunckel, too, desired to have this extraordinary substance, but Kraft was faster and cleverer, so he was the first to make a deal with Brandt. Kunckel only learned that Brandt had obtained the substance from urine; he was nevertheless persevering in his alchemic quest, so in July 1676 he obtained it independently and described its properties. He also revealed that it could be obtained from animals and plants. Thus, for more than a century Kunckel was regarded as the discoverer of this luminescent substance.[10]

However, due to Gottfried Wilhelm Leibniz (1646–1716) who was also interested in alchemy, we know the true discoverer of phosphorus, as it is high time to reveal that the "glowing substance" is **PHOSPHORUS**,[11] from Greek φωσφορος *[fōsforos]* which meant ***light-bringing***[12] (φωσ *[fōs] = light, φερω [ferō]* = bring). This is what Brandt called it.

Kraft made a fortune on demonstrations of the new discovery at European courts. He was generously paid for it. He showed off the luminescent substance as his own discovery before the king of Hanover, and also at the court of the elector of Brandenburg in Berlin in 1676, and even in the presence of Charles II, King of England in London in 1677.[13] Morris writes:

> In 1677 Charles II invited Kraft to England to demonstrate his phosphorus to the royal

[6] See: http://www.vanderkrogt.net/elements/elem/p.html — *Elementymology & Elements Multidict* by Peter van der Krogt, *Phosphorus*.

[7] I. Eichstaedt, *Księga pierwiastków* (Warszawa 1973), p. 162.

[8] *Ibid.*, p. 163.

[9] R. Morris, *The Last Sorcerers: The Path from Alchemy to the Periodic Table*, Science (2003), p. 72.

[10] *Ibid.*

[11] A chemical element bearing the symbol P. In the periodic table it neighbors nitrogen and arsenic in the group and silicon and sulfur in the period. It occurs in several allotropic forms, that is, depending on conditions, in varieties that differ in their crystalline form and the structure of their space lattice. Its allotropic forms differ in physical and sometimes also chemical properties. Brandt probably obtained white phosphorus contaminated with other allotropic varieties, which at room temperature slowly oxidizes into phosphorus trioxide, this phenomenon being accompanied by the emission of faint luminescence (chemiluminescence). When phosphorus oxidizes into P_2O_5 chemiluminescence does not occur.

[12] A.D.F. Toy, E.N. Walsh, *Phosphorus, Chemistry in everyday living* (2[nd] ed.; Washington: ACS, 1987), p. 1.

[13] *Ibid.*, I. Eichstaedt, *op. cit.*, p. 163.

> court. Kraft replied that he would do so for a fee of a thousand thalers. This was a lot of money, but Charles apparently did not want to forego witnessing a monumental discovery (…) and he agreed. (…). When Kraft arrived in London, Robert Boyle (1627–1691) contacted him and invited him to put on a display for the fellows of the Royal Society also. Kraft agreed, and on a September evening he arrived at Boyle's home, where the fellows had gathered. After the room had been darkened, Kraft passed around a bottle containing a small piece of phosphorus. Boyle wrote later that it glowed "like a cannon bullet taken red hot out of the fire, except that it was more pale and faint". But when the bottle was shaken, (…) the phosphorus glowed more brightly and emitted flashes of light. Then Kraft exhibited a tube containing a small amount of phosphorus at one end, which made the whole tube seem to glow. He then took another lump of phosphorus out of its container and allowed the fellows to hold it in their hands. They said that it emitted no smoke or fumes. Kraft then shattered this piece of phosphorus into fragments, which continued to shine after he scattered them on the floor.(….) After the demonstration Boyle asked Kraft to leave a little of the phosphorus with him, or at least tell him how it was made. When Kraft declined, Boyle offered him a secret alchemical formula in return for the recipe. Again Kraft declined. However, he did say that phosphorus was made from something " that belonged to the body of man.[14]

Brandt probably wrote numerous alchemic treatises. No doubt he also corresponded with other alchemists. Nevertheless, hitherto no notes by Brandt that would refer to his discovery have been found.

Boyle's assistant, Ambrose Godfrey Hanckwitz, learned the art of making phosphorus. In 1682 he left Boyle[15] and set up the famous "Ambrose Godfrey" pharmaceutical firm. It placed an advertisement in the London press, informing that Hankwitz prepared various medicines and that in London only he could produce all kinds of phosphorus for 3 pounds sterling per ounce.[16]

The English ounce weighed 28.35 g. Phosphorus was thus the most expensive substance then, stirring up strong emotions among the elites of contemporary Europe.[17] For Boyle it was an object of scientific investigations, but for Brandt, Krafft and many others an interesting and profitable curiosity. Morris writes:

> Godfrey was able to sell all the phosphorus he could make. He sold it to natural philosophers, to alchemists, to physicians, and to those who wanted to put it on show as Kraft had done. Phosphorus soon acquired a reputation as a medication that could cure almost anything.[18, 19]

What discovery could be so intriguing and significant at that time that the artist chose it as the subject of his picture? The luminescent substance in the bottle, painted by Cornelis de Man, is probably **phosphorus**. The artist has shown the moment of its demonstration. The scene is set in a rich house with a fragment of the laboratory visible in the background.

Comparing the scene in De Man's painting with a description of the demonstration of phosphorus to the members of *The Royal Society*, as given by Morris in his book, one cannot help but get the impression that the bottle contains the glowing phosphorus.

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[14] R. Morris, *op. cit.*, pp. 74–75.

[15] See: http://www.vanderkrogt.net/elements/elem/p.html — *Elementymology & Elements Multidict* by Peter van der Krogt, *Phosphorus*.

[16] I. Eichstaedt, *Księga pierwiastków* (Warszawa: Wiedza Powszechna, 1973), p. 164

[17] J.B. Calvert, *Phosphorus*, 2002; http://www.du.edu/~jcalvert/phys/phosphor.htm.

[18] R. Morris, *op. cit.*, p. 77.

[19] White phosphorus is inflammable, so it is stored in water. It is an unstable variety with a tendency to convert into other, more stable forms, this proceeding slowly at as low as room temperature. The surface of white phosphorus turns yellow then. White phosphorus is extremely toxic (a lethal dose amounts to a mere 0.1g). Source: A. Bielański, *Podstawy Chemii Nieorganicznej* (Warszawa 2002), p. 659 (Thus the use of white phosphorus as a medicine is astonishing. The demonstration in Boyle's house as described by Morris also shows how carelessly it was handled — the luminescent substance was touched and scattered on the floor. The phosphorus produced in the 17th century was probably a mixture of several allotropic forms — Author's note).