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## **The dead do not dress: contribution of forensic anthropology experiments to burial practices analysis**

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**Abstract:** The specific question of clothing presence in burial context is often answered positively, thanks to artifacts like brooches for example. But when artefacts are missing, the task is more difficult, and frequent osteological arguments can only suggest the presence of clothing with the deceased.

The gap in determining the presence of clothing is essentially related to a misunderstanding of the effect of clothing on the rate of human decomposition, and thus on the final arrangement of bones (in both forensic and archaeological contexts). Some forensic experiments have been conducted in this regard (essentially in the United States) but no synthesis or archaeological applications have been documented to date.

Therefore, our presentation has two main goals: first, attempt to provide synthetic answers about the effect of clothing on the rate of decomposition (impact on entomological activity, progress of putrefaction, etc.) and, secondly, attempt to apply those forensic arguments to archaeological examples from a methodological and interpretative perspective (methods for recognizing clothing in burial context, contribution of clothes to burial practices analysis, etc.)

**Keywords:** burial archaeology, forensic sciences, decomposition process, clothing, wrapping, forensic anthropology

Following a death, a series of decisions and actions (suited to the circumstances of death) are initiated to remove the newly dead person from the world of the living to which they belonged. These include choosing the location, arranging funerals, grooming the dead body (washing, dressing, embalming, choosing the method of burial, etc.), all of which are final decisions that the relatives of the deceased have to make within a relatively short period of time. Whatever these choices may be, they serve the double goal of helping the deceased into the afterlife and contributing to reforming the group - social, familial, economic, etc.

### **From archaeology to forensic sciences**

As we archaeologists excavate a burial, most of the available information is not easily detectable. In fact, the burial of an individual from the past represents a static and terminal image of fairly long processes that we can only partly understand (DUDAY and GUILLON 2006).

Despite our attempts to reconstruct the initial image of the deposit (biological identity of the deceased, inhumation method), it is difficult to grasp all the practices performed between the moment of death (or even

prior to death) and the moment of inhumation.<sup>1</sup> These actions leave few traces, the materials used are usually short-lived and we rarely know the underlying intention of these actions.

However, the few preserved elements, combined with archaeological and anthropological observations allow us to recover a substantial portion of the taphonomic evolution of the corpse and all the funerary practices. These corroborate assumptions that help us approach the initial form of the deposit and the various vagaries that it presumably underwent.

One of the major methodological hurdles that we face is the difficulty, or even the impossibility, of performing tests in Europe on fresh corpses that may help confirm or disconfirm certain archaeological observations (DUDAY 2005, p. 177). As a result, the confirmation of our assumptions hinges on the recurrence of certain archaeological observations that ultimately become genuine guidelines for our interpretations (DUDAY 2005, p. 177).

Unlike archaeology, forensic sciences are essentially based on recent events involving a shorter but not necessarily less destructive taphonomic process. Thus the possibility of performing experiments provides opportunities to work more specifically on one particular factor that may influence the decomposition process per se or the estimation of the post-mortem interval. This can be an intrinsic parameter (position, clothing, etc.) or an extrinsic parameter (environment of decomposition, for example) of the treatment of dead bodies. This methodological difference is coupled with differences integral to each discipline, which should be delineated if we want to be able to transpose forensic data to archaeology.

In fact, while medical examiners play an active role in our society as they face crime scenes requiring precise answers that impact the future of a number of people, the action of archaeologists rarely has the same legal, financial and emotional implications. The answers they provide are simply assumptions that must be adapted to the remains that they unearth. Arguably then, they assume a kind of “memorializing role” toward the past populations that they examine using whatever ephemeral remains turn up.

Besides, one fundamental difference between these two disciplines lies in their scope of analysis and more specifically from an osteo-biological point of view. A medical examiner can determine the sex of the deceased more reliably and estimate their age more accurately, in particular due to the possibility of using multiple methods (sternal extremity of the fourth rib, progress of pubic symphysis, odontological approach, degree of cranial suture closure, etc.) (BEAUTHIER 2011). On the other hand, an archaeologist can only guess at the biological identity of the deceased. Generally, they only have a skeleton, sometimes incomplete, from which they must attempt to determine sex or age at death. In favorable preservation conditions, it is possible to determine sex with over 95% reliability<sup>2</sup> whereas the estimation of age at death is much more difficult to perform.<sup>3</sup> In the absence of relevant osteological elements, resorting to sex diagnosis through the artifacts associated with the deceased can be considered (one then refers to archaeological sex

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<sup>1</sup> Except in some cases for which historical or osteological data make it possible to partly address certain features, for example the sawing of skulls revealing embalming treatment (FIZELLIER-SAUGET and DEPIERRE 1990) or the identification of a deceased in a specific context, as was the case for Alain Fournier (ADAM 2006).

<sup>2</sup> Methodology based on observation of the hip bone (BRUZEK 1991 ; BRUZEK et al. 2005).

<sup>3</sup> Even current methodology based on observation of the auricular surface only helps classify individuals into probable age classes (SCHMITT 2005).

diagnosis as opposed to osteological sex diagnosis). While this method is questionable, it does suggest that weapons are predominantly (but not exclusively) associated with men. Of course, this approach must be qualified according to the site periods, or even individuals (MILLET 2008, 2012).

Beyond these differences inherent in each discipline, it is worth mentioning that archaeology and forensic science complement each other in some ways. Archaeologists resort increasingly to forensic science to help them understand and interpret the remains that they excavate. While some forensic research aims to recover or approach the identity of the deceased, archaeologists only single out the references that serve as material for their research. This applies to entomological studies, for example, which have flourished in archaeological context and spawned archaeoentomology (HUCHET 1995; CRUBEZY and DIEULAFIT 1996; LECLERCQ *et al.* 2006; CHARABIDZE 2008, HUCHET and GREENBERG 2010). In this respect, the use of forensic sciences for interpreting archaeological data has been documented. Conversely, forensic science has also used archaeological processes such as grid excavation, individualized sampling, depth measuring, sieving, etc. However, the transposition from one discipline to the other must not be performed in an identical manner but must be moderate due to the differences mentioned above.

### **Introductory observations on the notion of “clothed burial” in archaeology**

In France, the existence of clothes presumably worn by the deceased is generally evidenced by the presence of metal artifacts (fibula, pin, etc.) (SALIN 1945, 1951; STUTZ 2000). For several years a number of anthropological arguments have hinted at this concept known as “clothed burial” (BONNABEL and CARRE 1998, BIZOT and SIGNOLI 2009). Yet, we feel that this designation is irrelevant because the archaeological structure itself is not clothed, the deceased is. That is why we prefer the term “clothed deceased” like some English language authors do (PARKER PEARSON 1999).

Also, it is crucial to make a terminological distinction between the notion of clothing and wrapping as interpretations may vary considerably in archaeology. In fact, the way the deceased is buried can be particularly telling of the culture and group to which he or she belongs. It reflects social, economic, religious and pragmatic concerns, and may vary significantly by region and period. Moreover, the choice of clothing and/or wrapping can impact the final arrangement of bones more or less sharply when they are recovered during the excavation.

As far as we know, clothing can be defined as a device usually consisting of several sections that variously cover the different anatomical areas of the body. From a forensic perspective, it appears that during the decomposition of the exposed cadaver, clothing forms a protective barrier against the vagaries of weather. During the “active” phase of decomposition, it seems that clothing affects entomological activity forcing insects to burrow their way through the clothes’ openings to access the corpse (fig. 1). Finally, more specifically when the body is in the bloating phase and clothes are quite close, they may be conducive to creating one or many rupture areas (fig. 2). However, it is not clear whether those “newly” accessible areas accelerate or delay the rate of decomposition.

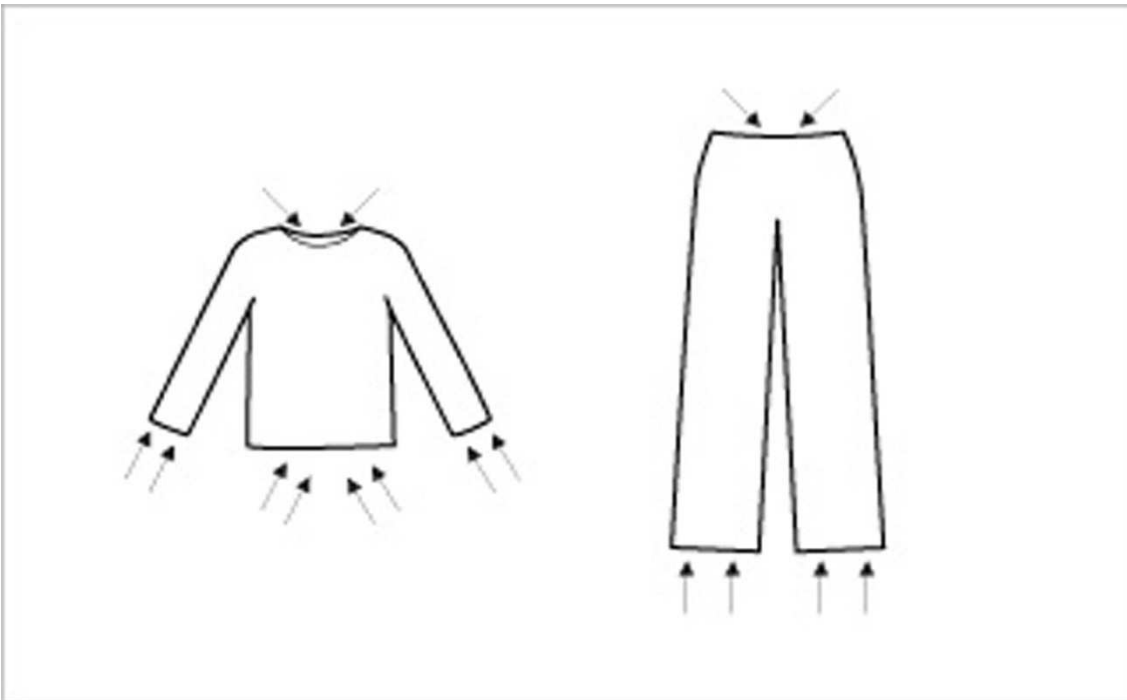


Fig. 1 – schematic of insects access points to corpse in presence of clothes (author: D. BOUQUIN).



Fig. 2 – example of rupture at abdominal muscle level due to presence of clothing (MILLER 2002, fig. 30, p. 49)

Wrapping can be defined as the process of wrapping one single piece of material around the deceased. It can be arranged in various ways (full wrapping or exposure of head and/or limb extremities, sleeve or leg type alterations). It can exert widespread or localized pressure on certain anatomical areas depending on its arrangement around the deceased (fig. 3).

Wrapping generates the confinement of the entire body, which raises the question, from a forensic point of view, of insects' access to the dead body, draining of body fluids etc., and thus more broadly, progress of the corpse during decomposition in these conditions.



Fig.3 – examples of shrouds. Left, iconographic representations (Source: TREFFORT 1997 : 9), right, shroud unearthed in archaeological context (Source: REEVE and ADAMS 1993, fig. 6-12 : 107).

In our view this distinction between clothing and wrapping is all the more important as the choice made by the deceased's contemporaries relates to various requirements that are elusive and not easily detectable from an archaeological standpoint. Except for certain preservation conditions, archaeologists only unearth a marginal portion of the initial components of the burial. That is, addressing textile devices and their initial arrangement in relation to the deceased's body in the grave is more akin to speculating than assuming. It is obviously very difficult to distinguish the clothes from the shroud only based on the position of the bone remains in the grave.

Archaeological reasoning is thus grounded in osteological and archaeological arguments almost solely corroborated by the elements that withstood the various alterations that the grave presumably underwent (corpse decomposition, breakdown of perishable materials, accidental or intentional anthropogenic actions). As a result and given the impossibility of performing experiments on human dead bodies for archaeological purposes (for ethical and legal reasons), one of us (D.B.) investigated forensic research on the decomposition process. We specifically examined researches and experiments focusing on the potential

influence of clothing, wrapping or both of these practices on the decomposition process. The goal was to gauge the actual relevance of our attempts to recover the textile materials associated with the deceased.

### **Forensic experiments involving clothing in decay process**

While some parameters such as outside temperature, climate, confinement, etc., have been extensively investigated, the influence of clothing is proportionally poorly studied given the number of forensic cases documented (MILLER 2002, p.6).

In the 80s and even early 90s, the characterization of the influence of clothing on decay was often addressed obliquely or contradictorily. Thus, as Dillon points out, Haglund's comments on the decomposition slowdown of a clothed individual (HAGLUND 1991), Mann *et al.*'s (MANN *et al.* 1990, p.107) on its acceleration in air exposure context, or Rodriguez and Bass' on inhumations (RODRIGUEZ and BASS 1983, p. 431) are merely observations made in contexts in which the characterization of the impact of clothing was not the research subject (DILLON 1997, p.67); thus they cannot be easily utilized within the scope of our research. Although most recent research provided more nuanced findings (PINHEIRO 2006, p.97; SHKRUM and RAMSAY 2007, p.41) by taking into consideration the multi-parameter nature of the influence of clothing or wrapping, it is still difficult to be positive about the impact of this factor with respect to the delay or acceleration of the decomposition process of an exposed body.

We found six experiments that specifically aim to gain insights into the role of wrapping, clothing or the combination of these practices in the decomposition progress of the corpse (table 1). Among those, five experiments conducted outdoors use human or pig corpses, the latter having been specially euthanized for the purposes of observation (CAHOON 1992, MILLER 2002, KELLY 2006, DAUTARTAS 2009, VOSS *et al.* 2011). The sixth study, conducted in a laboratory, examines mice and rats (ATURALIYA and LUKAZEYCK 1999). While the transposition of data from the latter experiment to human corpses is contentious, the authors showed that they were fully aware of the limitations of their experiments (ATURALIYA and LUKAZEYCK, 1999).

Since these experiments were performed in climatic contexts that differ from the European climate, the role of this parameter during the decomposition process must be considered with caution. Finally, all the experiments cited above were performed on exposed bodies. In most cases, the locations were enclosed and protected, keeping predators at bay and allowing us to a certain extent to make comparisons with burial contexts. However, we should keep in mind that the decomposition process differs depending on contexts (exposure to air, burial, etc.).



Author, year	Aim of experiment	Material	Object of experiment	Length of experiment	location
Cahoon - 1992	Influence of clothing on PMI estimation	Human corpse (N = 2)	Naked/clothing	115 days	ARF Texas
Alturalia, Lukasewycz - 1999	Impact of certain factors on cadaver moisture loss	Mice (N = 2) and rats (N = 4)	Wrapping	Between 55 and 69 days	Laboratory
Miller - 2002	Influence of clothing on PMI estimation	Human corpse (N = 6)	Clothing	Between 42 and 215 days	ARF Texas
Kelly – 2006	Influence of clothing, wrapping and injuries on entomological activity during decomposition	Pig cadavers (N= 32)	Naked/Clothing/wrapping/wrapping & wrapping	50 days	Bloemfontain, South Africa
Dautartas – 2009	Influence of clothing and wrapping on PMI estimation	Human corpse (N=6)	Naked/Clothing/wrapping	30-31 days	ARF Texas
Voss <i>et al.</i> - 2011	Impact of clothing on entomological activity	Pig cadavers (N = 10)	Naked/clothing	98 days	Wildlife reserve, Western Australia

Table 1 – Synthesis of experiments considered in this study.

### First hypothesis on the impact of clothing and wrapping on decomposition process

The main commonality between these six experiments is that clothing and/or wrapping limits the direct observation of the corpse, which suggests great caution in our final interpretations (fig. 4). Besides, the authors agree that the influence of those practices during decomposition seems insufficient to affect the estimation of the postmortem interval.

Still, it appears that these pioneering experiments lead to certain insights that can help us better understand the impact of clothing and/or wrapping on the decomposition process.

As we mentioned previously, in the context of air exposure, clothing/wrapping forms a layer around the corpse protecting it from varying weather conditions. Also, studies conducted on the progress of insect activity in clothed or wrapped corpse context show that these factors alter insects' accessibility to the corpse as they are forced to burrow their way through to it (fig. 5). However, while insects' accessibility is altered, their pace of action remains fairly similar.





Fig.4 – photographs showing the difficulty of direct observation of corpse in wrapping and clothing context (source: DAUTARTAS 2009, fig. 16:40; MILLER 2002, fig.19: 39)

The various authors (CAHOON 1992, ALTURALYIA and LUKASEWYCZ 1999, MILLER 2002, KELLY 2006, DAUTARTAS 2009, VOSS *et al.* 2011) agree that clothing/wrapping goes a long way toward draining and absorbing body fluids, sometimes facilitating mummification of one or several anatomical areas of the corpse (fig. 6). This finding is all the more important in wrapping contexts because there are no separation areas between the various pieces and the largely widespread confinement of the corpse is instrumental in draining body fluids.

The experiments performed on exposed cadavers mainly probe the initial stages of decomposition and thus do not help appreciate the potential impact of clothing/and wrapping during the skeletonization phase and in turn on the final arrangement of bones. In archaeology, however, this is a fundamental premise on which most of our hypotheses regarding the presence of textile material are based.

While the skeletonization phase is rarely addressed in the context of air exposure, it has been sporadically documented through certain burials from the 19<sup>th</sup> and 20<sup>th</sup> centuries. Recent research demonstrated, for example, that when hands rest on the front of the abdomen, clothing may in some cases delay the fall of hands into the abdomen, or even help preserve some labile joints (FAVRE *et al.* 1997, GEMMERICH 1999) (fig. 7). In fact, this premise gives us an opportunity to speculate on the presence of clothing/wrapping in certain archaeological contexts.



Fig.5 – picture showing insect activity in progress at skull level in clothed corpse context (Source: MILLER 2002, fig. 27:47)





Fig. 6 – example of corpse wrapped in cotton blanket for 30 days. Note that mummification stretches across the corpse and that the blanket absorbed the majority of body fluids (Source: DAUTARTAS 2009, fig.40: 17)



Fig. 7- example of preservation of joint connections of hands placed on the front of the abdomen of a clothed individual (Source: GEMMERICH 1999, fig. 12:22)

## Archaeological applications

### Example 1 (fig.8) Notre-Dame de Nevers Abbey (Nièvre, Fr) burial 107 (VII-X century)

(MARANSKI *et al.* 2009).

This is the primary and individual burial of an adult woman. The subject rests on her back, upper limbs bent at right angles and lower limbs extended. The excavation limits of the pit are not visible and the grave was subsequently recut by a column due to the construction of a sacristy, causing the disappearance of the right lower limb. Along the left side we note a wall effect that maintains the humerus and hip bone in primary position, but the most striking observation concerns the lower slippage of the proximal section of the left forearm and the lateral displacement of the right hand. This movement cannot have occurred prior to the dislocation of joints between the hand's bones because its constituent elements retained their attachments. Although it is not possible to place this shift accurately in the decomposition timeline of the corpse, there is reason to think that a device similar to a sleeve worked to guide the hand along the forearm. Also, because material is conducive to the absorption of bodily fluids and the hand is generally poorly fleshy, we can assume mummification of the hand, which then might have helped to preserve joint connections. This assumption also suggests an empty space around the corpse, and thus that the deceased lay in a perishable chest.



Fig.8 – Nevers, Notre-Dame Abbey, burial 107. Left, overhead view. Right, details of trunk. The arrows point to the downward displacement of the proximal end of the left forearm bones and the outward slippage of the right hand bones (Photo: D. MARANSKI)



**Example 2 (fig.9): Notre-Dame de Nevers Abbey (Nièvre, Fr) burial 39 (XI-XII century)**

(MARANSKI *et al.* 2009).

This primary and individual grave, consisting of a coffin made of durable material, presents a narrowing at head level. Large limestone slabs were placed over the body for covering. The individual, an adult male, lies on his back, arms bent, hands on the front of the pelvic region, lower limbs extended. The bilateral strain exerted from the shoulders down to the pelvis brings the long bones of the limbs closer to the sagittal axis of the body, causes a marked displacement of the anterior sections of the right ribs toward the left side of the rib cage and the forward projection of the lower lumbar vertebrae and sacrum.<sup>4</sup> As the overall bone arrangement suggests, decomposition likely occurred in an empty space. This and the remotely visible strain of the chest walls, both left and right, though with a bigger space on the left side, hint at the existence of a funerary covering. Moreover, the narrow space occupied by the trunk and pelvic girdle may advance this hypothesis by suggesting the existence of a shroud tightly wrapped around the body and perhaps a holding, closing and/or tying system at waist level. This may explain the disarticulation of the elbows, the increased obliqueness of the humerus position, the forward projection of the lower vertebrae and sacrum following the coming together of the posterior sections of hip bones.



Fig. 9 – Nevers, Notre-Dame Abbey, burial 39. Left, overview; right, details of the upper half of the grave. The arrows locate the bilateral strain probably related to the presence of a very tight funerary covering (photo: D. MARANSKI).

<sup>4</sup> This movement is also facilitated by the very nature of the joint between the sacrum and hip bones. Indeed, the sacrum fits in between the hip bones like a corner, which due to the bilateral strain and breakdown of joints is predominantly thrust toward the front of the subject.

**Example 3 (fig.10): Crotenay (Jura, Fr) burial (VII century)**

This is the primary and individual grave of a man lying in a trapeze-shaped coffin sealed up by horizontally placed flagstones. The spaces in between these were repointed with mortar. Sedimentation solely occurred through percolation, more specifically on each side of the proximal end of the cavity. In this case, it is not anthropological arguments that allow us to propose the hypothesis of a textile covering but the preservation of the textile remains per se. These are particularly located around the right forearm (sleeve) over the upper section of the torso's right side and around the distal extremity of each tibia-fibula pair. In this particular case, we have substantial evidence to argue that it is clothing made up of a top and bottom section most probably separated at the waist, though this is as accurate as we can get. For the top section, at least two types of material were used; the outside piece consists of thick fibers and covers one or several pieces of much thinner material. The material used for the bottom section is similar to the outside textile of the body's top section. The bottom of the legs was adorned or reinforced with a strip of thick material placed perpendicularly to the main axis of the leg.



Fig. 10 - Crotenay, burial 63 :left, overview, right detail of the right upper limb with the mineralized fragments of a sleeve (Photo : Cl. MERCIER).

These examples document the wide variety of methods that archaeologists can use to demonstrate the existence of clothing and/or wrapping utilized for the deceased and the relevance of considering archaeological as well as anthropological arguments.

### **Concluding remarks**

The first observations resulting from the few forensic experiments cited above suggest that clothing and wrapping have an influence on the cadaver's progress during decomposition, though it is not strong enough to impact the estimation of the post mortem interval. Note, however, that wrapping seems to facilitate the dessication of soft tissue and may therefore bring about relatively widespread mummification of the corpse, as we assumed regarding the right hand in the burial 107 of the Notre-Dame de Nevers Abbey (fig. 8). Consider that these experiments are conducted during the initial stages of decomposition for medico-legal purposes and involve exposed and unburied subjects. Experiments on this issue have been few and far between, not yet allowing for synthesis.

Despite this limitation, resorting to forensic science remains a viable alternative since we are unable, in archaeology, to perform experiments on human cadavers for the ethical reasons previously mentioned. In this respect, body farms (initiated in the US by W. Bass) might be appropriate places for archaeological perspectives based on medico-legal observations regarding the issue of the impact of clothing and wrapping on decomposition. This hypothesis on the location of experimentation requires considering critical factors such as (i) the duration of experimentation which will necessarily be long for buried bodies; (ii) a sample that should be large to ensure representativeness; (iii) implementing technical resources for recording and monitoring buried clothed cadavers.

Another method that can be considered is to perform observations on cadavers exhumed for legal reasons or archaeological cases originating from populations of a recent and well-documented past of western Europe, such as Christ Church, Spitalfield, London (REEVE and ADAMS 1993; MOLLESON and COX 1993). This is the strategy we decided to pursue as part of our research in order to build a database comprising recursive or exclusive criteria, a first step toward developing a repository usable in archaeoethanatology to recover funerary equipment (including head rests, clothes, wrapping materials, sleeves, shoes, etc.). Attempting to better understand the impact of clothing/wrapping in the decomposition process of buried cadavers of past populations is one of the ways to address the questions raised by the archaeologist in terms of funerary practices (mindsets, relationship with death and the deceased, etc.).

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