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Napoleon the First, a Corsican with Pale Skin, Clear Eyes and Red Hair: DNA Evidence for these Phenotypic Traits

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Abstract: Objective: We report the results we obtained on DNA concerning the colours of the face, of the eyes and of the hairs of Napoléon the First (1769-1821). **Methods**: His genomic DNA was previously extracted from one of her authenticated hair lock (dating from 1811). The DNA polymorphisms tested were those of the MATP gene for the skin colour, and of the rs 12913822 in intron 86 of the HERC2 for the eye colour ; for hair colour, the entire DNA sequence of the MC1-R gene was studied, in the search of alleles responsible of the red hair. **Results**: The genomic DNA is homozygous FF for the F374L polymorphism of the MATPgene ; consequently, Napoléon had a pale face. It is also homozygous CC for the rs12913822 polymorphism ; it results that he had a 99% probability of having clear (blue or green) eyes. The examination of the complete DNA sequence of the MC1-R gene shows the Napoléon genomic DNA is heterozygous CG for the rs1805009 polymorphism , that corresponding to the D294H mutation which is the most frequent of the three common mutations of the gene causing red hairs. **Conclusions**: According to results obtained on genotypic studies, Napoléon was of the phenotype : pale skin of the face, blue or grey colours of the eyes, and with red hairs. These distinctive features can be observed on a picture of Napoléon dating from 1803, and was also reported by several of the Napoléon's contemporaries.

Keywords: Napoléon the First, Genomic DNA, Predictions about Colours of the Skin, the Eyes and the Hairs

1. Introduction

Napoléon I (Napoléon Bonaparte ; 1769-1821) was the first French Emperor. We know his physical appearance thanks to many portraits that were drawn or painted, which represent him at different periods of his life [**1**].

We concentrate on a particular painting, that reproduced on **Figure 1**, which represent the Emperor at the Consulate period. The main interest of this painting is that it is one of the rarer portrait of Napoléon known to be painted from life (Bonaparte had exposed him in front of the painter on February 1803 in Tuileries). On this portrait skin is pale, eyes are blue and hairs are red.

Figure 1. The Bonaparte portrait (1803), by François Gérard (Condé Museum of Chantilly). In the insert (below and at the left) representing the face : **1** indicates the colour of the skin , **2** that of the eyes, and **3** that of the hairs (r : red is that of the collar , which accentuate the colour of the hairs).

We have now the possibility to deduce, directly from DNA studies, some physical characteristics of the

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face of an individual [**2-4**]. Specially it is possible to study the colour of the skin from a polymorphism in the MATP gene [**5**] , that of the eyes from a polymorphism in the intron 86 of the HER C2 gene [**6**] and the red colour of the hairs from several polymorphisms of the MC1-R gene [**7**]. In the present article we have studied the skin colour of Napoléon's face, that of his eyes and the red colour of his hairs, from his genomic DNA.

2. The DNA sample.

The genomic DNA used is that which was extracted [**8**] from dandruffs of an authenticated lock of hairs of Napoléon dating from 1811. A few picograms of this genomic DNA reserve were processed to study the genetic basis of the colours of the skin, the eyes and the hairs of Napoléon.

3. Methods

For the genetic basis of the skin colour, we have studied [**9**] the F374L polymorphism of the Membrane Associated Transporter Protein (MATP) gene. Regarding to the 374F variant, which predispose to a white colour of the skin, individuals tested can be genotyped as FF homozygous (two doses of the F allele) or FL heterozygous (one dose of the F allele).

For the genetic basis of the eye colour , we have studied the rs12913832 polymorphism located 21.1 kb upstream of the OCA2 first exon, in intron 86 of the Hec Domain and RLD2 (HERC2) gene, according to [**6**]. Regarding for the C variant, which predispose to a blue or green colour of the eye, individuals tested can be genotyped as CC homozygous, CT heterozygous and TT homozygous ; individuals carrying the CC genotype had only a 1% probability of having brown eyes , and by contrast TT carriers had a 80% probability of being brown eyed.

Colour of the hairs of the lock was observed using confocal stereoscopic micrography, using a white substratum.
Hairs were also studied by Scanning Electronic Microscopy (SEM), using a Philips XL30 instrument (environmental version) ; both GSE (Gaseous Secondary Electrons) and BSE (Back Scattering Electrons) procedures were used.

The gene corresponding to the Melanocortin 1 Receptor (MC1-R) was entirely sequenced, according to [**10**], in the goal to detect among the three common variants associated with red hair. The main of these variants, known as Asp294His (or D294H) is detected using the rs1805009 polymorphism (located at the position 89920138 of the gene) where is this red hair allele.

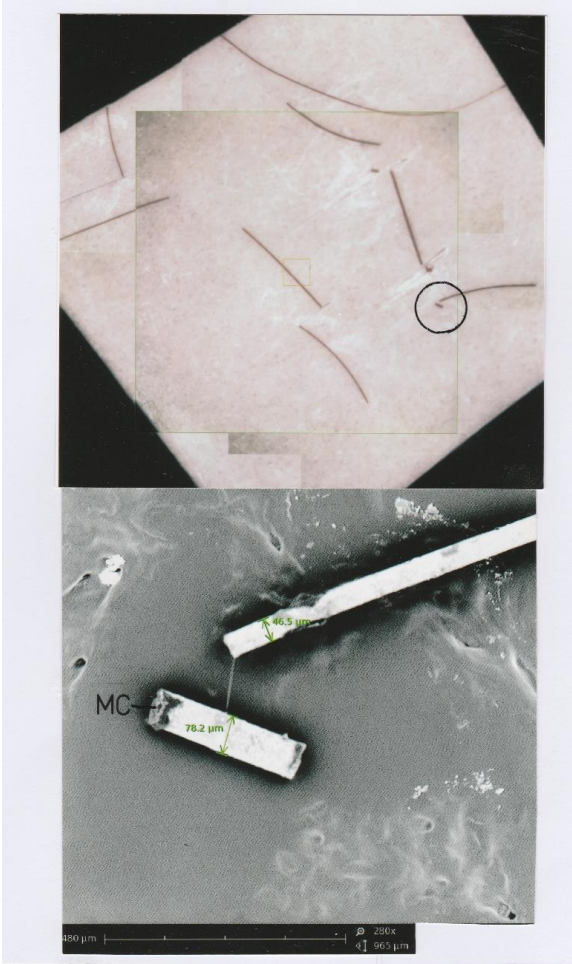
4. Results

Our first assay on the genomic DNA of Napoléon establishes that he is homozygous FF for the F374L polymorphism of the MATP gene. So not only he had the F allele, but it also contains doses of this allele of the white skin ; consequently the skin colour (and that of the face) must be pale.

Our second assay establishes that this genomic DNA is homozygous CC for the rs12913832 polymorphism ; consequently, Napoléon had 99% probability of having clear (blue or green) eyes. CC homozygous have probably blue eyes because they have two doses of the C allele.

Figure 2 (above) shows some hair fragments of the lock, observed in confocal stereoscopic micrography. The colour of these hairs is red, with a more or less pronounced russet-black colouration among the fragments. All the authenticated hair –locks of Napoléon we have the opportunity to examine previously are of that particular colour.

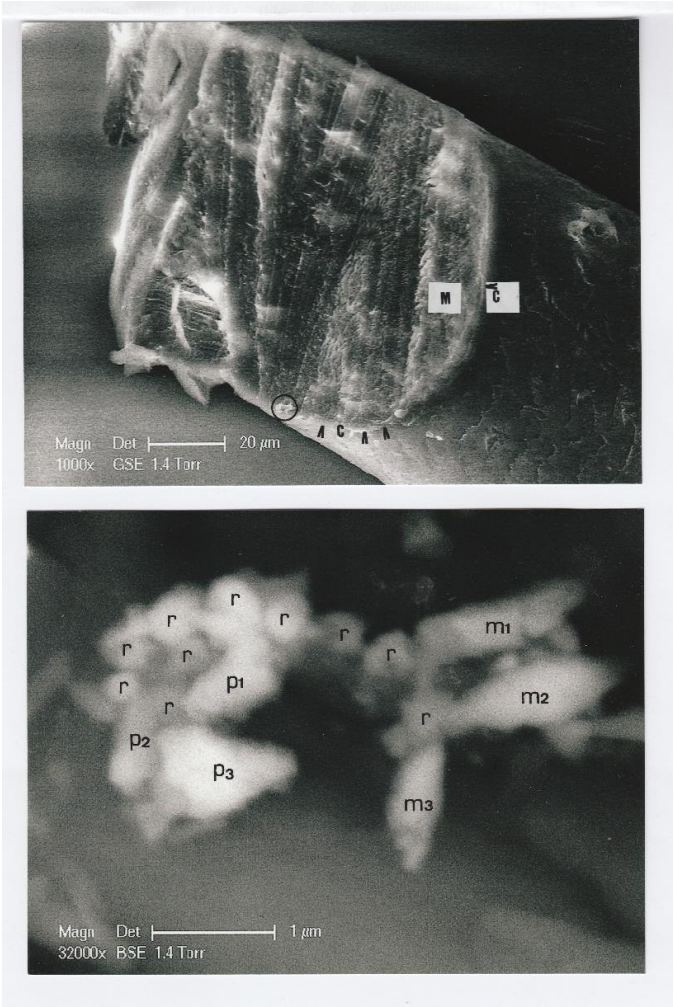
Figure 2. Photographs of the hairs of the lock. *Above* : optical view (20x) of hair fragments (the circled area is enhanced in the below photograph). *Below* : SEM photograph (280x, in BSE) of the two hair fragments located inside of the circle. Thickness measures are in µm ; MC : medullar canal of the thickest.



The study of the complete DNA sequence of the MC1-R gene in the genomic DNA of Napoléon permits us to detect the G allele in the rs1805009 polymorphism (it is in the heterozygous CG form in the sequence) ; consequently the corresponding variant triplet is GAC, coding for the D294H mutation. So Napoléon is heterozygous for the most common variant of the MC1-R gene corresponding to the phenotype red hairs.

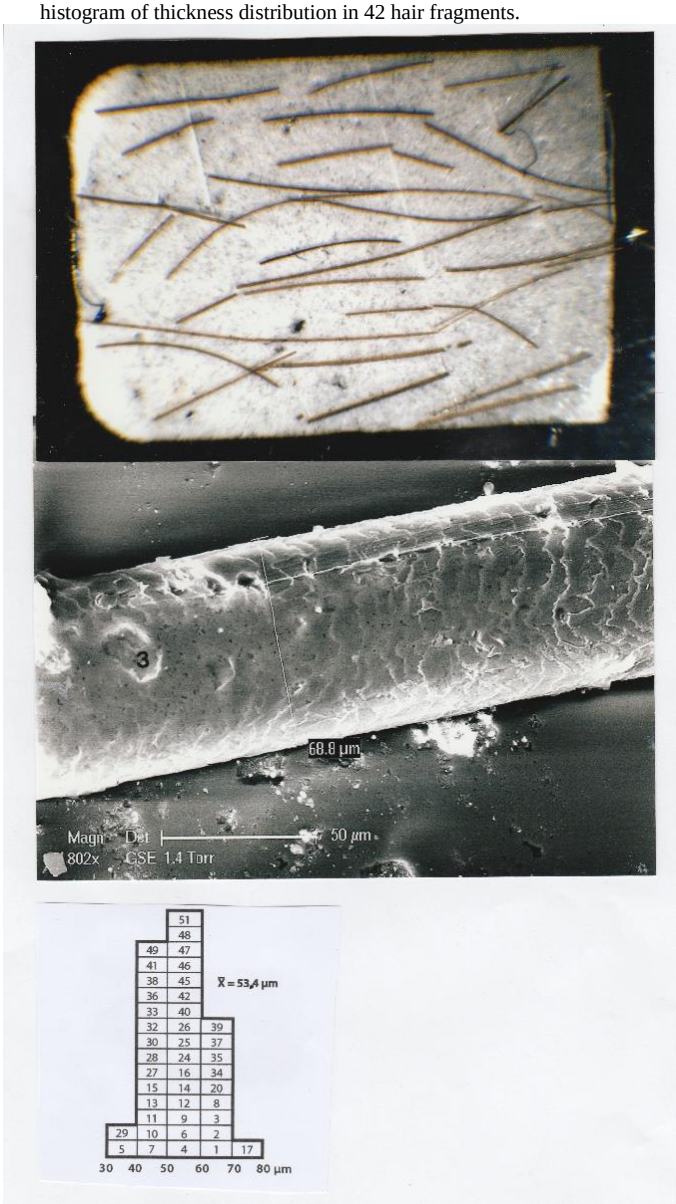
To confirm that hairs of the lock contain well some red pigments [**11**], we have cut with a fine blade some of them in the external cuticle region containing melanosomes (**Figure 3**). Observation in SEM of a typical piece cut at this level shows that it contains two sorts of melanosomes, according to form and size : elongated melanosomes (of 1-1.5µm of length), or melanosomes of type 1, that are "grains of rice shaped" and contain the eumelanine pigment (black) and little and rounded, or bigger (of up to 1.5-2µm of maximal length), or melanosomes of type 2, containing the pheomelanine (yellow-brown) pigment. As the surface area of the piece is more covered by pheomelanin melanosomes than by the eumelanine melanosomes, the colour of the corresponding hair is effectively yellow-brown , so red [**12**].

Figure 3. *Above* : SEM photograph (1000x, in GSE) of the transversal view of one hair of the lock, showing (arrow points) pieces of the hair cortex that are cut (the circled area is enhanced in the below photograph). C : cortex ; M : matrix. *Below* : SEM photograph (32000x, in BSE) of the piece in the circled area. Three eumelanosomes (m1-3) ; three great pheomelanosomes (p1-3) ; r : rounded melanosomes.



Measured in SEM, hairs of the lock are very fine (**Figure 2**, below) and without medullar canal (it is only in the thickest of them that the medullar canal can be observed). To obtain a precise measurement of the hairs, 42 of them are selected for the study (**Figure 4**) ; measurements are realized at the middle part of each hair segments. The thickness distribution evolve between 30 and 80 µm, with a peak for the 50-60 µm class (mean = 53.4 µm). So, hairs of Napoléon are very fine. That is the second characteristic (after the red colour) of Napoléon's hair.

Figure 4. *Upper photograph* : optical view (20x) of most of the hair fragments chosen for the study. *Lower photograph* : SEM photograph (802X, in GSE) of an example of the hair fragment number 3, where thickness measurement is made. *Below* : histogram of thickness distribution in 42 hair fragments.



5. Discussion

Results we obtain on genomic DNA show that Napoléon's face was pale, that his eyes were clear (probably blue) and that he had red hair. These three characteristics were clearly depicted by Gérard, on the 1803 portrait of Napoléon (**Figure 1**). François Gérard (1770-1837) was a most famous artist at that time, named as "the painter of the kings" ; he is well known for his splendid pictures, and specially for the precision in the details of his compositions [**13**].

We cite now observations about Napoléon's appearance made by some of his contemporaries. During his life he met many people, and some of them have written detailed descriptions of Napoléon's aspect that they observed directly. We concentrate on the three characteristics of the face studied.

The various testimonies concerning Napoléon's younger ages agree on his sickly appearance, with a skin having a yellowish pallor. In particular in his Memoirs (1844-1845) Claude Méneval, one of the main Emperor's secretary, gives the following description of Napoléon's face : "He had an elevated and wide forehead, grey and investigative eyes… *His carnation was without colour, but of a transparent pallor*…His chestnut hair, very fine…"

His eyes, deep-set, were always reported as grey, or grey-blue. Only two of the many reports concerning eye colour of Napoléon are cited here, relating to the blue/grey controversy : Constant (a Napoléon's servant) : "… His forehead was very elevated and bared ; he had few hairs, almost located on the temples, but his were very fine and soft. He had chestnut hair, and *the eyes of a beautiful blue*, that depicted in an incredible manner the different emotions that perturb him…" A. Fain (Memoirs published in 1908) : " His chestnut hair was shortly cut around the head… The front was large and elevated ; *eyes grey-blue*…"

To our knowledge , there are only two reports published in the literature concerning some like red hair of Napoléon. The first is that of Dennis Davidov (from his Memoirs), who met Napoléon at Tilsit in 1807 : "The hairs on his head were not black, but *dark reddish-blond*; his eyebrows and eyelashes were darker than the colour of his hair and his blue eyes, set off by the almost black lashes, gave him a most pleasing expression."

The second one is that of Lord Lyttleton (on the 7th of August 1815) : He had the top of the head completely bald. His hair, of a *red-brown*, were long…" This report is interesting because it concerns the last phase of Napoléon [**14**], that of the final exile at St Helena. Probably during this period he was less demanding on his physical appearance, and in particular he neglected the previous dying capillary cares (intended to mask his red hair colour) that he used during his active life.

In a recent book concerning The St Helena exile [**15**], some representations of Napoléon at that time are given. One of them is reproduced on **Figure 5**, where Napoléon had red hair.

Figure 5 . An example of a drawing of Napoléon at St Helena.

The fact that Napoléon had fine hair is also attested, notably in the Méneval and Constant reports , as previously cited.

6. Conclusion.

We have demonstrated on the material of an authenticated genomic DNA of Napoléon, by study of the responsible alleles at the adequate genes, that he had a pale face, clear (probably blue) eyes and red hair. These characteristics of his face are confirmed by examination of the corresponding colours of Napoléon's portrait painted by François Gérard in 1803, and by numerous reports of contemporaries who have the opportunity to closely observe him.

The present study, concerning the genetic determinism of the colours of the skin , of the eyes and of the hairs – well established in recent populations (**2-4**) – is a new example of prediction of the phenotype by using the genotype of a past individual .

In any cases Napoléon sported dark eyes and hair and a tanned skin (in a word a true Southern facial type) as it is generally believed.

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Conflict of Interest

The authors declare no conflict of interest.

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