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## **Jeanne Calment: the secret of longevity**

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**Here, I challenge the validity of Jeanne Calment's universally recognized record of human lifespan**

***Keywords: Jeanne Calment, mortality plateau, supercentenarians, IDL, GRG***

*Then the LORD said, "My Spirit will not contend with humans forever, for they are mortal; their days will be a hundred and twenty years". - Genesis 6:3*

*"Our days may come to seventy years, or eighty, if our strength endures; yet the best of them are but trouble and sorrow, for they quickly pass, and we fly away", – Moses (lived 120 years) - Psalm 90:10*

*"I want to prove ... that the boundaries set up by the gods are not unbreakable", –  
Gilgamesh, clay tablets (years of life unknown)*

*"He's forgotten me. He can't be in any hurry to see me. He knows me all too well." –*

*Jeanne Calment [13] (lived 122 years and 164 days [31]).*

Here, I challenge the validity of Jeanne Calment's universally accepted record of human lifespan. I assess the plausibility of the record based on the lifespans of other centenarians in the International Database of Longevity (IDL) and analyze and refute the arguments put forward by gerontologists in support of this record, such as the hereditary longevity of Jeanne's ancestors and her life-long residence in the center of a small town. I review the literature dedicated to this reportedly oldest documented human being and reveal multiple contradictions in her interviews, biographies, photos, and documents. I suggest an explanation of these discrepancies based on the hypothesis that Jeanne's daughter Yvonne acquired her mother's identity after her death in order to avoid paying inheritance tax and that Jeanne Calment's death was reported by her family as Yvonne's death in 1934. I discuss the importance of reconsidering the principles of validation due to the possibility of similar problems regarding other long-lived people. The phenomenon of Jeanne Calment could also be used as an example of the vulnerability of seemingly well-established facts.

### **Evaluation of the plausibility of Jeanne Calment's lifespan**

A lot of attention was recently devoted to the dynamics of mortality in older ages (105 years and older) [6, 11, 16, 18, 25]. A detailed analysis of these papers, and explanations for the causes of the disagreements between some of them, was provided in [1]. For this evaluation, the only important

consequence of this review is that none of these studies nor other studies revealed any decrease in mortality with age, at least until the data become too scarce.

Most authors come to the conclusion that, for one reason or another, the force of mortality is almost constant after 105 years. In addition, it has been observed that if validated supercentenarians have equal chances to be recorded regardless of their age of death, the force of mortality does not vary much with sex, country and year of birth [25].

It can be assumed that the expected yearly survival in a representative group of validated supercentenarians (people who are at least 110 years old) does not exceed the annual survival of the Italians born in 1904 during the period from 2009 to 2016, approximately half of whom died during any year of follow-up observation [6].

Thus, the probability of the event that anybody from a group G consisting of N supercentenarians would be alive after t years is not higher than

$$P(t, G) = 1 - (1 - 0.5^t)^N.$$

Jeanne Louise Calment had been alive for 12 years and 164 days after her 110th anniversary and was under close (and growing with age) scrutiny from the general public and the scientific community. Jeanne was born on February 21, 1875. All the other 48 supercentenarians in the French section of the International Database of Longevity (IDL) containing verified supercentenarians [24] listed on [www.supercentenarians.org](http://www.supercentenarians.org) were born later than the person under the ID number 584, whose lifespan corresponds to that of Jeanne Calment.

Thus, the first (by date of birth) French woman to be validated as a supercentenarian by a large project searching for long-lived people (funded by the Ipsen foundation ) achieved the world record. If we consider the group G to be all the members of IDL born before 1876 (N=80), then  $P(t, G) \approx 0.0141$ . The longest-lived member of the simulated population consisting of 80 or even 5000 individuals who have a constant force of mortality, and half of whom die every year, did not live as long as the longest-lived member of group G. At the same time, the survival curve of the Italian cohort after 105 years (ISTAT data) and the survival curve of the group G after 110 years without Calment do not differ much from the simulations (Fig. 1).

The second place in this group (and the first one among all the validated long-lived people of African descent) belongs to Lucy Hannah (7 years and 248 days). Similar to the majority of the US supercentenarians in the IDL [18], her validation was based on archive data, such as censuses, which can hardly be considered as reliable age confirmation [2]. Independent researchers from the 110club forum discovered that she was probably 20 years younger than her claim <https://the110club.com/what-was-lucy-hannah-39-s-actual-age-t16664.html>, but she is still present in the IDL and GRG databases.

Robert Young noted in a Facebook conversation that the study of French supercentenarians was inspired by Jeanne Calment, so it is not correct to consider her exceptional age in the context of the other supercentenarians. Nevertheless, she became well known to the gerontological community as an

exceptionally long-lived person already in 1989 [5]. From that time, her personal likelihood of living until 1997 was less than 0.5%.

### **The reasons for the gerontological community's confidence in Jeanne Calment's record**

While gerontologists acknowledge Jeanne Calment's case as unique, and some authors mention the low probability of surpassing this record in coming decades [7, 16], the validity of her result seems to be very well established. Madame Calment was rigorously verified by the gerontologists and demographers [13] who have found her name in numerous censuses of the commune of Arles (Bouches-du-Rhône, Provence-Alpes-Côte d'Azur, France) and other documents. She also became famous for settling a life annuity deal with the notary André-François Raffray in 1965, and he apparently had no doubts about her age [4].

Raffray had to pay 2500 francs monthly in exchange for acquiring her apartment in the center of Arles, where she has been counted in censuses since her marriage in 1896. The annuity was calculated according to the life expectancy of 90-year-old French women in 1965, which was around three years. Thus, the notary and, after his death in 1995, his widow Huguette Raffray had to pay 11 times more than they expected. According to Huguette, whom I have called recently, the apartment was sold immediately after the death of Jeanne, and she does not know who the buyer was.

Jeanne Calment lived in the same house as one of the largest drapery stores in the region, Nouveautés - Calment, which was run by her spouse (and cousin) Fernand Calment, so Jeanne should have been constantly seen by the commune. This belief can be traced back to Robine and Allard's validation report on Jeanne Calment's lifespan [14], where the authors claim that, apparently, the whole time between her wedding and moving to the nursing home, Jeanne had been living in the house where her husband's store was located. Moreover, they write that Nouveautés - Calment still exists at the same location on Gambetta Street. It was hard to imagine how Madame Calment could successfully lie about her age while living in the center of a small town.

In fact, the commune of Arles is the largest commune in France, with a surface almost 9 times the surface of Paris. It incorporates several nearby villages where the wealthy inhabitants (including the Calments) used to have country houses. The population of the commune of Arles was around 24000 people in 1875 and almost doubled by 1997, while there are around 380 inhabitants in a median French commune.

According to her biographies and mortgage documents, Calment had many other places in several communes to live in, and her favorite property was La Miquelette, a villa in the village of Paradou near Arles [9]. There is now only a renewed historical sign on the façade of the Maison Calment, the house where the store was formerly located. Contrary to what is asserted in [14], the drapery store itself has been permanently closed since 1937 [9], and now there is a supermarket, Casino, in that location.

## Town or village?

According to the biography of Calment [9], just before the start of World War I, when Jeanne was almost 40 years old while her daughter Yvonne was around 16, she went hunting with Fernand for the first time. She liked hunting so much that she acquired the masculine nickname "Jean Calment" (in French, the names Jeanne and Jean have the same pronunciation) and became a member of the male-only hunting club. After that, she was going to master skis on the glaciers of Grenoble [9].

However, in another biography, we can read that Jeanne was already a huntress when she was 20 years old: "*Do you remember how were you dressed at the time... when you were 20 years old for example?* Oh, you ask too much of me. You go too far! I led a man's life. I was a huntress, you understand. That will surprise you." [5] I will try to resolve this inconsistency in the next sections.

Here are a few other excerpts of Madame Calment's interviews with her validators [5]: "My husband liked walking, like me. Even at sixteen, I had good legs... *How did you come to get married?* Ah! That I don't remember... *You never thought about working with your husband?* What I did do with my husband was hunting. I was a huntress... That was my life, my man's life... I didn't like visiting, I didn't like mundane life and I liked outdoor life, the life with my husband who was a hunter. I have a masculine nature. I'm not afraid of anything... I was very strong; I was a man. My father said: My girl is a tomboy... *Did you help your husband in the shop?* I never went there. I didn't take care of the business." *She knew how to lead a group of men, the hunting society, of which she was always very proud... She was nicknamed "Madame Partridge". It's a subject she loves to talk about* [5].

Such a lifestyle had shaped even the gait of Madame Calment. Here is one of the few statements from outsiders who were in contact with Jeanne before she moved to the nursing home; this is an excerpt from an interview of the former mayor of Arles, Jacques Perrot\* [15]: "When I learned that a woman from Arles was 100 years old, I was going to visit her, invite her family, and bring a gift. I received a polite but firm rejection. Madame Calment did not want the ceremony, so the birthday passed unnoticed. Jeanne finally called me back and agreed to come to the city hall herself... I waited for a long time for her at the reception, until it turned out that one of the seated women, who did not appear to be more than eighty, was the guest of honor. We did not agree on political views [*The mayor was communist and she has never liked this political group* [5, 15]] but talked about common subjects... When she left the office, I noticed that she had a hunter's gait." A resident of Arles Michele Gil also said that Jeanne Calment looked thirty years younger than her age and had the gait of a young woman [9].

Madame Calment managed to stay in the shadows until she moved to a nursing home in 1985 when she was almost 110 years old. Jean-Claude Lamy studied the archive of the local newspaper, Le Provençal, in Arles and didn't find any mention of the new centenarian. Instead, the newspapers wrote about another long-lived person who celebrated her 95<sup>th</sup> birthday in 1975 [15]. Jeanne's attitude completely changed in the nursing home, where she adored the press, gifts, and parties and was not confused by the attention of journalists. "I've waited 110 years to be famous. I intend to make the most of it for as long as possible." [13]

Thus, Jeanne Calment does not satisfy the first criterion of validating long-lived people as proposed by Robine and Allard [14]: a public declaration of reaching the age of 100 years or recognition of the centenarian in the local press. They decided to make an exception for Calment because of the census in 1975, which listed her as born in 1875.

Jeanne's father, shipbuilder and town hall advisor Nicolas Calment, was a rich and influential man who once employed 60 to 80 workers. As a child, Madame Calment spent a lot of time in his farms in Saint Martin de Crau and Paradou. Nicolas grew different crops and made wine and goat cheese. Jeanne loved to run in the fields and look after the cows [5].

In the early thirties, Jeanne and Fernand bought La Miquelette, a suburban villa in Paradou, for their daughter Yvonne and her son Frédéric Billot (1926-1963). This villa had become a favorite dwelling of Jeanne until she sold it after Frédéric's death [9]. The trail of Yvonne Calment was lost in 1931. According to the 1931 census, the house on Gambetta Street was inhabited by homeowner Fernand Calment along with his wife Maria (validators suggest that this is a typo and should be read as Jeanne), mother Maria Felix, Yvonne's husband Joseph Billot, Yvonne's son Frédéric Billot, and two maids [14, 32]. The authors try to explain the absence of Yvonne by a recopying error [14, 32], but the true reason could be different. Anyway, one can see that the census information is not rigorous and can not prove anything.

According to the testimony of Pierre Maxence, son of Marius Maxence, the oldest employee of the store Maison Calment who worked there for about thirty years until its closure in 1937, Madame Calment almost never appeared there [22]. The fact that she is mentioned in many censuses at the address of the store does not mean that she lived there all the time. According to validators, Jeanne is counted twice in the 1901 census: at St Martin de Crau and in Gambetta street in Arles [14, 32]. Moreover, her brother François was also counted at St Martin de Crau in 1901 [14, 32] while being counted with his wife and daughter in Toulon in the census kindly found for me by Cyril Depoudant (of note, Robine and Allard write that François had no family and children [5]).

Obviously, then, as now, census takers trusted the property owner to tell them who was in residence; personal presence was not required. The fact that censuses can't serve as a reliable source of information was well established by Soviet gerontologists who were trying to validate long-lived people from Azerbaijan [2]. The phenomenon of Caucasian longevity was a subject of lots of papers and books, but it was based on a shaky foundation: "Abkhazian long-lived people always willingly tell legends and traditions about national heroes... But they do not like to talk about themselves, considering it extreme indiscretion. Therefore, collecting information about their lifestyle is difficult." [3] Below, we will see that despite the apparent differences, Madame Calment had much in common with these long-lived Abkhazians.

### **Analysis of interviews with the "Doyenne of humanity"**

In her numerous interviews, Madame Calment discusses a lot of hard-to-check details of her childhood, starting from the age of three, but does not mention the epidemic of cholera that devastated Arles

in 1884 when Jeanne was 9 years old [5]. Jeanne often refused to talk about her family [5, 9]. The hearing of the old woman deteriorated when the topic of conversation did not suit her. The validators state that *Madame Calment's "technique" in conversation was clear – when she didn't have any answer to a question, she answered with an obvious statement or generalization: when asked "What did your father do at the town hall?" she replied, "What advisors do..." and when asked if her daughter was a pretty baby, she replied, "All babies are beautiful" [5].*

Here are some examples of inconsistencies that will be resolved later on: *Did you ever meet Frédéric Mistral? "Yes! Yes, he was a friend of my father... um, he was a friend of my husband." You told me that Espartero died in front of you in Nîmes. "Yes, the bull tore off his coat. Then he jumped on top of him. A painful memory! Oh! Oh! The arena was packed!" [5]* The validators wrote that they checked this information and it was correct. However, the only famous Torero named Espartero I managed to find online died in 1894 in Madrid: [https://es.wikipedia.org/wiki/El\\_Espartero](https://es.wikipedia.org/wiki/El_Espartero).

According to the validators, *Madame Calment didn't really become famous until 1988, when the centennial of Vincent Van Gogh's stay in Arles was celebrated... Without the link to a famous artist, perhaps she would have remained unknown. In 1994, the second-oldest French person died at the age of 113 years without either having been studied or having received national recognition. But Jeanne Calment quickly passed from local fame in Arles to worldwide fame [5].* In the Canadian film "Vincent and me"

<https://www.youtube.com/watch?v=ADIZoNQP78>, which made Jeanne the oldest movie star, the 114-year-old woman informs a young girl that she met the artist in her **father's** shop. Newspapers also mentioned this **father's** shop: <https://www.dailymail.co.uk/femail/article-1008681/Alcohol-cigarettes-chocolates-sweets--The-secrets-long-life.html> as well as the GRG website

<http://www.grg.org/Gallery/1875Gallery.html> and Robert Young on the 110 Club

[https://web.archive.org/web/20170227010118/http://z3.invisionfree.com/The\\_110\\_Club/ar/t3663.htm](https://web.archive.org/web/20170227010118/http://z3.invisionfree.com/The_110_Club/ar/t3663.htm).

However, Jeanne's father, Nicolas Calment, unlike Yvonne's father, Fernand Calment, never had any store.

For some reason, the validators did not become suspicious after this inconsistency. In the interview [33], Jeanne makes another mistake: "My husband sold the canvases to Van Gogh... and introduced me to him in the shop - 'here is my wife.'" This testimony can't be true since Jeanne was not married until the age of 21, six years after the death of the painter.

When interpreting these kinds of statements, one should take into account that, despite the *CT scan, which showed marked temporal, parietal and occipital atrophy... the subject's performance on tests of verbal memory and language fluency was comparable to that of persons with the same level of education in their eighties and nineties... A high initial level of intellectual ability may have constituted a protective factor... Geriatricians have often observed a relative stability in the health profiles of persons over 85 years, as if this group of survivors, having lived beyond the years of highest risk for the major causes of mortality in the elderly (cardiovascular disease, cancer and dementia), experience a period relatively free of disease. Death is commonly caused by increasing vulnerability to external trauma and difficulty in re-establishing*



*homeostasis, a condition that may perhaps be labelled 'terminal frailty'* [23]. Excellent cognitive abilities are also emphasized by Jeanne's validators [5].

Here is another example of confusion: *Gilles, whose name was that?* "It's my grandmother's name, my grandparent on my father's side." [5] After some discussion, she corrected herself and admitted that it was her mother's side, but the important thing is that neither grandmother of Jeanne had a surname of Gilles: actually, Gilles was the surname of her mother, who was the grandmother of her daughter Yvonne (in those days, the wives did not take the husband's surname) and the grandfather of Jeanne on her mother's side.

There is another revealing story concerning the maternal grandmother: Dr. Georges Garoyan, in response to my request to send me his dissertation about Jeanne, has kindly agreed to look for it (unfortunately, he had not found it yet) and added that the most important condition for personal longevity is a long-lived (at least 90 years) maternal grandmother. I was surprised by this response because Rose Minaud, Jeanne's grandmother on her mother's side, lived to 72 years. However, many of her ancestors lived relatively long, and below, I will discuss the possible causes of this phenomenon.

### **Analysis of longevity of the ancestors of Jeanne Calment**

One of the common explanations of the extraordinary longevity of the "Doyenne of humanity" is her extraordinary genetics. The validators write: "Many ancestors of Madame Calment could have been unconsciously chosen (by the spouse or by their families) because they were carriers of genes favoring longevity. Gradually, there would have been a concentration, a unique enrichment of this type of gene, to permit such a long existence." [5] Here is an example of the widespread belief in these family roots of her extraordinary lifespan: "Examination of her paternal and maternal ascendants show at least three generations of exceptional longevity." [23]

Indeed, Caroline Boyer did an impressive job of studying the longevity of many generations of Jeanne Calment's relatives, compared them to the control group of residents of Arles, and found that "infant mortality was 27% in controls as compared to 15% in the Calment group; the life expectancy of the residents of Arles was 27 years against the 41 years in the Calment group; the direct ancestors of Jeanne lived on average 80 years compared to only 58 years for the ancestors of other members of her family of the same generation." [5, 8]

Unfortunately, these authors do not provide the raw lifespan data of Calment's ancestors. With the help of French researches Arnaud and Cyril from <http://centenaires-francais.forumactif.org/>, a forum on French centenarians, I've got the lifespan data for four generations of the ancestors of Jeanne, 30 persons born between 1723 (Vincent Calmen, great-grandfather of Nicolas Calment) and 1838 (Marguerite Gilles, wife of Nicolas Calment). The average lifespan of these ancestors appears to be 72.3 years which is less than declared 80, underscoring the importance of public availability of raw data of any scientific research.

It is easy to notice that representatives of the male line of the Calments, including Jeanne's father Nicolas Calment, his father, grandfather, and great-grandfather, who were all ship carpenters by profession,



and their wives lived long lives. In addition, the parents of their wives lived for a long time as well. I considered three groups of Jeanne's ancestors: the Calments and their wives; the Calments, their wives, and their parents; and Jeanne's other ancestors, and drew the survival curves of these groups as well as synthetic survival curves based on the death rates in France in 1875 and 2014 from the age of 31, when the first death was recorded (Fig. 2).

The survival curves of the first two groups are almost indistinguishable, and the third group experiences much higher mortality in young ages. Apparently, the longer lifespan of the family members of ship carpenters was due to a more favorable environment: prosperity, quality of food, the ability to escape from an epidemic by retreating to a country house (during the cholera epidemic in 1884, the Calment family was living in their "mas" in Saint Martin de Crau [5]), respect in society. The low infant mortality among the Calments' relatives could also be explained by a large number of midwives in this family [5].

However, the survival of Jeanne's ancestors after 70 years is not impressive, and none of her ancestors had reached 95 years. The life expectancy in Monaco is now approaching 90 years, and I was able to contact several living people who knew Jeanne and are at least 90 years old. Analysis of the lifespans of twins who were separated and grew up in different families [17], numerous genealogies [26], and analyses of complete genomes of supercentenarians [12] question the contribution of genetic differences to human lifespan.

Caroline Boyer, who performed the archive work concerning Jeanne's validation and genealogy on behalf of Robine and Allard gave me the information about the more distant ancestors of the Calments. It turned out that Vincent Calment (1723-1808) was the founder of a dynasty of carpenters. His father was a hostler and died at the age of 68 years, and his grandfather was a worker and died at 50 years. Other ancestors of Vincent also could not boast longevity.

### **Jeanne and her daughter Yvonne – who is who?**

Despite the widespread belief in the reliability of Jeanne's record, clinical gerontologist Valery Novoselov was very skeptical because of the phenotype of the "doyenne of humanity", which, in his professional opinion, corresponded to a much younger age. Novoselov conducted a poll on his Facebook which asked participants to estimate the age (with an accuracy of a year) of the lady on this photo:

<https://www.facebook.com/photo.php?fbid=1679131822208934&set=a.218820481573416&type=3&theater>.

It was a photo taken by journalists during the celebration of the 117th anniversary of Jeanne Calment (Fig. 4C), but the 224 users did not know who it was (very rare connoisseurs were filtered by hand). The average result was 95 years, the age of Yvonne Calment - the only daughter of Jeanne who presumably died in 1934. Jeanne reluctantly answered questions about her daughter, and here are a few excerpts from [5]: *the daughter and the mother shared characteristics in their behavior, their liveliness, their gait... Did she like hunting?* "...I didn't think about it myself. She liked music, that's all. I played piano duets with her. The usual." *Do you remember her illness?* "We took her to . . . . Oh! I don't recall any more" ...*Did she die at*

*home or in the hospital?* "At home. When she came back from the hospital, it was Advent and she came to die at home."

Caroline Boyer and Cyril Depoudent confirmed that a noticeable portion of the French population of that time was not using the names given to them at birth. Jeanne and Yvonne are variants of the same name of Ioanna, the female form of Ioan (Ivan in Russian, John in English). Probably, Madame Calment preferred the variant that differed from the one she was given at birth. As mentioned above, she used the nickname Jean for membership in the hunter society.

Nicolas Calment was not only a grandfather but also the godfather of Yvonne, so Jeanne's living memories of her father, which she shared in her interviews [5], might well have a real background. Her close relationship with her godfather could play a role in the identity switch. Nicolas was active in old age; he was the founder of an anti-German society during World War I [15]. In [27], there is a photo of Nicolas and his wife Marguerite Gilles ([https://1drv.ms/b/s!AveUIZgMErhBi4sFaLwZLEPw2\\_yEpg](https://1drv.ms/b/s!AveUIZgMErhBi4sFaLwZLEPw2_yEpg), page 51) to the left of the photos of the young Jeanne and Yvonne (Fig. 3C), the one that many sources, including Wikipedia and GRG, mistakenly marked as the photo of Jeanne (Fig. 3D). It is dated as 1880, but this dating is probably erroneous, and the cause of error could be again the confusion between Jeanne and Yvonne, since both look very old on the photo, and the much more probable date should be 1903, which is when Yvonne, not Jeanne, was 5 years old.

A 71-year-old widow, Joséphine Audibert (born in Tarascon), claimed to have seen Yvonne's corpse, and her testimony was signed by the aide of the mayor of Arles, Justine Valle, who claimed to have ascertained the fact that Yvonne Calment died at 2:00 a.m. on 19 January 1934, at the age of exactly 36 years at her home on Gambetta Street.

After Yvonne's official death, her son Frédéric was brought up by his grandmother Jeanne Calment. He called her "Manzane", meaning mama Jeanne. According to [9], when Frédéric was one year old, his parents went for a vacation to Italy, leaving the child to his grandparents. The child persistently tried to call his grandma "mama", but they reached a compromise. After Yvonne's death, Jeanne treated Frédéric as her child [5, 9, 15].

According to the 1954 and 1962 censuses, Madame Calment lived together with her son-in-law colonel Joseph Billot, and Frédéric lived with his wife René in the nearby apartment [14, 32]. Jeanne was an unusual mother-in-law; she perfectly got along with Joseph with whom they previously co-raised Frédéric [5]. In the 1962 census, Joseph Billot was originally labeled as "M"-Married, then fixed on "V" – Widower [32]. On the other hand, as far as I know, Jeanne did not communicate with the widow of her grandson when she became a supercentenarian.

According to the validators, *the daughter and the mother shared characteristics in their behavior, their liveliness, their gait. Admittedly, Jeanne said that Yvonne resembled her father more than her mother. Besides, the two women appeared quite different in photographs where they appear together* [5] (Fig. 3A). In the first French edition of the verification biography of Calment, the authors put a joint photo of Jeanne and Yvonne and sign it: *Jeanne and Yvonne, who is who?* Indeed, at first glance, it is difficult to understand

which of the women in the photo is older. However, based on the other available photos of young Jeanne, it is obvious that Yvonne is the taller woman to the left of the observer (the same is written in the English edition of the book). According to a sister of Joseph Billot, at the magnificent wedding of Yvonne in 1926, Jeanne looked so young that she could be taken for a 28-year-old daughter [9]. This mistake was allegedly made by Joseph's father at his first acquaintance with Jeanne [27].

Unfortunately, available photos of the Calment family are scarce. In 1994, shortly before the new year, Madame Bigonnet, a cousin of her grandson and heiress of Jeanne Calment, said: "When she says something to you, it is impossible to disobey. One day, she told me to burn all her old photos. I had to obey, reluctantly." *Luckily, Madame Bigonnet managed to save some photos from the fire* [27]. Apparently, Jeanne decided to destroy the photos and other documents when she was requested to send them to the archives of Arles [15]. Being in the nursing home and not being able to destroy the documents herself, Jeanne resorted to the help of a distant relative. Most likely, it was a result of cold calculation and acute necessity instead of an emotional act.

Here is how her validators describe this event: *While she was still in the Maison du Lac, Madame Calment destroyed all her personal archives, all her family photographs. That's a bit surprising; yet, this attitude is not so unusual. Many people in her situation, without direct descendants or close friends, decide, in the twilight of their lives, to leave nothing "dragging" behind them – nothing that affects them, no trace of their existence... She would say: "I don't want my image scattered."*

It should be noted here that Madame Calment have not destroyed all traces of her existence. In the nursing home, the photo portraits of the old lady were hanged on the walls; she starred in a film about Van Gogh and was a subject of various photo sessions, including the joint photo shoot with the oldest man of France, who was taken to her by helicopter [15]. For her 120th birthday, she was given a huge photo album tracking her stay in the nursing home. At the age of 121, Calment became a rap star with the *Time's Mistress* CD. After the release of this disc, the director of the nursing home was dismissed, and Jeanne almost ceased to admit visitors, including gerontologists and validators, who believe that this isolation had adversely affected her health and led to premature death [5, 15].

However, some of the photos have been preserved and published in her biographies, which might be just the tip of the iceberg. It is known that Jeanne's grandson Frédéric had a hobby of making family video. Perhaps some of the videos remain with his widow René Yvonne Bonnary, born in 1926, who has changed her surname and lives now in Sausset-les-Pins. According to a biography [9], Frédéric died on the road near Sausset-les-Pins in a car accident, but his death report stated that he died at his home on Gambetta Street.

On all published photos (except the joint photo with the daughter), the young Jeanne is turned in profile to the left side. The only good facial photo (Fig. 3D) which, until recently, was labeled as Jeanne on various Internet sources (Wikipedia in multiple languages, GRG's site, etc.) turned out to be the photo of Yvonne [27] (Fig. 3C, bottom), which was confirmed by Michel Allard in personal correspondence. Now, after Dr. Novoselov's official request to GRG, it was renamed as *Daughter Yvonne* (<http://www.grg.org/jcalmentgallery.htm>).

Amazon Rekognition, which uses machine learning for facial recognition, identified two photos of Yvonne (Fig. 3A, left and Fig 3C, bottom) and the supposed photo of Jeanne – the only photo in the biography [15] (Fig. 3F) as photos of the same person. I've made the same conclusion after aligning them in Photoshop and smoothly changing the transparency of one of them. The differences between Jeanne and Yvonne in their youth are apparent despite similar poses, necklaces and hats (Fig. 3C, top and Fig. 3F).

I've morphed young Yvonne to old (presumably 113-year-old) Madame Calment, having imposed pupils and maintaining proportions of both photos. By changing the transparency, I created a transition video at <https://www.youtube.com/watch?v=2pKZRFjx2bU>. The intermediate stage of this transition is shown in Fig. 4A. In old age, the bottom lip has deteriorated, the skin has sagged, a second chin has emerged, and the tip of the nose has moved down, but the main features (e.g. the shape of the main part of the nose and the chin) show a very high level of similarity. In addition, one can see a little fibroma on the nose of young Yvonne. A similar fibroma can be seen in one of the photos of the old Calment (Fig. 4B).

I failed to repeat the same procedure with young Jeanne because of the lack of facial photos. Photos of young Jeanne's profile are poorly superimposed on similar pictures of an elderly Calment, probably because the bad fit of the facial skulls. There are some other photos available for analysis, including the photo of a 60-year-old Madame Calment at <http://www.grg.org/images/JCalment/JCalment60.jpg>, and there are arguments that this woman looks like Yvonne (and thus Yvonne hadn't died at the age of 36), such as <https://medium.com/@yurideigin/jaccuse-why-122-year-longevity-record-may-be-fake-af87fc0c3133>. Professional expertise could potentially strengthen all the arguments based on visual inspection.

In a biography [9], there is a photo of Jeanne's passport (Fig. 3H) from the thirties (Jeanne then was about 57 years old, so, probably, she used an old, younger photo). In the document, there is information on several parameters: height (*152 cm*), hair color (*black*), eye color (*black*), and forehead shape (*low*). All of these parameters differ from those expected from the old Jeanne Calment. According to Dr. Garoyan, who wrote a medical dissertation on the health of 114-year-old Calment, her height was then *150 cm*; the same figure is given in [27]. Dr. Garoyan also reported that at closer to 120 years, Jeanne's posture became bent, and perhaps her height in this bent state shrank to 137 cm as stated in [5].

Thus, in almost 60 years, she has lost only 2 centimeters in height, which is not consistent with observed dynamics of longitudinal changes in height [28]. Based on a photograph of a 109-year-old Jeanne in a nursing home (Fig. 3E), geriatrician Valery Novoselov estimated the age-related loss in height due to osteopenia and osteoporosis as 8-10 cm, which is consistent with the average loss of women from 57 to 87 years (Fig. 3G) and inconsistent with the passport data. The young Yvonne is obviously taller than the old Jeanne (Fig. 3D vs Fig. 3E), and her height can be estimated by conducting appropriate measurements in the church of St. Trophime in Arles. Fig. 3A shows that young Yvonne was taller than Jeanne.

According to [5], *her eyes were light grey and her hair was once chestnut brown*. Michel Allard suggested in personal correspondence that the eyes were *light blue* in her youth. As for the height of the forehead, it is a rather subjective parameter, but the elderly Madame Calment, the young Yvonne Calment,

and her father Fernand had foreheads that go vertically upwards and do not look low, while on the photo of young Jeanne, the forehead goes at an angle and may be considered low.

It is impossible to retrieve the eye color from the old photos, so let's trust Allard and the fact that, in full agreement with him, some photos from when Madame Calment was 110 to 113 years old show that her eyes are indeed *light grey* (Fig. 4B). Even on the black-and-white photos [4, 27] (Fig. 3A, 3B), one can see that Yvonne's and Fernand's hair are lighter than Jeanne's. *Admittedly, Jeanne said that Yvonne resembled her father more than her mother* [5].

In the report [14, 32], validators write that Jeanne has mentioned the servant Marthe Fousson, and they cite the census of 1911 in which she is counted together with the Calment family. The only mention of a servant with the name Marthe that I found in the biographies of Calment was the following: *Did you go to school with your friends, or did you go alone? "My father or the maid accompanied me..." What was the maid called? "Marthe, Marthe Touchon."* [4, 5]

In the last years of Calment's life when these validation talks took place, she had difficulty with speaking precisely [5]. On the basis of almost identical-sounding surnames and the coincidence of the name, and taking into account that there was nobody named Marthe living with Jeanne or nearby when she was a child according to censuses, and the only servant found in the census of 1886 was called Marguerite Minaud (who was a relative of Jeanne born without a father), I conclude that Marthe Touchon is the same maid as Marthe Fousson from the validation report. But, according to the archives of the commune of *Fontvieille*, she was born on 8th of March 1885 and thus was 10 years younger than Jeanne, so she couldn't accompany Jeanne to school. However, she could well accompany her daughter Yvonne.

### **Analysis of the validation of the age of Madame Calment**

*The American demographer, James W. Vaupel; the Finnish demographer, Vaino Kannisto; and the Danish epidemiologist, Bernard Jeune visited Jeanne Calment the day after her 120th birthday. Together, they formed an unofficial committee whose purpose was to look through the documents that Robine and Boyer had found in the city archives. There was a good deal of speculation at the time as to whether Mme Calment really was as old as reported. If the comprehensive documentation that Robine and Boyer had dug up could conclusively rule out all error and confusion, then she would indeed be "la doyenne de l'humanité" (the elder of humankind), as her compatriots called her. It was, therefore, of great importance that impartial experts examine the original documents. The only errors this team of researchers found were minor—for example, a wrong middle name in some of the censuses* [13].

I asked the authors [13] about these inaccuracies with the middle name, but no intelligible answer was received. Then, I tried to check the formal validation [32] of the age of Calment based on the archive data. The census data for Arles is available on the Internet until 1911 and the acts of birth, death and marriage until 1902, so I focused on this period. The work was hampered by the fact that not all pages of archival data are downloadable (the archive support service did not respond to requests) and that the report



[14, 32] contained many minor inaccuracies, possibly appearing after the translation into English and often not very important, but showing that, despite being heavily cited in scientific publications, the validation was not thoroughly checked by anybody.

For example, in the validation [14, 32], they write that Jeanne was born in a house on Duroure, while the correct street name is Du Roure, and that in 1876, Jeanne was counted in the western Canton, section J, but she was counted in section I. The validators write that in 1906, she was counted on St Estève Street, but she was counted on the Rue de la République (it is the same house, located on three streets at once). It is written that Jeanne moved to a nursing home at the age of 110 years, and, in fact, she moved at the age of 109 years (and 10 months). In addition, not all links (for example, "Blois, P. (1993) The Interview with Master Raffré, a notary from Arles") from the validation are available, and the authors themselves could not answer me as to where the source could be found. These small problems show that despite the fact that the validation report is available on the Internet [32], so far, no one has informed the authors about them or they have not made the corrections.

In the 1901 census, the validators found Jeanne Calment at two addresses, and the 1931 census did not count Yvonne Calment in Arles. The validators found that Marthe Fousson was born in 1885, according to the 1911 census, but did not pay attention to the fact that Madame Calment, born in 1875, said that Marthe accompanied her to school.

For a strange reason, the validators write that in 1891 and 1896, *no 'list of population counts' was established*, which is wrong. I have not been able to obtain the information of these censuses at the certain addresses because of the download problems on the archive's website, but in the 1896 census, it was possible to find a notary, Victor Arnaud, who executed the marriage contract of Jeanne in 1896, and, 30 years later, the marriage contract of Yvonne in 1926.

As mentioned above, Jeanne and Yvonne had a lot in common, so it is not surprising that they were married in the same church of St. Trophime where Yvonne was also baptized, and, as Denis Danilov remarked, her photo (Fig 3C, D) was also taken there. It turned out that the notary was also the same. On the other hand, the ancestors of André Raffré, who was paying the lifetime annuity to Jeanne, did not live in Arles. Cyril Depoudant found out that Raffré came to Arles from the opposite end of France; he was born in Cancale.

### **An example of a perfect fraud**

The possible financial motive for the identity switch could be tax evasion. As far as I know, the first time this version of events was expressed was in the discussion of Calment's article in the French Wikipedia [34] by the user hbourj. Thanks to Cyril Depoudant, we managed to get a list of ten real estate transactions conducted by Jeanne Calment from 1897 to 1955 as well as transactions made by her family members. These include a large rental deal in Arles (probably of the space of the shop which was closed in 1937) of 375,000 francs in 1938, which could purchase roughly the same amount of gold as 375,000 modern dollars,



and the sale of the farm in Saint Martin de Crau, which was formerly owned by Jeanne's father Nicolas Calment, in 1951 for 5.5 million francs, which is equivalent to around \$500,000 today. One of the sellers was Jeanne, and another was Frédéric Billot, who had probably bought the share of François in 1943 for 500,000 francs (approximately 350,000 modern dollars). This farm was probably inherited by Jeanne and François from Nicolas Calment after his death in 1931, since the only large gift by Nicolas to his children was made in 1926 and amounted to 72,000 francs (approximately 130,000 modern dollars). After the death of Nicolas in 1931, both Jeanne and François sold some property for 35,000 francs each, and it was stated that Jeanne had sold the apartment at Roquette, 53 – the address of the parents of Jeanne Calment (they both had died there, according to the death certificates obtained by Cyril Depoudent).

*Between 1791 and 1901... the proportional tax rates were fairly small (generally 1%-2% for children and spouses), so there was really very little incentive to cheat. The estate tax was made progressive in 1901. In the 1920s, tax rates were sharply increased for large estates. In 1901, the top marginal rate applying to child heirs was as small as 5%; by the mid 1930s, it was 35%; it is currently 40%. Throughout the 20th century, these high top rates were only applied to small segments of the population and assets [21]. Interestingly, the tax laws seem to affect the timing of reported deaths [35].*

Perhaps the Calment family suffered from taxation after the death of Maria Felix (widow of the founder of the store, Jacques Calment) and especially after the death of Jeanne's father Nicolas Calment, the owner of land and real estate in the surrounding villages [5, 15] in 1931. The inheritance tax for the farm in Saint Martin de Crau could amount to hundreds of thousands of dollars in modern money. It is not hard to imagine that the family had neither desire nor ability to pay the tax, especially twice in a row (here, one should recall that Jeanne hated socialists [5, 15]). Information about paid taxes must be stored in the relevant archives [21], so one can try to check the taxes paid after the death of Nicolas in 1931, given access to them. In addition, Jeanne and her husband had a lot of common property (which they had rented out after the closure of the store), the inheritance of which could also be heavily taxed.

If it was Jeanne and not Yvonne who died on Yvonne's birthday in January 1934 (or even earlier; recall that there was no Jeanne already in the 1931 census), the family could persuade 71-year-old Joséphine Audibert that the body belonged to Jeanne. As the Calments had a large influence in high circles of Arles [5], there could be several ways for them to manage this identity switch. Yvonne could spend a lot of time outside of Arles where she could be known under the pseudonym Jeanne (recall that she used the masculine form Jean in the hunting society). In addition, most people knew her just as Madame Calment, no matter what name she used. One should also take into account the specifics of Provence, which was a region with its own language and mentality where the idea of paying huge taxes to the French Treasury could be not very popular and corruption at the local level was probably not uncommon.

The inner circle knew about the substitution but did not tell anyone. Jeanne and Yvonne, unlike Fernand, were not sociable people, and from afar they were not easy to distinguish: they dressed similarly (Fig. 3A), Jeanne looked young and, as we have seen above, people who were unfamiliar with her often confused her with Yvonne. When one journalist asked Madame Calment: "You were a charming woman;

you must have had a lot of gallant proposals?" she answered him: "My husband was a marvelous man. When one has an angel, one keeps him, and the rest don't see you." [5] World War II brought chaos with it [9, 15], and after the war, it all settled as if Madame Calment was always Madame Jeanne Calment.

In addition to many biographies that do not question Jeanne's identity, I managed to find a rare book on insurance published in 2007 [10], where there is a short paragraph in the chapter on insurance fraud devoted to Madame Calment. The author describes the rumor that a certain insurance company has found out that instead of Jeanne Calment, it was her daughter who received the rent, but by agreement with the authorities, it kept the secret given how much the character of the "doyenne of the French" had become legendary. The details of the story are not clear. An officially sanctioned visit to Arles and Marseille and an investigation into various archives could clear some of the remaining questions. Forensic analysis of the bodies and DNA of the family members could be done to establish the truth, but political will is necessary to make it possible. However, after studying this case as deep as I could, I can state that the likelihood that Jeanne Calment had really set a record of longevity is extremely low. To conclude, here is the

### **List of arguments supporting the identity switch hypothesis**

1. The first (by date of birth) French woman to be validated as a supercentenarian by a large project searching for long-lived people (funded by the Ipsen foundation [19]) achieved the world record. The probability of such luck is very small. In a simulation of 5000 110-year-olds, who died at the rate of 105-year-old Italians, none lived to the age of Calment, while there are only 80 validated long-lived people born before Jeanne in the IDL database. Jeanne became well-known to gerontologists when she was 114, which is when her personal probability to reach 122 was less than 0.5%.
2. According to numerous testimonies, Calment looked 20-30 years younger than her age, at least from 100 until 117 years. The geriatrician V. Novoselov noted that she had no signs of the syndrome of senile frailty (R54 in the ICD-10), which is common in people over a hundred years of age.
3. Dr. Novoselov's professional opinion that the photos and videos of Calment in the nursing home correspond to the appearance of a woman who is 20-25 years younger was confirmed by the poll of 224 people on the assessment of the age of the woman in the photo (a professional photo portrait of Jeanne on her 117th birthday). The average result (95 years) coincided not with the age of Jeanne but with the age of her daughter Yvonne. A similar "error" in the assessment of the age of 100-year-old Calment was made by the mayor of Arles in 1975. A mayor's position requires him to contact a lot of people of different ages, so he should be good at age assessment.
4. No mention was found of her centennial in the local press. Jeanne became famous only after she was 110 years old. Jeanne didn't want publicity when she was 100 years old.

5. Intentional, remote destruction of photos and family archives after moving to the nursing home suggests that Jeanne had something to hide.
6. Comparative analysis of photos of young Yvonne and old Jeanne shows a very high visual similarity in the height and shape of the frontal bone, the shape of the nose, and anthropometric parameters of the facial skull.
7. There is a documented mismatch in anthropometric and physiological data (standing height when age-related changes are accounted for, eye color, the height/shape of the forehead, and hair color) in different years of life.
8. Jeanne willingly spoke about historical events and encounters with celebrities, but her claims often did not match reality.
9. Jeanne was reluctant to give detailed answers about her family; she confused her grandmother with Yvonne's grandmother, her husband with her father, et cetera.
10. According to one biography, Jeanne said that she first went hunting around 1914 (Jeanne should have been near 40 years old, Yvonne near 16), got the pseudonym Jean in the hunting society, and then mastered skiing in the mountains of Grenoble. In another biography, she said that she was a huntress when she was 20 years old.
11. Jeanne said that her maid Marthe Touchon brought her to school when she was a child. The only servant with a similar name related to the Calments was Marthe Fousson, who was born in 1885 and was thus 10 years younger than Jeanne, so it was Yvonne who could go to school with her.
12. Jeanne's grandson called her mother "Manzane", and Jeanne shared an apartment with her son-in-law until his death in 1963. In some censuses, he was first labeled as married, then corrected to widower.
13. Yvonne had a strong motive to acquire the identity of her mother in case of her death: the inheritance tax on large assets was as high as 35 percent in the thirties, and in 1931, the father of Jeanne and the mother of her husband had died. Further inheritance taxes could put the family on the brink of ruin.
14. Yvonne had the opportunity to pretend that she was Jeanne: mother and daughter dressed similarly, Yvonne did not enjoy socializing, and she had a villa outside of Arles. Probably, before the death of Yvonne's mother, she used the nickname of Jean/Jeanne. Anyway, she was just Madame Calment to

most people. Contrary to popular opinion, Jeanne almost never visited her husband's shop, and the store ceased to exist in 1937. The Calments were an influential family and could solve problems using their vast ties in Arles.

15. Census data is not reliable: in some censuses, Jeanne is counted twice; in some, there is no Yvonne. The commune of Arles is the largest in France, and Jeanne had property in nearby communes.
16. The validators stressed that Jeanne Calment comes from a family of long-lived people, but an analysis of the relevant survival curves shows that a relatively long lifespan was only an attribute of her ancestors who were part of the family line of wealthy shipbuilders (the Calments themselves, their wives and parents of wives); the survival curve of other ancestors of Jeanne was similar to that of ordinary Frenchmen of that time. After 70 years of age, the family members of the shipbuilders demonstrate the usual survival curve, and none of Jeanne's ancestors lived longer than 94 years.
17. As the forgery could be carefully planned beforehand, and Jeanne profited from it later in life through invoking her life annuity contract at the age of 90 years, special efforts would have been required to uncover it, but gerontologists have not considered the scenario of intentional forgery; it was not previously described in the relevant literature.

With the knowledge of the background described above, many phrases of Jeanne Calment acquire new meaning, and her famous sense of humor shines even more. A number of her sayings directly indicate that she has made a substitution of identity: "The Merciful God has missed my name. And now he's not remembering me anymore. Merciful God forgot me... They say that the rascals are lucky - I have to be a big one... I think I'm going to die laughing, it's part of my program... When they put me in the coffin, put the photo of my grandson at my right, and the one of my daughter at my left, and they will be buried with me. Oh, that will only be an imaginary burial, they are both in the ground already..." In the case of disclosure, she would be able to say, "Look, I told you about it." Given her age and charisma, and the life circumstances that pressured her to make such a replacement, it would probably have been understood and forgiven. However, history went in another direction, and there is considerable merit to the "gerontologist phenomenon" defined by Valery Novoselov – it is not difficult to deceive those who are happy to be deceived [1].

## **Discussion**

It should be noted that the science of extreme longevity is becoming more rigorous. In the past, oral testimony was enough to recognize the age of a person, but now various pieces of documentary evidence are required for validation, and a lot of myths have been debunked [14, 24, 29, 30]. Formal study of censuses

and other archival data dispelled doubts about the validity of Calment's record. Many inaccuracies in the published validation show that no one has checked it thoroughly.

However, "conspiracy theories" periodically arose (discussions on Wikipedia [34] and on the gerontological forum The 110 Club as well as a paragraph from the book about the insurance business [10]) but quickly lost steam. Finding truth is a collaborative effort, and any contribution can serve the cause; even an accidental mention by a curious stranger of a related fact can help uncover an important clue. This is the case with the tax hypothesis.

Until recently, there was an old thread on the 110 Club forum dedicated to the plausibility of Jeanne Calment; now its cache is available at the link

[https://web.archive.org/web/20170227010118/http://z3.invisionfree.com/The\\_110\\_Club/ar/t3663.htm](https://web.archive.org/web/20170227010118/http://z3.invisionfree.com/The_110_Club/ar/t3663.htm). The majority of the participants of the discussion converged on the fact that the reliability of Jeanne is indisputable, and if one wants to challenge Calment, all the other long-lived people automatically become unreliable.

This work was born thanks to a conversation started by Valery Novoselov in the Facebook discussion of a post by Leonid Gavrilov concerning aging:

[https://www.facebook.com/leonid.gavrilov.90/posts/542614616118354?comment\\_id=543648066015009](https://www.facebook.com/leonid.gavrilov.90/posts/542614616118354?comment_id=543648066015009).

Despite acknowledging Calment's record in their publications, Leonid and Natalia Gavrilova were skeptical based on their hypothesis that mortality in older ages continues to grow exponentially. However, if this hypothesis is true, then one should question the validity of not only Calment but most of the other documented supercentenarians. Besides, this hypothesis is based on questionable analysis: supercentenarians from later cohorts from the IDL considered in [11] were representative by the year of death, but not by the year of birth, since the number of publicly available supercentenarians reduced sharply in the beginning of this century, while the data from the GRG considered in [11] were not representative by the age of death [1].

Anyway, I am aware of only one gerontological publication questioning the validity of Jeanne Calment. It is a review (<http://longevity-science.org/PDR-00.pdf>) of a book [14] by the Gavrilovs, and it raises doubts of her validity based on the large gap between her and other supercentenarians. No calculations explaining why the gap is "large" are provided in this review.

Robert Young, the director of the GRG, a consultant for the Guinness Book of Records and the administrator of the 110 Club, writes that in cases when the declared age is approaching 120 years, the validation should be very thorough, as was done in the case of Jeanne Calment. To stress this point, a lot of false examples of long-lived people is provided in [30]. Jean-Marie Robine, one of the validators of Jeanne Calment, and his colleagues from the IDL note that "Studying extreme ages necessarily involves small numbers, and, therefore, a single age error, especially at the highest ages, may well have strong implications for predicting the trajectory of mortality. It is thus of great importance to check the reliability and accuracy of each reported age from such a dataset." [24]

One of the well-known examples of disproved supercentenarians, Pierre Joubert [14], who died in 1814 at the age of 113, was not questioned until the end of the 20th century, when the demographer Hubert

Charbonneau showed that Pierre Joubert had in fact died in 1766 and it was his son, born in 1732, who has been mistakenly considered as the oldest Canadian for a long time. It is important to note that in this and other false examples of long-lived people [29, 30], the substitution was not pre-planned, so it was quite easy to expose (thus, Charbonneau has found the real death record of Pierre Joubert). In the case of Jeanne Calment, it seems that the researchers were not ready to investigate a well-planned and brilliantly conducted identity switch in the distant past of 1934.

The validators of Jeanne Calment obviously have not found anything suspicious in the inconsistencies in Jeanne's interviews nor the destruction of photos and other documents, and they have not carried out comparative examination of the surviving photos and documents. They haven't conducted conversations with witnesses of Jeanne's early life since *all such witnesses have already died* [5]. However, even after 25 years from the start of the validation, some witnesses or their children were still alive [15, 22]. Admittedly, these witnesses do not talk about substitution and maintain the accepted story. Some might not be aware, and others might not want to tell the truth. As even the most studied centenarian of the world, apparently, managed to deceive the scientific community, the principles of validation should be reconsidered and tightened.

For obvious reasons, among the formal supercentenarians, there should be a disproportionately large number of people whose documents contain intentional or accidental errors that overestimate their age. On the 21th of February 1986, when Jeanne Calment turned 111 years old, the previously universally recognized record holder, Shigechiyo Izumi, died at the age of 120. It was soon revealed that Izumi acquired the birth certificate of his deceased older brother, and, in fact, he lived "only" until 105.

Two other universally recognized rivals of Jeanne Calment were also "devalidated": 117-year-olds Lucy Hannah (Fig. 1), for whom the users of The 110 Club forum showed that the corresponding census data was related to another person, and Carrie White (it turned out that a mistake by an employee of a psychiatric hospital led to an overstatement of the age of Carrie by 14 years).

Errors in a small fraction of birth and death records can significantly distort the observed dynamics of mortality. For example, if errors are distributed normally, then the observed force of mortality would decrease in old age, even if in reality, it is increasing exponentially [20]. It is easy to show that if errors are distributed exponentially, then a mortality plateau will be observed at the end of life.

However, the mortality plateau in humans could exist in the real data. To verify this, it is necessary to revise the validation principles and try to create a small, representative (the probability of being recorded should not increase with age – this principle was not taken into account in [11], cf. [1]), and truly verified list of semisupercentenarians over 105 years old. If in addition to participating in validation, geriatricians become involved in the study of these long-lived people and collect longitudinal data on their health, the analysis of this data will help in understanding the process of individual aging. It is also necessary to avoid any conflict of interest. Selective revalidation of existing supercentenarians will allow estimation of the frequency of fake cases.



Jeanne Calment died on August 4, 1997, the birthday of the English Queen Mother, who lived to 102 years. The story of the Queen's life is documented in great detail, so there is reason to believe that in her case, it is possible to know for sure that she had actually lived to such a respectable age. For ordinary people, there is a need to develop methods of age verification based on forensic methods, various biomarkers such as radiocarbon analysis, analysis of the racemization of amino acids in long-lived proteins, DNA methylation patterns, et cetera.

Oddly enough, despite so many years of work with Jeanne Calment, the gerontological community was unable to obtain any of her biomaterials. Validators describe several reasons for this: they were afraid that a conversation about biomaterials could ruin the atmosphere of trust between them and Jeanne [15]; *she was buried hastily... in the strictest privacy, said to be what she would have wanted... which was certainly strange for a woman who loved attention, honor and celebrity so much* [5, 15]; "We could not imagine that nobody could reach this age again." (Dr. Garoyan, personal correspondence). Calment's medical card is not available for study [15]. Here again, political will is needed.

Madame Calment probably never became a centenarian. However, she was a good example of healthy aging. She had a bright personality, and, unlike most other long-lived people, the interest of the general public in her person was not extinguished shortly after her death: one can check the frequency of requests of the surname Calment in Google Trends – people are Googling the record holder more often than all the other supercentenarians together, especially in France, where she is more popular than such a prominent politician as Lenin.

In addition, the name Calment is probably one of the most frequently mentioned in books and papers on the topic of aging. The study of this story can be useful not only for gerontologists but also for scientists in general, as it shows the potential fragility of common knowledge.

### **Acknowledgements**

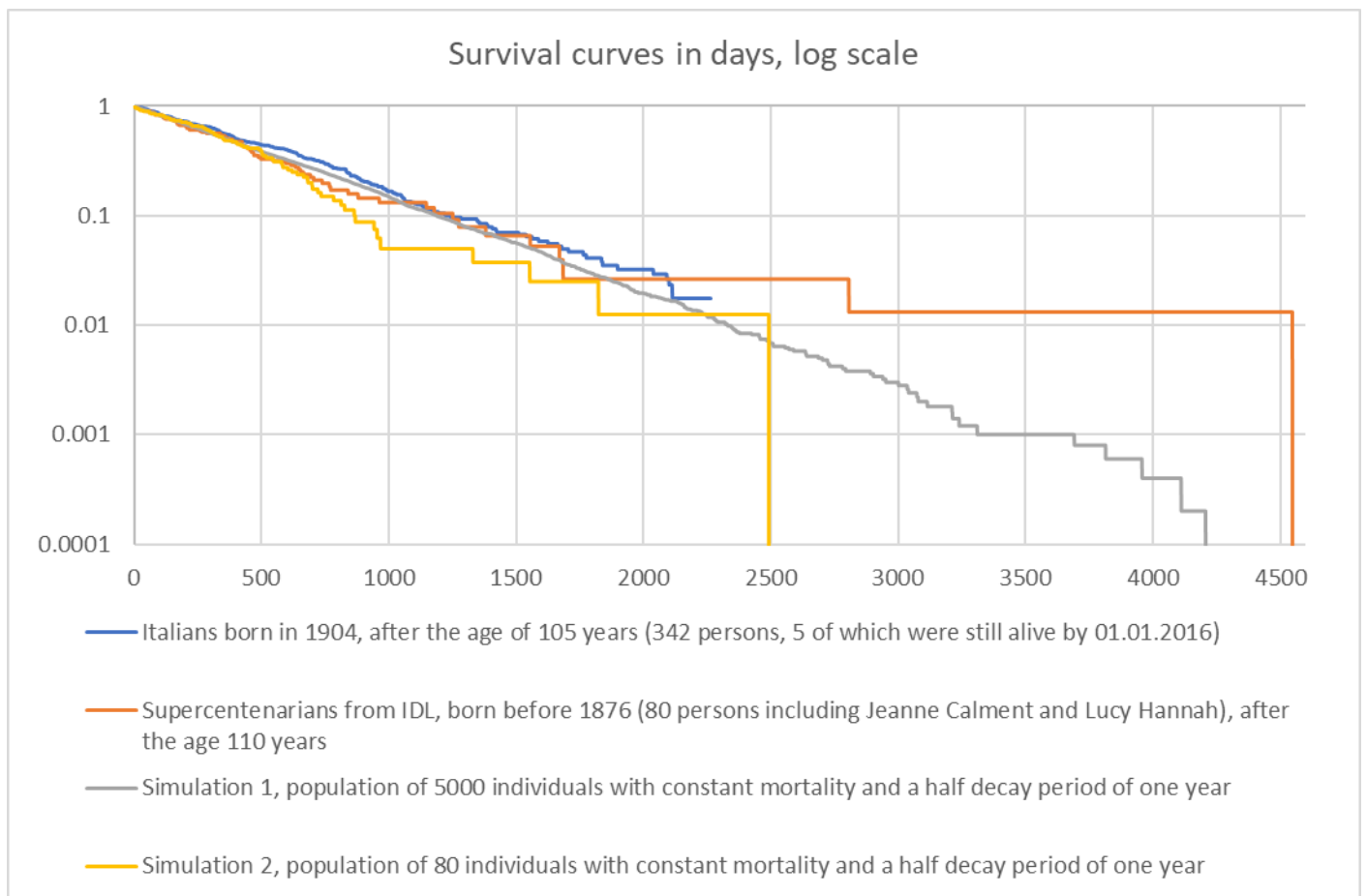
I would like to thank Valery Novoselov for motivation, useful advice and support, Cyril Depoudent for his kind help in extracting numerous archival data and answers to my questions, forum users from <http://centenaires-francais.forumactif.org/>, Caroline Boyer-Bisson, Ilya Krouglikov, Sergey Gorchinskiy, Sergey Sinitsyn, Yuri Deigin, Alexander Fedintsev, Fedor Zak and Galina Shagieva for their help and discussions during the various stages of the investigation, Georges Garoyan, Jean-Marie Robine, Michel Allard, and Heiner Mayer for their answers to my questions, Robert Young for his criticism and suggestions, Elisabetta Barbi, Anna Rita Dionisi and ISTAT for the access to the data of the Italian semisupercentenarians, IDL for the open access to the supercentenarian data, and Joshua Conway for English editing.

\* I try to convey the meaning of the translated text from French sources as accurately as possible. I will be happy to provide the relevant fragments from the quoted books and other documents on request.

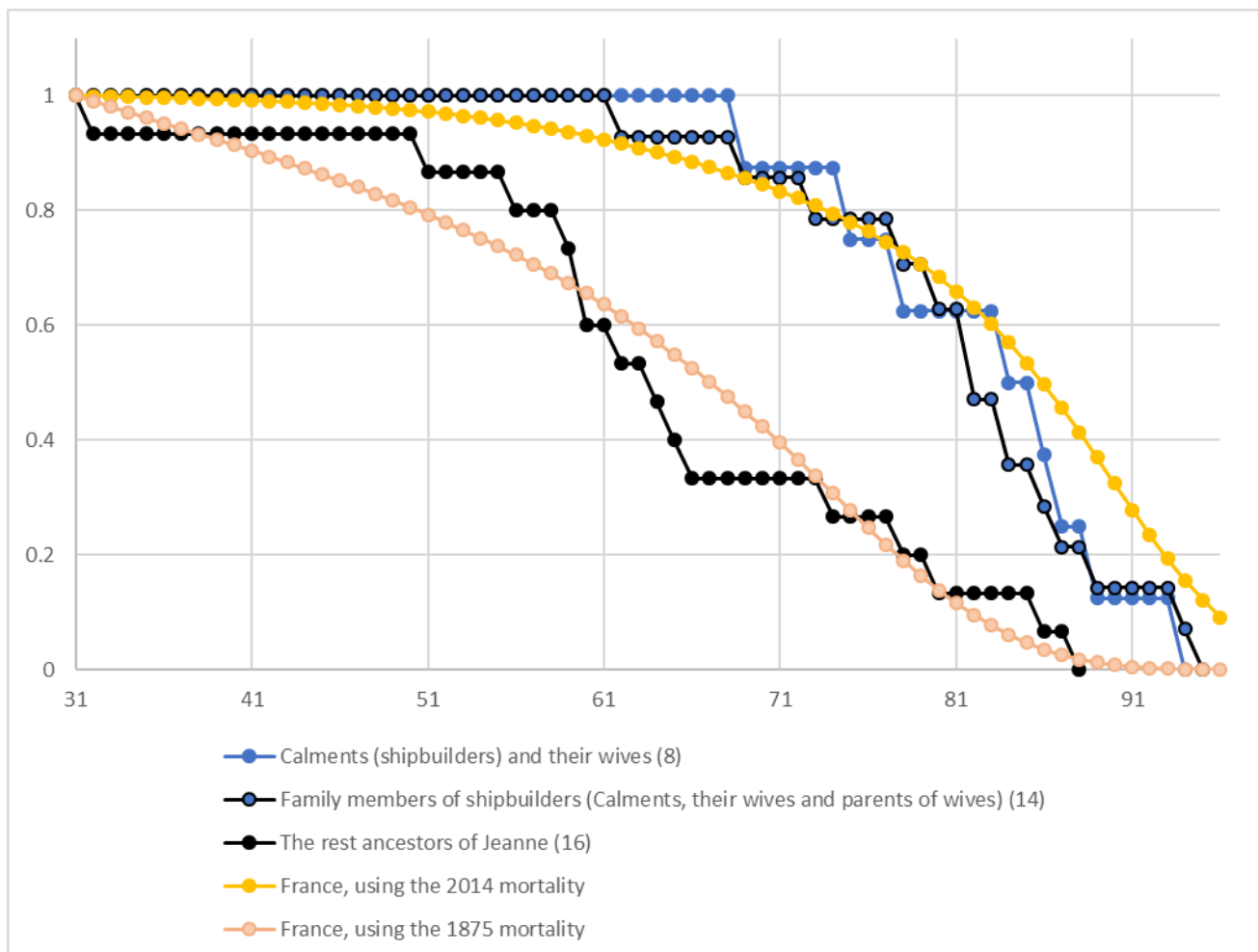
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*Figure 1. Survival curves of the cohort of Italians (ISTAT) after 105 years, the group of supercentenarians from IDL born before 1876 after 110 years, and simulated populations with a constant mortality rate. Jeanne Calment died last.*



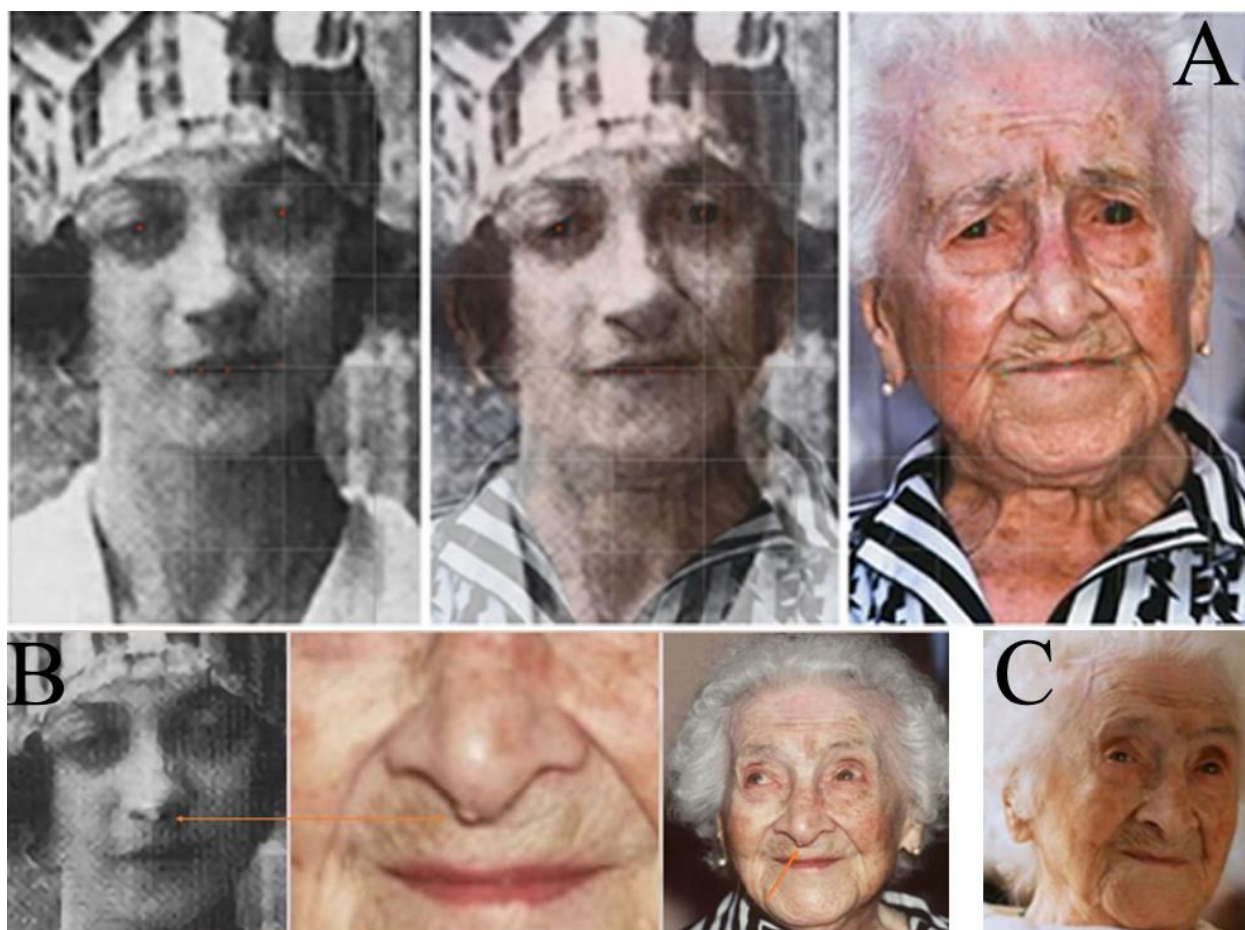
*Figure 2. Survival curves of three groups of the ancestors of Jeanne Calment. The shipbuilders and members of their families lived longer than the other ancestors, just as the French live longer nowadays than in the 19th century.*





Figure 3. **A:** "Jeanne and her daughter Yvonne: who is who?" [4] (in [5] Yvonne is stated to be to the left of the viewer). **B:** Jeanne and her husband Fernand, 1900 [27]. **C:** Top: Jeanne Calment, bottom: Yvonne, daughter of Jeanne Calment [27]. **D:** Yvonne Calment in the St. Trophime Cathedral (Wikipedia). **E:** Madame Calment at 109 [27]. **F:** Yvonne Calment mistakenly taken for Jeanne in [15]. **G:** Longitudinal dynamics of height in humans [28]. **H:** Passport of Jeanne Calment in 1937 [9].





**Figure 4. A:** Yvonne Calment; Yvonne Calment over the old Madame Calment; old Madame Calment. **B:** Possible fibroma on the nose of Yvonne (contrasted with Photoshop) and the old Madame Calment. **C:** Madame Calment at 117 used in the age estimation poll.