

## Gauguin's Teeth

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### Abstract

Four teeth were discovered, as a well was being uncovered on a property formerly owned by Paul Gauguin. The teeth were examined, subjected to DNA testing, compared to the artist's deceased father's DNA and were analyzed by strontium isotope analysis. The teeth were determined to be from a male of European origin. Their DNA matched that of Paul Gauguin's father. Strontium isotope analysis showed them to have gone through a critical time of development in Western Peru where Gauguin lived as a child.

**Keywords:** Gauguin; Art history; Teeth; Dental DNA; Strontium isotope analysis

### Introduction

Many anthropological studies do not lend themselves to traditional scientific research methodology. These studies are case based, involving the piecing together of historical and scientific facts. In addition, case-based studies do not lend themselves readily to traditional frequency based statistical analysis.

This study arose partly by chance, partly as scientific research, and partly as a detective story. It concerns four teeth found in a glass jar, along with hundreds of other items, which were dredged from the bottom of a newly discovered well. It was uncovered and emptied in 2000 during the construction of the Centre Paul Gauguin on the site of Gauguin's former home on the island of Hiva Oa, in the Marquesas (French Polynesia).

The artist Paul Gauguin (1848-1903) arrived in Atuona, a village on Hiva Oa, in 1901. He had abandoned Tahiti as too European, disillusioned that the traditional Polynesian culture had been destroyed by the French colonial and ecclesiastical powers. He wanted to find somewhere more "authentic" where he could experience not only the sensual beauty of the region, but also something of the rapidly fading traditional life-style and artistic traditions of the Marquesan people. Unfortunately, he only had twenty months left to achieve his goals.

When he arrived, he was already in poor health, which hindered his creative energy, sapped his morale and finally led to his death on May 7, 1903. In that short time, however, he made over 35 paintings, carved many sculptures and reliefs in wood and created scores of transfer drawings. He also wrote three lengthy manuscripts while tangling with local authorities to try to preserve indigenous rights. In the end, he was condemned to three months in prison, given a hefty fine, and suffered enough pain to drive him to use heavy doses of morphine. There remain many questions surrounding his death. Did he take an overdose after being sentenced to prison? The burial and later reburial remains shrouded in controversy. He was initially buried in the Catholic cemetery high above Atuona [1].

When Gauguin died on May 8, 1903, his possessions were sold and the remainders dumped in his well by the new owners of the property. The well was probably filled because Marquesans obtained their water from rivers rather than wells. The artist likely used the well because it was difficult for him to walk down to the river due to his leg ulcers and a badly healed broken ankle that made walking painful. It would seem

obvious to conclude that the teeth belonged to the famous artist of the South Seas, Paul Gauguin, given where they were found. The question was: how this could be proven and what else the teeth could tell us about the man.

The story of answering this question began with a chance encounter between Dr. William A Mueller (WAM) and Dr. Caroline Boyle-Turner (CBT) on a cruise ship in the South Pacific. As a part of the cruise CBT, an art historian, professor, and specialist on Paul Gauguin, was giving a series of lectures on Paul Gauguin (PG), and the story of his life and art production during the time he spent living in the Marquesas in 1901-1903. During one of the lectures CBT asked if there was anyone aboard the ship who could assist her with understanding four teeth in her possession, which may have come from Paul Gauguin. WAM, who is a founding member of the Dental Anthropological Association, happened to be aboard and the two were introduced. An initial meeting took place, during which the teeth were photographed and identified while the morphology and carious destruction of the teeth were discussed.

CBT's interests were if anything about the teeth could tell her whether they came from PG and, if so, could they be used to determine if PG had syphilis. She related that it was a common belief in the art world, especially in France, that PG had the disease. This belief was due to his own statements, his leg ulcers, which the artist called "eczema" and what some maintain was his progressively saddle shaped nose, typical of tertiary syphilis. But syphilis manifests itself with symptoms that mimic many other diseases such as diabetes, which also may provoke leg ulcers.

All of the evidence was circumstantial. The definitive Wasserman Test was not developed until 1906 three years after Gauguin's death [2]. For many reasons, including the above, CBT was questioning the consensus that Gauguin had died from syphilis and seeking scientific information that could either prove or disprove it.

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**Figure 1:** Teeth were extensively damaged by caries which prevented further morphological identification.

## Methods

An initial physical examination of the teeth was conducted, which indicated that they likely consisted of one permanent upper central incisor, two permanent maxillary premolars and one permanent mandibular molar. All of the teeth were extensively damaged by caries, which prevented further morphological identification (Figure 1).

WAM sent an email to all members of the Dental Anthropological Association to determine if any of the members had an interest and expertise which could be of assistance in finding answers to the above questions. Several responses came in and ultimately researchers associated with the Field Museum in Chicago were selected to assist.

Following a meeting of all parties in Chicago, it was decided to proceed on the course of attempting to extract DNA from the teeth and comparing it to known decedents of PG. Additionally, the teeth were to be analyzed for trace minerals, which may have shown treatment indicating syphilis. The DNA was to come from the pulpal tissue of the teeth.

The pulpal tissue was removed through the apical foramen by an Endodontist at the University of Illinois, Chicago School of Dentistry and analyzed by the anthropological genetics expert from the Department of Anthropology. Our intention was to use the Mitochondrial DNA (mtDNA) [3] from the teeth for comparison to a known female descendant of PG then living in Europe. The Mitochondrial DNA (mtDNA) was extracted from the teeth and compared for location of origin by the Human Genome Project in Cambridge, England [4].

The analysis for trace minerals was completed in the labs of the Field Museum, Chicago. They were tested for Cadmium, Mercury and Arsenic, which may have been used as treatments for syphilis [2].

Research does not always progress in a straight line. As sometimes happens, we had a stroke of luck. CBT's research led to a short news story in *The Art Newspaper* (This is the formal title of the newspaper) about our project. This small story found its way to researchers in Physical Anthropology at the Human Genetics Program of the University of Chile. They contacted us to report that they had discovered in a cemetery a single European body, which might be the body of Clovis Gauguin the artist's father. He died in 1849 of a ruptured aneurism. His death occurred off Port Famine in Patagonia, which was the first landing site for ships coming from France in the Straights of Magellan, Chile [5].

The Gauguin family, including two-year old Paul, had left France suddenly in 1849 when Clovis, a journalist and outspoken critic of the

Bonapartist cause, was shocked by the election of Napoleon III. PG's mother, Aline had family connections through her activist mother Flora Tristan to powerful people in Peru. After the election of Napoleon, Clovis saw his position in France as untenable and the family decided to leave France for Peru. It was on this voyage that Clovis passed away and was buried in Chile [5] The location site of his burial was unknown until now.

This discovery opened a new pathway. Matching the DNA of the body, thought to be Clovis Gauguin, to that of Marcel Gauguin, PG's grandson then living in Tahiti allowed confirmation of the identity of the body in Chile bringing us a step closer to confirming that the teeth belonged to PG. The Y chromosome data was extracted in Chicago from the sample provided by Marcel Gauguin, Paul's grandson. These data were then sent to the researchers in Chile and compared to the Y chromosome data extracted from the body.

A final chance encounter occurred during a casual lunch where WAM met Matt Sponheimer, PhD. Both were at the lunch accompanying other people. During the conversation, both realized their interest in Dental Anthropology and a discussion of this research ensued. Dr. Sponheimer suggested strontium isotope analysis as a possible way to further establish ownership of the teeth.

A premolar tooth was sent to South Africa. The researcher was not told of our reasons, but was asked to analyze the tooth by laser ablation multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS). This method, for measuring strontium isotopes in teeth, is virtually non-destructive and leaves only small traces on the enamel surface. The  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of animals directly reflect the ratios of their foods, which also reflect local geology. Strontium is ingested and incorporated in trace quantities into mammalian teeth during their period of enamel mineralization allowing  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios to be used in locating the geological area where the person lived during the period of enamel mineralization [6].

## Results

The morphology of the teeth, where they were found, and the findings of the Human Genome Project showed them to be consistent with being from the same person and European in origin. However, just because they were from a European and found on PG's former property, did not prove that they belonged to PG or tell us anything about their owner's diseases. Y chromosome data were necessary to make the DNA comparison.

The comparison between Gauguin's grandson and that of the body of Clovis Gauguin showed that all the comparable STRs, Short Tandem Repeats, which are short sequences of DNA used to compare DNA samples, matched, indicating that the Gauguin Y lineage from Marcel, Gauguin's grandson, in Tahiti matched that of his now confirmed great grandfather's body in Chile.

Mercury was used for syphilis as far back as 1363. Arsenic was also used as a treatment, but according to some sources, not until 1910 [2]. However, Gauguin mentioned Arsenic and Mercury in 1900 in a letter to a friend back in France as homeopathic remedies for syphilis (LaRochelle, 2003). These heavy metals could have left trace residues in the teeth, but none were found.

PG lived in Peru from the age of 18 mo. until 7 1/2 years [5], a critical period in the development of permanent teeth. It is well known that maxillary pre molar teeth begin hard tissue formation between 18-30 months and complete enamel formation between 5-7 years. This period of development coincided almost exactly with the time Gauguin

spent in Peru. The strontium isotope tests compared to known standards showed  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of 0.707-0.708, more consistent with formation in Peru, rather than  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of 0.701-0.725, which could have indicated formation in Paris. This data shows that the premolar tooth tested is more consistent with formation in Western South America rather than Europe.

## Discussion

The initial physical examination, morphology and degree of carious destruction did suggest something about the origin of the teeth. Natives of the island region, in which the teeth were found, rarely suffered from caries, due to their diet of fish, fresh fruits and vegetables. The heavy damage by caries to the teeth suggested that they came from a European, where caries were common, rather than a local individual.

The DNA analysis of the pulpal tissue removed from the teeth was technically incomplete. We were unable to confirm the Y chromosome lineage from the teeth to that of PG's father. However, we were able to show DNA linkage between his grandson and the remains of Paul's father, Clovis Gauguin.

In most species, including humans, mtDNA is inherited solely from the mother [3]. This enables researchers to trace lineage through uninterrupted maternal inheritance. Gauguin's great granddaughter lives in Denmark and she was contacted but proved unacceptable as a specimen donor. She did not have uninterrupted maternal lineage back to PG.

We no longer had access to a direct female descendent of PG, which rendered the mtDNA unusable as a tool to determine if the DNA from the teeth matched that from the female descendent.

Testing performed on the teeth did not show any traces of minerals, which may have been used to treat syphilis at this point in history. This did not mean PG did not have syphilis, only that he had not been treated with either mercury or arsenic, at least with a sufficient dose of either to leave a residue.

We knew the teeth came from a well on PG's property, that they were all from the same person and that they were of European origin. We knew that they did not contain traces of mercury or arsenic that would suggest treatment for syphilis. We also knew the strontium isotope analysis was consistent with tooth formation in Western South America [7].

## Conclusion

The four teeth discovered in 2000 in a well on the property, which had previously belonged to PG, are in all probability his teeth. This finding is based on strong circumstantial and direct scientific evidence. The teeth were found to all be from the same person, who was of European descent by the extent of carious destruction and by DNA analysis. There were few other Europeans on Hiva Oa at that time and the teeth were in PG's well. We uncovered no scientific or circumstantial evidence that they were from anyone other than PG. The DNA from PG's grandson, Marcel, matched that from the body in Chile, confirming that it was that of Clovis Gauguin, PG's father. This also matched the historical record of the death and burial of Clovis in Chile.

The final evidence is that the teeth from the well show strontium isotope ratios of  $^{87}\text{Sr}$  to  $^{86}\text{Sr}$ , 0.707-0.708, which is consistent with formation in Peru. If they had been formed in Paris the ratios would more likely have been  $^{87}\text{Sr}$  to  $^{86}\text{Sr}$ , 0.701-0.713.

In our opinion, based on the scientific evidence and analysis, that the probability is very high the teeth are from PG. It is not possible with our data and findings to assign an exact percentage of probability. Because there is no medical information available from that era and we did not uncover any evidence from the teeth, we cannot confirm or deny that PG had or died from syphilis.

Teeth are one of the most remarkable and durable structures of the human body, resulting in their frequent use in Anthropology. Traditionally morphology was the basis of their utility. Today, with the completion of The Human Genome Project and development of other techniques, such as strontium isotope evidence, new scientific developments have the potential to greatly increase our understanding of individuals, their ancestors, and humanity going far back in time.

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### Genetic analysis

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### Strontium isotope analysis

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