Montreal Irish Monument Park Foundation

Organization of burials and paleodemographic data

10 graves in place (**5 adults**: 20 yrs.+, F 21+, M25-30 yrs., M30-60 yrs., F60 yrs.+; **3 children**: 12-24 months, 2.5-5 yrs., 9-14 yrs., **2 teenagers**: 14-16 years old, M 15-17 years old)

+ 4 other displaced individuals (2 adults – 5A6 (17-25 years old) and 5A8 - and 2 immature – 1 year old and teenager)

TOTAL: 14 individuals (7 adults, 3 teenagers, 4 children)

Organization of burials:

- two levels
- fabrication method of the coffins: hexagonal, white pine, cut nails, asymmetrical, side walls made up of two boards
- small coffins inserted in the other direction between the adult coffins or at the foot of them
- size of the pit unknown
- depth: 2.00 to 2.20 m (7 feet underground)

Pathologies (macroscopic examination)

1. **Cribra orbitalia** (2 individuals), HP (1 individual), growth delay +

Etiology still debated. Mainly due to iron deficiency anemia, the causes of which are various. In our case, diet is probably one of the main factors. We must also consider certain diseases including infectious or chronic diseases and certain processes or constitutions (blood loss, pregnancy, growth, vitamin C deficiency, etc.).

Cribra orbitalia in adults: result of incomplete or imperfect remodeling due to repeated episodes of stress. Otherwise, the healing is complete and the lesion no longer appears once the anemic episode is over.

2. Porotic hyperostosis (1 individual)

Iron deficiency. Iron binds to the “heme” pigment in hemoglobin which brings oxygen to the cells of the body. If missing, premature destruction of red blood cells. Need for expansion of the space needed for the hematopoietic marrow. Diploe hypertrophy.

3. Few cavities: low sugar diet. The sugar feeds the bacteria which then produces acid, lowering the pH, an environment that favors the formation of cavities. Lots of tartar; alkaline environment favored by a protein diet.

4. Growth retardation +: dental age exceeds bone age

Artifacts

The objects accompanying the deceased are very few. They relate exclusively to clothing items. Grave 5A11, that of a 15–17-year-old boy, yielded seven circular eyelet buttons 1 cm in diameter with a conical surface. The top is brass and the back is ferrous metal. The eyelet is made up of a circular thread inserted into the back of the button. The top of the buttons was originally covered with fabric, some traces of which are still present on some of them. A single button, of similar manufacture, was found in adult burial 5A17. In burial 5A12, a small ferrous metal ring was found, but its function remains undetermined between a piece of clothing or a piece of jewelry. In summary, the hardware assembly is very reduced. The socio-economic status of the individuals such as the epidemic context or that of the burial could explain it. Perhaps they didn't have many possessions? Or were these items kept by surviving family members and the clothing reused by others?

General questions

• What pathologies or indicators of stress have been observed in the exposed individuals?

• Where exactly do they come from?

• What did they consume in childhood, adolescence or in the years preceding their death?

• Can we detect dietary strategies/changes to mitigate the effects of the crisis, particularly those of the famine caused by the destruction of crops?

• How were the bodies handled after death? As a reminder, we are in a context of mortality crisis.

Methods to answer these questions

Archaeoentomological analysis

Method: soil sample close to the skeleton – U. Laval - Flotation in lukewarm water and soapy solution; Sieve 250 µm; Light fraction in ethanol and sorting of insects under the microscope

The presence of insect remains in funerary contexts results from two distinct modes of colonization.

1. First phase, called "pre-depositional": intervention of necrophagous insects colonizing the corpse in the very short term after the death of the individual. Links to an “open air” phase (remains exposed on the surface before their burial)

2. Second phase, “post-depositional”: underground phase involving ecological groups with the ability to colonize buried remains.

A total of 213 identifiable remains of insects and arthropods were found for all 11 lots taken from the Irish Post and 175 individuals were counted.

Among the 175 individuals: nine taxonomic units belonging to a well-defined functional group (intelligible presence according to their trophic relationship to the context).

80% of the species identified at the Irish Post are of forensic interest.

3. EXAMPLE 5A7 (excerpt from Clotilde's report):

Burial 5A7 is the second richest in archaeoentomological remains with 47 remains (NR) for a total of 41 individuals (NMI). Among these we find Staphylinidae (Aleocharinae indet.), Phoridae (Megaselia sp.), Sphaeroceridae (Leptocera spp.), indeterminate Diptera and

several Pediculus humanus (Linné) – fig. 8. The presence of lice is not insignificant in archaeological contexts or in burials in general (Huchet 2016: 59). On the other hand, since it is synanthropic, the louse coexists with its living host (in this case the human) by feeding on its blood and depends on it to live, which means by extension that a burial, and therefore a dead individual, is not a viable niche for it (Durden 2019: 79; Gullan and Cranston 2014: 370). Its presence in large numbers in burial 5A7 nevertheless leads to two conclusions: it is there accidentally because it was not attracted on its own by the ecosystem of the burial and since it did not have the time to change hosts on the death of "his last", we can assume that the burial was quick.

This can also be confirmed not only by the absence of necrophagous Diptera that only operate in an exposed environment (such as Calliphora cf. vomitoria) but also with the presence of Phoridae and Sphaeroceridae, recurrent Diptera in the process of decomposition. In a closed environment, as well as rove beetles.

IN 3 BURIALS: Since the development of Calliphora cf. vomitoria (diptera) and Cicindela purpurea (beetle) depends on the temperature (between 9 and 24°C), it is then possible to consider that the individual died between August, date of the first use of the cemetery, and the month of September. The seasonality of death is thus essentially placed in the summer. We can therefore define the dating of the grave more precisely and place it at the beginning of the use of the cemetery (it having been used between August 1847 and April 1848).

• Exposure of the body or rapid burial?

Comparison with the Annals of the Gray Nuns

• Seasonality of death: summer 1847 therefore August-September 1847 because cemetery: August 1847-April 1848

Isotopic analyzes

The stable isotopes of carbon, nitrogen (for the analysis of the diet), oxygen, strontium, lead (for the geographical origin) was analyzed.

Isotopes are atoms that have the same number of electrons – and therefore protons, to remain neutral – but a different number of neutrons. Stable isotopes are non-radioactive forms of atoms (no radioactive decay so the values are those recorded over the life of the individual and do not change even 175 years after death).

Bone is made up of an organic part and a mineral part. In the organic part: collagen = fibrous protein. This protein is made up of different atoms, in particular carbon and nitrogen, whose isotopic composition (δ13C and δ15N) is linked to that of the protein portion of the diet. In nature, plants have δ13C and δ15N specific to their environment (marine, terrestrial, arid, temperate, etc.), their photosynthesis (C3, C4 or CAM) and their species (e.g., legume or non-legume). This specific isotopic composition is reflected along the food chain with heavy isotope enrichment (13C and 15N) at each trophic level through fractionations during protein assimilation. In this way, an herbivore will have bone collagen whose isotopic composition is enriched compared to the protein portion of its diet. It is the same for a carnivore in relation to its prey.

To answer these questions, it was necessary to sample tissues that contain isotopic values corresponding to different stages of an individual's life. Bone remodels itself over an individual's lifetime, but not all bones do so at the same rate. Bone tissue replacement, i.e., the rate at which the total volume of tissue that resorbs and forms through the remodeling process over a given period of time is faster for ribs than for bones compact like those of the humerus or femur, for example. As for dentin and enamel, they trap the isotopic values of childhood since these tissues do not remodel. Ultimately, the tooth contains the isotopic values of childhood and adolescence. The compact bone gives an average of the values of the last 10 years while the ribs give a shorter-term isotopic signature, i.e., approximately the last 5 years of life.

Geographic origin

E-mail. Enamel is the hardest substance in the human body. Mainly composed of calcium phosphate and calcium carbonate, comprising less than 1% organic matter.

Strontium-87Sr/86Sr

Strontium is present in bedrock and is transmitted to plants growing near it, animals grazing near it, and water flowing through it. These elements are then consumed by humans and the strontium is fixed in human tissues such as bones or teeth. In fact, strontium has a similar molecular structure to calcium (calcium being a major component of bones and teeth). Considering that what they consumed at that time was local, the isotopic signature corresponds to their geographical origin. Indeed, the isotopic values of strontium vary from one place to another depending on the nature of the source rock. To interpret the measurements made on bone and dental tissues, it is therefore necessary to have a solid knowledge of the Irish distribution of isotopic compositions of strontium in the landscape = Isoscape (distribution of isotopic compositions). The isotopic value of strontium will vary depending on the type of rock. The older the rock (granite for example), the higher the value will be. The measurements are also compared with those made on other archaeological populations (Irish, North American, English).

Oxygen - 18O/16O

Process:

Evaporation and precipitation are two factors that influence the ratio of heavy oxygen (O18) to light oxygen (O16) in the oceans. When seawater evaporates, it is the O16 isotope that is more easily washed away, while the O18 isotope is left behind. When water vapor condenses, heavy oxygen leaves first, as precipitation.

Reasoning:

Using the same principle of isoscape and comparison with other archaeological populations, observations of strontium will be combined with those of oxygen, the distribution of isotopic components of which also varies across the landscape. If everything looks the same, we can't discriminate.

Diet

Dentine. Collagen. Sub-annual precision. Ribs. More compact bone. Bone collagen obtained by the demineralization of each section of dentin. 1mm sections corresponding to 200 days. Development – eruption – complete chronology well known.

Nitrogen (N) – number ratio 15N/14N – δ15N

The trophic level connects the predator and its prey. There are then exchanges of elements such as the flow of carbon and nitrogen that take place between the different levels of the food chain. In the case of nitrogen, the isotopic ratios increase by about 3‰ at each trophic level. Plant → cow → carnivorous.

Undernutrition leads to a catabolic state. The body will begin to degrade its own tissues, to use the amino acids of its own body to draw the energy necessary to maintain vital functions: breathing, heartbeat, movements, digestion, immunity, regulation of body temperature, etc. In this case, we will see an increase in delta-15-N (δ15N), as seen during a change in trophic level.

Carbon – 13C/12C number ratio – δ13C

The isotopic values of the food and water we consume are incorporated into the tissues of the human body including bones and teeth. Depending on their photosynthesis mechanism, we distinguish between different types of plants: C3 or C4. C3 is the most widespread (95%). The C4 mechanism differs in the mode of carbon dioxide fixation during photosynthesis. This C4 mechanism makes photosynthesis more efficient for plants facing water stress or a decrease in the availability of CO2 during the day, in subtropical to tropical regions in particular. This mechanism is therefore found in plants such as corn, millet, sorghum or sugar cane. BUT C3 and C4 plants use different amounts of 12C 13C isotopes meaning that they contain different ratios whose ranges of variation do not overlap.

Details: The C3 plant has less than 13C compared to the atmosphere. This is also the case of the C4 plant but in a less severe way. This is due to the way plants fix carbon. In C3 plants, 12C can slip through the mechanism at C3 more easily than C13. Same for

the C4 mechanism, but less easily. The isotopic signatures are therefore different. The 13C/C12 ratio is measured by mass spectrometry.

During an episode of illness or under-nutrition, the body recycles carbon from adipose tissue, which is poor in 13C. By integrating more 12C in the synthesis of new tissues, the δ13C will be lower.

More specific questions that the methods used would make it possible to answer

Depending on the methods used, answers could be provided to the following more specific questions:

• Dietary profile focused on the consumption of C3 vs C4 plants?

• Trophic level, diet based on terrestrial or marine food?

• Signs of nutritional stress?

• Rural or urban environment?

• Irish geological and trophic environment?

Proteomic analysis on dental calculus

The study of the proteins present in the pie will make it possible to specifically identify the origin of the milk or the meat consumed.

70% of our genes code for at least 4 different proteins.

Identify, quantify and finely characterize the proteins present in a biological sample at a time T.

https://www.inserm.fr/dossier/proteomique/ (excerpt):

Mass spectrometry consists in identifying molecules according to the precise measurement of their mass. To carry out a proteomics study, it is first necessary to digest the proteins of the sample to be studied using an enzyme, in order to obtain protein fragments (or “peptides”) which are soluble in the solution which is injected into the spectrometer. massive. These peptides are then fragmented by the machine. The masses of each peptide and of the fragments are measured. They make it possible to identify the peptides contained in

the sample, by comparing the experimental data with the data already existing in the banks.

The data is returned in a form that can be compared to a puzzle. It is up to the scientists to piece together this puzzle to find the identity of the proteins that were present in the sample. This work is of course facilitated by increasingly efficient computer software and ever richer databases.

Harmful bacteria such as Porphyromonas gingivalis will take over and attack the gums, destroying the surrounding tissues. Detected in two individuals (adult and 9-14 years old).

Results

Common: Trophic level associated with a terrestrial diet with little marine influence

9 individuals were identified as most likely immigrants from Ireland since carbon and nitrogen isotopic ratio values allow identification of dietary profiles consistent with starvation indicators and what is known of the diet at this place and at this time:

- Opposite covariance model (famine pattern)

- Terrestrial diet rich in C3 plant (potato)

- Nutritional stress (high nitrogen isotope ratios)

- Introduction of maize (C4 plant) in the diet (1846 or earlier)

Ex. 5A11:

Rise d13C before 1846. Famine pattern (fall d13C, rise d15N)

2 individuals have been identified as having possibly immigrated from England to Ireland. For one (5A4 adult):

- no starvation patterns

- absence of introduction of maize in their diet.

For the other (5A9 woman)

- Dissimilarity of values of carbon and nitrogen isotopic ratios in dentin, ribs and compact bone compared to values associated with probable Irish immigrants.

The well-known history of the BiFj-139 site already provided information on the probable Irish origin of the individuals buried in this common grave of the cemetery. The ratios and concentrations of δ18O, 87Sr/86Sr, and 204/206/207/208Pb are also consistent with the values recorded in this region of the world. The isotopic analysis of dental enamel was also able to provide details as to the living environment of these individuals and a more precise origin on Irish territory.

The δ13C values clearly fall within the C3 variation which are consistent with the presumed Irish origin of the individuals and the consumption of potatoes and buttermilk. A C4 signature would have been obtained for individuals originating from the American or Asian continent due to the consumption of C4 plants such as corn in these places. It would also have been obtained for Irish individuals who benefited from the importation of maize to replace potatoes unfit for consumption.

• Rural environment (low level of lead)

• Western and Southern Ireland

The multiple ports of departure from Ireland bring together a population from very diverse regions. The population that will immigrate will mainly come from the counties of western Ireland since that is where the situation was most serious. There are no passenger registers. However, the registers of orphans from Grosse-Île and Montreal combined with those of the Catholic parishes of Toronto enabled McGowan (2009) to establish the preponderance of migrations from the provinces of Munster and Connaught. The isotopic data agree with the historical data and allowed further precision by targeting the south of Ireland for some of the individuals.

5A15 Ba++

https://www.corkcoco.ie/sites/default/files/2020-04/ccc-industrial-heritage.pdf

Barytes or barium sulphate (Ba SO4), which is often found in association with lead and copper sulphide deposits in Ireland, began to be used as a filler in the second half of the nineteenth century in many materials such as linoleum, rubber and paper. But the undisputed center of Irish barite mining and, indeed, of the United Kingdom, were the mines of the Bantry district of County Cork. Mining for barytes appears to have begun at Derreenalamone, near Durrus, County Cork in the 1840s, where some 2,500 tons were being raised in 1851, compared to a combined output of just over 800 tons for the other three localities in the United Kingdom producing barytes in the same period.

Intoxication: vomit, abdominal pain, diarrhoea, Hypokalaemia (decreased potassium level): cardiac arrhythmia