



# Toxicological Investigations Around the Humorous Stories of the Halm Curls of Beethoven's Hair

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## Abstract

Beethoven died of liver failure with pre-existing liver cirrhosis on March 26<sup>th</sup>, 1827, after pneumonia accompanied by therapeutic complications. Fractionated elemental analysis of two of Beethoven's curls allowed the determination of the lead content during the last 420 days of his life with several pathological lead peaks during his last year. These correlate with Beethoven's records in the "Konversationshefte" about the therapy of his pneumonia and the dates of the performed paracenteses. The detection of abnormal lead concentrations in Beethoven's hair has opened up discussions in recent years about whether Beethoven's deafness might have been the result of chronic lead intoxication caused by the consumption of adulterated wine. Further heavy metal analyses based on Halm's curl presented here provided that Beethoven was not exposed to any relevant lead amounts between February 1826 and September/October 1825. Our investigations did not reveal any evidence that Beethoven's chronic progressive deafness could have been the result of long-term exposure to lead.

**Keywords:** Halm's Beethoven curls; LA-ICP-MS; Deafness and lead exposure

## Introduction

In 1989, a group of American music lovers bought a Beethoven curl at Sotheby's auction. The origin of the curl and its history are described in the book "Beethoven's Hair" by Russell Martin [1]. It comes from the possession of Dr. Ferdinand von Hiller, who was allowed to take it from the body of Ludwig van Beethoven the day after his death, on March 27<sup>th</sup>, 1827. The curl, which originally comprised 582 hairs with a length between 7 and 15 cm, consisted of gray, white and brown strands. Part of it was transferred to the Ira F. Brilliant Foundation, "Center for Beethoven Studies" at San José State University in California. Dr. Alfredo Guevara, urologist in Nogales, Arizona, received his share of 160 hairs and provided material from it recurrently for scientific tests.

One of Beethoven's skull bone fragments was entrusted to the Institute of Forensic Medicine of the University of Münster in 2005 for molecular biological examinations in order to compare it with the DNA of the hair from the Guevara curl [2]. Nuclear DNA could not be isolated from the bone, but a segment of the hypervariable region 2 (HV2) of mitochondrial DNA could be obtained. In view of the fact that at that time, two different institutes were entrusted with the molecular biological examinations of one of each of the two samples, a clear identification could not be achieved. But the assumption of the authenticity of Dr. Guevara's curl was supported by this molecular biological examination.

According to Bill Walsh, chief scientist at the Pfeiffer treatment center in Warrenville, IL, a heavy metal analysis of the hair from the Guevara curl was performed, which demonstrated an average of 80 times the lead content of normal hair [3].

In 2005 unusually high lead concentrations were found in one of Beethoven's skull bones by the U.S. Department of Energy's Argonne National Laboratory using an X-ray fluorescence elemental analysis. The Pb-XRF signal from a control subject's bone had an intensity of approximately 30 ± 30 counts. The signal associated with the Pb-XRF signal from Beethoven's bone fragment had a Peak intensity of ~210 ± 30 counts. Unfortunately, due to limited financial resources, no further measurements to quantify the Pb concentration in bone could be performed, nor were the results published in a scientific journal. However, it was concluded that the elevated Pb concentrations in bone were due to prolonged exposure to Pb during Beethoven's life [4].

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In 2006 a 4 and a 9.3 cm long hair from the Guevara curl were analyzed at the Institute of Analytical Chemistry of the University of Natural Resources and Applied Life Sciences, Vienna, using LA-ICP-MS (Laser Ablation -Inductively Coupled Plasma -Mass Spectrometry). This is a method in which hair tissue is vaporized by means of a microscopically thin laser beam and the resulting smoke is analyzed in a mass spectrograph [5]. Approximately 40 individual measurements can be made per millimeter of hair, fractionated, both from the surface and selectively in the hair center [6,7]. On the basis of Dr. Guevara's hair, several phasic excessive lead exposures in the last 15 weeks before Beethoven's death were detectable, whereby conclusions can be drawn on the therapeutic measures taken after Beethoven's pneumonia from the beginning of December 1826. Comparable values were also found on the basis of the Bernhard-Rollet curl kept in the Beethoven Memorial, Jedlese, 1221, Vienna [8].

### The object of investigation

When our first investigation results had become known by a television film [9], Mrs. M.G. contacted the first author. As the owner of a painting gallery, she regularly required stylistically appropriate picture frames for the paintings to be sold in her store. Therefore, she periodically visited various junk dealers who provided her with picture frames from estates. According to her statements, she had acquired various picture frames - including a small oval frame with a lock of hair - from a junk dealer in Brunn am Gebirge, Lower Austria, in about 1973.

On November 22<sup>nd</sup>, 2006, the object in question was made available by Ms. M.G. for a detailed examination of the question of authenticity. It is a black, oval picture frame with the external dimensions 11.6 cm × 9.8 cm, the innermost edge of which has a gold-colored border. The inner dimension and thus the outwardly visible light of the glass panel is 7.3 cm × 5.8 cm. The glass pane showed radial fracture rays emanating from a point between 5:00 and 6:00 about 5 mm from the inner edge of the frame. The background of the area covered with glass shows a sandy or light brown color and, on this background, hairs are glued. It is a longer strand of hair consisting of gray and light brunette hair with an average length between 10 and 11 cm, shaped in the form of a loop. Where the loop is crossing at its intersection it is knotted with a string. Between the downward-facing legs of the loop, arranged at a slight angle, lies a second bundle of hair averaging between 3 and 5 cm in length, of a brunette reddish color, which is connected to the crossing of the loop by knotting (Figure 1).

The back of the frame is covered with paper decorated with roses and leaves. In the upper part there is a fastening ring screwed into the frame. Attached to the rose paper there is a red framed label with the handwritten text: "Locke Beethovens aus dem Besitze von Professor Julius Epstein. Letzterer erhielt sie von seinem Lehrer Anton Halm, widmete sie als Treffer einer Wohltätigkeitslotterie und gewann sie zurück. ("Curl of Beethoven from the possession of Professor Julius Epstein. The latter received it from his teacher Anton Halm, dedicated it as a hit to a charity lottery and won it back"). Between the hanging ring and the red framed label, there are remnants of another label with the printed words: "Beethoven Locke. Frau M.G".

### Historical framework

According to Theodor Frimmel the musician, composer and pianist Anton Halm (born 1789 in Wies in Lower Styria, died 1872 in Vienna), is said to have played some of Beethoven's compositions

in public as a very young man, even before his military service [10]. In Graz, where he received his education, he also became acquainted with other works of the master. Around 1811, he was already giving concerts in Graz with significant success. Around 1813 Halm lived for a long time with the Hungarian noble family Gyika de Desanfalva. With the Gyikas he met Fräulein Sebastiani, his later wife, and in Hungary he also became acquainted with Count Franz Brunsvik, Beethoven's youthful friend. A letter of recommendation from Brunsvik to Beethoven accompanied the Halm couple to Vienna in 1814 or 1815. There, Beethoven was invited by the Halms in 1816. Around that time, Halm was already performing repeatedly and with success as a piano player. Halm quickly attained prestige, reputation and probably also prosperity. However, he remained modest towards Beethoven. Halm's arrangement for piano of the great Quartet Fugue in spring of 1826 was not to Beethoven's full satisfaction, but the friendly relationship was neither disturbed by this, nor by the embarrassing lure story that is to be told here: Mrs. Halm greatly admired the great master and had long wished to possess a curl of his. Halm himself told the story many years later in the following way to Beethoven's great biographer A.W. Thayer [11].

"On the occasion of the concert rehearsal for the performance of the B-flat Major Trio, my wife, a native Sebastiani from Trier, whom Beethoven always called "his compatriot", was also present. On this good occasion, my wife enforced me to ask Beethoven for a lock of his hair. However, since Beethoven did not hear anything and since several people were present, I took the liberty of negotiating with Beethoven personally through his notebook. I therefore requested Karl Holz to present my wife's wish to Beethoven. After a few days my wife received a lock of hair through a third party, supposedly Beethoven's."

Soon thereafter, Halm visited Beethoven in the matter of the Quartettfuge. According to his recollection, it would have been a visit during which the four-hand arrangement was presented by Halm. Halm then continues:

"As I was about to leave, he confronted me with a terrible seriousness in his face with the words: You are deceived with the lock of hair! You see, with such terrible creatures I am surrounded, that they put all respect, which they owe to respectable people, on the side. You have hair of a goat! And speaking in this way, he gave me in a white sheet of paper a significant quantity of his hair, which he cut out himself completely backwards, with the words: 'This is my hair.' Probably he cut the hair from behind, because there it was still black, while in front everything was already snow-white. So, I went home in triumph with this preserved rare gift. Not so my wife. She was indignant about Karl Holz's perfidy and immediately wrote a letter appropriate to the circumstances. One or two years later - on March 29<sup>th</sup>, 1827 - my wife stood by Beethoven's open grave and saw Holz crying on the other side, who could not look at her out of shame. Moved by this, she extended her hand to him over the grave in reconciliation."

Although going back to Halm himself, the narration is not to be accepted in all details as compellingly correct. Because there is still another tradition from the family Halm, which deviates in some, not insignificant points.

According to this Mrs. Halm would have turned to Beethoven's nephew in order to receive the curl. The nephew Karl had procured a tuft of grayish hair from a goat from one of his acquaintances and



Figure 1: a) Front of the picture frame with Halm's Beethoven curls after removing the broken cover glass, b) Back of the picture frame with provenience information's.

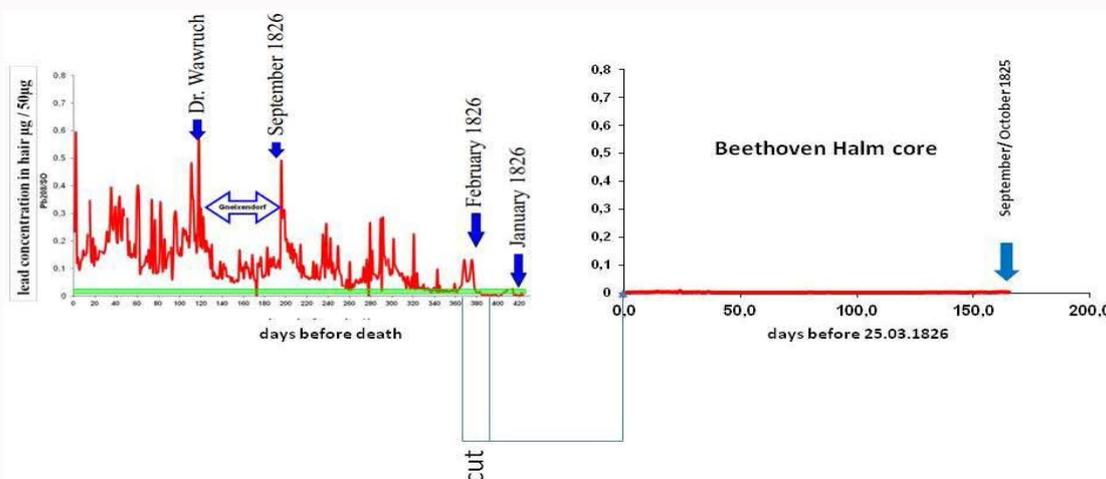


Figure 2: Lead concentrations of the cores of Beethoven's hair locks from September 1825 until his death. The green basal area corresponds to normal lead exposure.

brought this to Mrs. Halm as the curl of his famous relative. She showered the donor with heartfelt words of gratitude and proudly boasted about her precious possession in front of her entire circle of acquaintances, arousing the envy of her friends.

The nephew, however, became uncomfortable with the matter, and he decided to confess to his uncle even before the discovery of the evil prank, since he, moreover, misjudging Beethoven's noble qualities, thought that he would laugh about the matter. But Karl miscalculated, and his confession unleashed a furious thunderstorm from Beethoven. The enraged master then grabbed his hat and cane and hurried to the Halms. Immediately upon entering, he shouted: "You have been deceived! My nephew has mystified you. The hair is not mine at all, but from a goat." And running his fingers through his gray hair, he held out his head to the stunned woman with the words: "You can cut it ... cut off as much as you want!" Mrs. Halm would now have cut off the tuft "from the vertex" of Beethoven's head. Whoever has read the reports attentively, cannot be unaware of the fact that there are strong differences. Without any doubt, memory errors play into both versions. As it seems, not only the nephew, at that time a boy in the lout years, but also Karl Holz were the culprits. Because the mischievous Holz was always inclined to jokes. Since, by the way,

two authenticated tufts of Beethoven's hair from Halm's possession can be proven, some traits from all reports can probably come close to the truth.

Thus, it is almost certain that both of Halm's tufts are genuine, and Theodor Frimmel assumed that the thick, dark tuft from the back of the head had already been cut off on March 25<sup>th</sup>, 1826 and the lighter one from the "vertex" on March 26<sup>th</sup>, 1826.

Given Beethoven's disposition, it is understandable that he wanted to make up for the insult with the goat hair by visiting Mrs. Halm in person, and that he once again held out his head to the offended woman in order to give her a second curl. This one, however, will be the gray one from the crown. Both differently colored strands of hair were then joined together to form the characteristic arrangement in the picture frame.

Julius Epstein, born August 7<sup>th</sup>, 1832 in Agram, died March 2<sup>nd</sup>, 1926 in Vienna, was a pianist and music teacher at the Vienna Conservatory from 1867 to 1901. In Vienna he was a pupil of Anton HALM, made his debut in 1852, quickly became one of the most popular pianists and teachers in Vienna. His pupils included Ignaz Brüll, Marcella Sembrich and Gustav Mahler.

Epstein edited Beethoven's piano sonatas as well as Mendelsohn's "Sämtliche Clavierwerke" and Schubert's "Kritisch Durchgesehene Gesammtausgabe". He had 2 daughters, Rudolfine (cellist) and Eugenie (violin), and his son Richard was also professor of piano at the Vienna Conservatory.

How the medallion finally reached the dawdler remains an unanswerable mystery.

### Analytical results

In 2006, the broken glass pieces from the picture frame were removed. The microscopic examination of the hairs showed no hair roots. While preserving the original knot and the stick-on, a 5.1 cm long hair, rather brunette colored, from the horizontally arranged dark strand was removed for chemical analysis.

In an analogous manner to the other curls, this hair was as well analyzed by LA-ICP-MS [5,8]. It was found that the center (core) of the hair in the oldest sections (last 1½ months before the interface) showed only very short-term low levels of lead. Otherwise, the lead content of the hair corresponds to that of an unloaded organism until about 170 days before the interface (Figure 2).

### Conclusions

The Bernhard-Rollet curl covers the last approx. 420 days before Beethoven's death and ends in January 1826 (Figure 2, left curve). Between February and January 1826, the Bernhard-Rollet curl shows no lead exposure. The hair from Halm's curl covers approx. 170 days before March 25<sup>th</sup> or 26<sup>th</sup>, 1826 - thus until about September/October 1825, whereby the hairs were cut off and it remains unknown at which height above the scalp the cut was made.

Our LA-ICP-MS analyses provided that the interior (core) of the hair in the latest sections (last 1½ months before the cut) shows only very short-term low lead loads. Otherwise, the lead content of the hair corresponds to that of an uncontaminated organism up to the interface.

If one adds up the data of all three hair curls examined by us, statements can be made about Beethoven's lead exposure during the last approx. 550 days before his death:

- From September/October 1825 until about Christmas 1825, the lead concentration is in a normal range.
- Towards Christmas 1825, there are phases of low lead intake.
- At the turn of the year 1825/1826, there is again a low lead intake.
- In January 1825, the lead concentration is again in a normal range.
- From February 1826 to September 1826, there are recurring significant lead loads, which are
  - then ceased from September to the end of November 1826 - i.e., on the occasion of his stay in the Wachau. The above-normal lead level should be considered as a result of lead redistribution from the previously loaded depots.
  - From the onset of his pneumonia at the end of November/beginning of December 1826, depending on the well-documented treatment steps, he was subject to recurring therapy-related lead exposures, which ultimately led to a massive culmination in the last

two weeks before his death as a result of incipient multiple organ failure.

At an auction at Sotheby's auction house on June 11<sup>th</sup>, 2019, the Halm curl provided its owner a whopping 35,000 pounds.

Even more valuable, however, are the findings of the analyses, because through this curl we now know that Beethoven was not exposed to relevant lead between September/October 1825 and February 1826 and thus the causes of his death in 1827 were related to pneumonia and the resulting fatal therapeutic treatment of lead during the last months of his life [8].

Since lead behaves like calcium in the metabolism of vertebrates, it is increasingly deposited in the bone matrix in the case of overload or intoxication. Following previous abnormal exposure to lead, this element is constantly redistributed in elevated concentrations into body fluids not only during pathological bone resorption, but also during normal bone remodeling later on [12]. This also leads to a long-lasting general increase in the basic content of lead in the hair matrix, as can be seen in Beethoven's hair for the time of his stay in Gneixendorf.

To date, however, there are only few and sometimes controversial scientific data on the prevalence and extent of hearing damage caused by chronic lead exposure [13-18].

Based on our toxicological studies of heavy metals in Beethoven's hair, covering a time window of 550 days before his death, there is no evidence that unusually high concentrations of lead were present in his hair during the four months before February 1826.

From this, it can be concluded that Beethoven did not suffer from chronic lead poisoning, so that, contrary to the opinion of other authors [19,20], there is no indication that recurrent exposure to lead, for example as a result of the consumption of adulterated wine, could in any way be related to his prodigious deafness, which had already become evident since the year 1798 [21]. In the future, more attention should be paid to the other possible causes of his hearing impairment [22].

### References

1. Russell M. Beethoven's Hair, Broadway Books, New York; 2000.
2. Meredith WR. The history of Beethoven's skull fragments. *Beethoven J.* 2005;20:1+2,3-39.
3. U.S Department of Energy. New release of the Argonne National Laboratory. Argonne researchers confirm lead as cause of Beethoven's illness. 2005.
4. Reiter C. On the authenticity of Beethoven's skull fragments from the estate of Prof. Dr. Romeo Seligman. *Wien Med Wochenschr.* 2022.
5. Stadlbauer Ch, Prohaska Th, Reiter Ch, Knaus A, Stingeder G. Time-resolved monitoring of heavy-metal intoxication in single hair by laser ablation ICP-DRCMS. *Anal Bioanal Chem.* 2005;383(3):500-8.
6. Rodiouchkina K, Rodushkin I, Goderis S, Vanhaecke F. Longitudinal isotope ratio variations in human hair and nails. *Sci Total Environ.* 2022;808:152059.
7. Luo R, Su X, Xu W, Zhang S, Zhuo X, Ma D. Determination of arsenic and lead in single hair strands by laser ablation inductively coupled plasma mass spectrometry. *Sci Rep.* 2017;7(1):3426.
8. Reiter Ch, Prohaska Th. Beethoven's death-the result of medical malpractice? *Wien Med Wochenschr.* 2021;171(15):356-62.
9. Beethoven's Hair. Documentary, Larry Weinstein, Rhombus Media and

- DOR Film. 2005
10. Frimmel Th. Beethoven-Handbuch. 1. Band. 1926. p. 192-6, Breitkopf & Härtel Leipzig.
  11. Thayer AW, Forbes E, Deiters H, Riemann H, Krehbiel EH. Thayer's life of Beethoven. Princeton, NJ: Princeton University Press; 1967.
  12. Marcus AH. Multicompartment kinetic models for lead. II. Linear kinetics and variable absorption in humans without excessive lead exposures. *Environ Res.* 1985;36(2):459-72.
  13. Cohen SM. Lead poisoning: A summary of treatment and prevention. *Pediatr Nurs.* 2001;27(2):125-6,129-30.
  14. Choi YH, Park SK. Environmental exposures to lead, mercury, and cadmium and hearing loss in adults and adolescents: KNHANES 2010-2012. *Environ Health Perspect.* 2017;125(6):067003.
  15. Park SK, Elmarsafawy S, Mukherjee B, Spiro A 3<sup>rd</sup>, Vokonas PS, Nie H, et al. Cumulative lead exposure and age-related hearing loss: The VA Normative Aging Study. *Hear Res.* 2010;269(1-2):48-55.
  16. Wang DH, Xu H, Zheng YH, Gu DS, Zhu YJ, Ren Y, et al. Environmental exposure to lead and cadmium and hearing loss in Chinese adults: A case-control study. *PLoS One.* 2020;15(5):e0233165.
  17. Carlson K, Neitzel RL. Hearing loss, lead (Pb) exposure, and noise: A sound approach to ototoxicity exploration. *J Toxicol Environ Health B Crit Rev.* 2018;21(5):335-55.
  18. Yin JZ, EM, Chao H. Population-based study of environmental lead exposure and hearing loss: A systematic review and meta-analysis. *Public Health.* 2021;197:63-67.
  19. Stevens MH, Jacobsen T, Crofts AK. Lead and the deafness of Ludwig van Beethoven. *Laryngoscope.* 2013;123(11):2854-8.
  20. Brotto D, Fellin R, Sorrentino F, Gheller F, Trevisi P, Bovo R. A modern case sheds light on a classical enigma: Beethoven's deafness. *Laryngoscope.* 2021;131(1):179-85.
  21. Albrecht Th. Der hörende Beethoven: Entmythisieren der Taubheit des Komponisten.
  22. Thomas JP, Dazert S, Prescher A, Voelter C. Aetiology of Ludwig van Beethoven's hearing impairment: Hypotheses over the past 100 years - A systematic review. *Eur Arch Otorhinolaryngol.* 2021;278(8):2703-12.