

# Invertebrate fragments associated with the preserved remains of Santa Maria Maddalena de' Pazzi, Florence, Italy (17<sup>th</sup> century CE)

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**Abstract.** This case study deals with some invertebrate fragments recovered during an inspection of the preserved remains of Santa Maria Maddalena de' Pazzi in Florence, Italy. Sampling of these fragments was followed by their careful identification by microscopic examination and direct comparison with identified voucher specimens. Results showed that a current infestation affected the precious relic and that a conservation treatment was necessary for both religious and curatorial purposes.

**Key words:** archaeoentomology, conservation, mummies

## Introduction

Archaeoentomology can be defined as the study of insects and other arthropods associated with archaeological contexts and, it relies upon the correct identification of the recovered specimens (1). Whenever this field deals with burial contexts, it can be further categorized as “funerary archaeoentomology”, and has been applied to sets of mummies or mummified individuals a number of times, providing information on both the taphonomy and the preservation condition of the bodies (2). In particular, within Italy, this approach was used on some human remains held in the Cathedral of Sant'Antonio Abbate in Castelsardo, Sardinia, demonstrating that the bodies had been buried in an open environment (3). In contrast, the lack of blowflies (Diptera: Calliphoridae) in the corpses from the Neapolitan Basilica of San Domenico Maggiore suggests that the deceased had been kept indoors for a long time, and that the use of oils and balms may have prevented early colonizers' activities (4). The study of individual bodies such as the Blessed Angela Veronica Bava case, also revealed relevant information, including that the relic condition had changed over time, and that the former was initially protected from flies (5).

Another example, San Davino Armeno, was mostly affected by arthropods that colonize the cadaver at a later stage, which may be evidence of an initial care towards the decedent (6). This short report deals with the arthropods found during a recent inspection of the mummified remains of Santa Maria Maddalena de' Pazzi, a prominent Carmelite nun of 16<sup>th</sup>-17<sup>th</sup> century Florence who died in 1607 aged 41 and was canonized in 1669 (7). The inspection was carried out with the aim to gain insight into the biodeterioration phenomena affecting the coffin in which her preserved body is contained.

## Materials and Methods

The naturally mummified body of Maria Maddalena de' Pazzi is curated in the homonymous Monastery at Careggi (North of Florence), where it was transferred from former locations in the late 19<sup>th</sup> century (Figure 1A). The building also holds the remains of the Blessed Maria Bartolomea Bagnesi, another religious figure connected to the Dominican order who died in 1577 aged 62. The relic studied in this paper is contained in an artfully designed coffin



**Figure 1.** The mummified remains of Santa Maria Maddalena de' Pazzi. A) the overmodelled head; B) detail of the hands; C) the damaged feet; D) the affected coffin.

created by Giovan Battista Foggini in 1705. Prior to that, she had been placed in at least three different coffins (Vasciaveo, original data, 2023). Inspection of the visible areas revealed that the face is over-modelled with wax, which is also seen at the level of the left hand. As far as could be assessed, the body appears to be complete, with the exception of the right hand, which is missing the fourth finger (Figure 1B). This was intentionally amputated post-mortem in order to create a relic that was sent to Rome, and was replaced by a golden prosthesis. Additional relics, represented by teeth and hair, had been sent to Naples and Vilnius, Lithuania. Punctuated defects are visible on the skin of the individual, notably at the level of the feet, and are associated with powder most likely resulting from the feeding activity associated with animal infestation (Figure 1C). Damage caused by insects in the form of exit holes seen on the wood, and a large amount of powder resulting from it, was also largely present on the historic coffin (Figure 1D). The archaeoentomological study was conducted at the Natural History Museum, London, United Kingdom. Photographs of arthropod remains were taken in natural

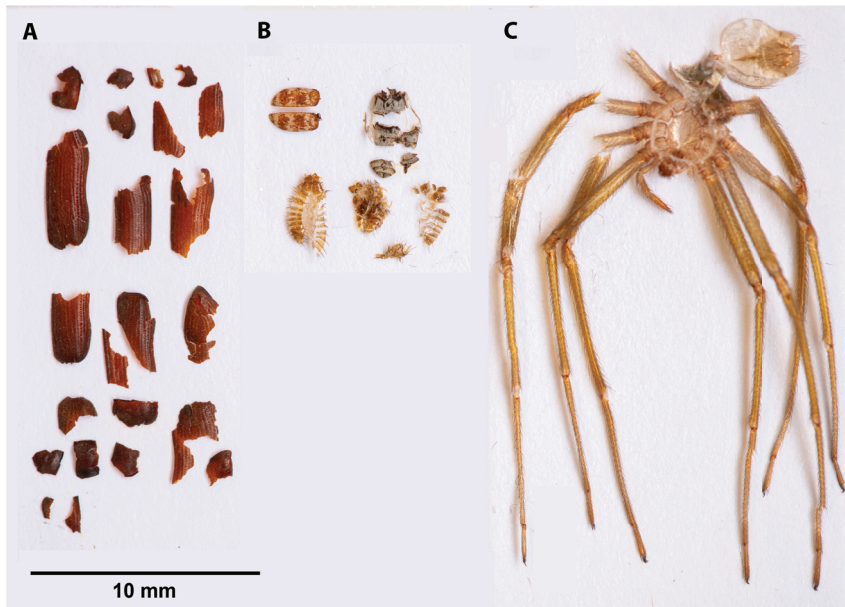
light using Nikon D850 camera with a 105mm f2.8 Micro Nikkor lens, and examined using a Leica® EZ4 stereomicroscope. Identifications were achieved by direct comparison with specimens held in the collections of the Natural History Museum, London.

## Results

Analysis of the sampled remains highlighted the presence of the following species:

1. *Priobium carpini* (Coleoptera: Ptinidae) adult fragments (Figure 2A)
2. *Anthrenus coloratus* (Coleoptera: Dermestidae) adult fragments (Figure 2B)
3. *Anthrenus coloratus* (Coleoptera: Dermestidae) larval exuviae (Figure 2B)
4. *Tegenaria* sp. indet. (Araneae: Agelenidae) exuviae (Figure 2C)

All adult Coleoptera fragments were partly consumed, most likely by larvae of *Anthrenus*.



**Figure 2.** Invertebrate remains from the mummy and coffin of Santa Maria Maddalena de' Pazzi. A) fragments of elytra and thorax of *Priobium carpini* (Coleoptera: Ptinidae); B) fragments of adult and exuviae of larvae of *Anthrenus coloratus* (Coleoptera: Dermestidae); C) exuvia of *Tegenaria* sp. indet. (Araneae: Agelenidae).

## Discussion

*Priobium carpini* (Herbst, 1793) (Ptinidae: Anobiinae) (Ptinidae) (Figure 2A) is a large species of woodworm beetle related to the Death Watch Beetles (genus *Xestobium*). *Priobium carpini* is distributed throughout Europe and introduced to North America. It feeds on dry wood, including structural timbers and furniture, which can be either deciduous or coniferous wood. An account of its habits is provided by Barclay (8). In the current situation, it is likely to have been feeding on the coffin, as evidenced by circular exit holes some 2-4 mm in diameter and associated dust, as shown in Figure 1D. The infestation of *Priobium* is judged to be comparatively recent, from the dust and fresh holes visible on the coffin timber (Figure 1D), and the fact that the chitin of the dead adult *Priobium* fragments appears relatively fresh, and they have been partly consumed by *Anthrenus* larvae (see below) which typically leave behind partly eaten elytra and abdominal sclerites (Figure 2A, 2B).

*Anthrenus* (*Anthrenops*) *coloratus* Reitter, 1881 (Dermestidae) (Figure 2B) was first described based

on specimens from Greece and appears to be originally Eastern Mediterranean. It has been noted from archaeological sites in 18<sup>th</sup> Dynasty Egypt by Panagiotakopulu (9). More recently, it has been disseminated widely through human agency and is now found through much of Europe, the Middle East and North America. It was first recorded in mainland Italy in 2014 where it was reported as a pest in museum collections by Nardi and Háva (10). Like most *Anthrenus* species, the larvae feed on chitin and keratin and can therefore be pests of insect collections, taxidermy, woollens and similar exhibits. While they may have been feeding on parts of the body or its clothing, they are most likely acting primarily as scavengers on other invertebrate remains. This is supported by the feeding damage to all the adult insect fragments received in the samples. Because *Anthrenus coloratus* is a recent arrival in Italy, its presence is unlikely to date back to the original preservation of the mummy. It is more likely to represent a subsequent recent infestation. Adults, which can fly, eat nectar and attempt to leave the larval development site to feed and mate on flowers, before the females search for a suitable habitat of dry animal material on

which to lay eggs. The comparatively few *Anthrenus coloratus* specimens recovered in these samples may all be descendants of a single female.

Lastly, *Tegenaria* Latreille, 1804 (Araneae: Agelenidae), commonly known as House Spiders, are common in and around human habitation. Three cast exuviae were found, left behind after the spider(s) had moulted (Figure 2C). They were all different sizes and may be all from the same spider, although the possibility they may represent multiple specimens cannot be excluded. Generic determination was achieved by examination of the teeth on the cheliceral retromargin. Unfortunately, as they are exuviae, neither sex determination nor species determination is possible. *Tegenaria* are predators of insects, and produce funnel-shaped webs in sheltered dry places, such as in caves, hollow trees, or inside buildings. In this case, their presence is probably the result of the spiders living in the building and opportunistically living near to the mummy and preying on the associated insects. *Anthrenus* spp. are frequently associated with spiders, the larvae feeding on the exoskeletons of insect prey discarded by the spider.

The damage to the feet (Figure 1C) is not likely to have been caused by any of the invertebrates reported here, and appears to be older. The circular holes resemble exit holes made by emerging adult beetles, particularly family Ptinidae, but few species attack dry cadavers. One candidate is the very common and widespread 'Biscuit Beetle' *Stegobium paniceum* (Linnaeus, 1758) (Ptinidae), which is polyphagous and leaves a similar pattern of exit holes, but usually (not exclusively) in starchy, plant-based materials. Larvae of *Dermestes* spp. (Dermestidae) are associated with dry animal material, and drill circular non-feeding holes in order to pupate (11), but there is no other evidence here of *Dermestes* damage, which is quite characteristic (12) and usually involves larval feeding traces as well as the holes. The cause of this damage could not be ascertained with confidence, but is assumed to have been Coleoptera.

## Conclusions

Based on the evidence collected, it is clear that the body of Santa Maria Maddalena de' Pazzi and its

housing was affected by biodeterioration issues caused by pest infestation probably due to the coffin becoming increasingly porous to insect ingress over time. As a follow-up to the inspection, both the mummy and its associated coffin underwent a thorough conservation treatment by creating an anoxic environment, which is the recommended approach for preserved mortal remains (13). Mummified figures associated with religious structures are a unique kind of heritage in religious, historical, and biomedical terms, and their proper conservation and maintenance are always necessary for both worship and cultural purposes (14).

**Ethical Statement:** The present research was carried out in 2022 at the request of the Roman Catholic Archdiocese of Florence. Within this framework, the first author of this paper was allowed to inspect the relic and its container, and to sample the visible animal remains. The body of Santa Maria Maddalena was treated with reverence and respect throughout the project, and was ensured the appropriate dignity by being cleaned and conserved professionally (15). This study saw the involvement of all relevant stakeholders, including the Carmelite nuns, local church, and government officials.

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**Conflict of Interest:** None declared.

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