



DOMINIQUE CASTEX, SACHA KACKI, HÉLÈNE RÉVEILLAS, ISABELLE SOUQUET-LEROY,
GÉRALDINE SACHAU-CARCEL, FRÉDÉRIQUE BLAIZOT, PHILIPPE BLANCHARD, HENRI DUDAY

REVEALING ARCHAEOLOGICAL FEATURES LINKED TO MORTALITY INCREASES

ABSTRACT: In this paper, we discuss criteria for evaluating the simultaneous deposit of multiple cadavers within a single pit. This archaeological approach is fundamental in identifying an abnormal mortality episode, whether occasional or linked to a mortality crisis, whatever its cause. This diagnosis must rely on the discussion of the relative chronology of body deposits, which can be particularly complex when numerous cadavers and superposition of bodies are involved. We illustrate our approach with several case studies from sites excavated as part of academic research and rescue archaeology. These examples emphasise the contribution, as well as the limits, of archaeoethanatology and highlight the need to use alternative arguments for the study of some plural burials.

KEY WORDS: Archaeoethanatology – Multiple burials – Taphonomy – Sepulchral management

INTRODUCTION

Some graves, generally known as plural burials (Leclerc, Tarrête 1988) contain the remains of several subjects within the same structure. In archaeological practice, according to the same authors, it is common to distinguish two types, collective and multiple burials. The distinction between collective burials, which are formed by deposits spread out over a long time and following the natural pattern of deaths, and multiple burials, which result from the simultaneous of several cadavers, is generally based on an archaeoethanological

analysis of the graves, which allows the pattern of body deposits to be reconstructed. In this paper, we will not discuss the methods of analysis in burial archaeology that have already been detailed elsewhere (Duday 2009, see also Duday *et al.* 2014). In fact, when several bodies are deposited in a limited space, it is possible to use the relative chronology of the articular dislocations to differentiate between the two types. If the deposits are spread over time, a new subject will cause disturbance in the arrangement of the skeleton(s) already present and perhaps allow the observation of acts of reduction (grouping of bone remains, tidying). Conversely, if the

deposits are simultaneous, the bodies will decompose at the same time and the articular connections will generally be more strictly respected. These observations must, however, be slightly modified in the case of partial or total superposition of the individuals. In such cases, as we will see in detail below, subjects placed on the floor of the grave will not generally be disturbed while dislocations could occur in the skeletons of the individuals above because the decomposition of the bodies deposited previously will create secondary empty spaces. Within the funerary domain, excluding certain natural catastrophes which can lead to the simultaneous burial of a large number of individuals, and in the absence of relevant archival sources, the timescale over which the burial of human remains has been formed represents a crucial point of information for the general comprehension of a site. Indeed, the presence of multiple burials invariably demonstrates a phenomenon of excess mortality, which can be considered a mortality "crisis" and which we can try to interpret using biological anthropological analyses adapted for site-specific questions.

With present dating methods it is not possible to confirm the simultaneity of several deposits within the same grave. The precision of these methods, whether absolute (physical and chemical) or relative (chronology of various artefacts associated with the dead (Périn *et al.* 2006) or of the architecture of funerary structures (Blaizot 2008), is generally insufficient for discussing the relationship between several archaeological events, if the time separating their deposit is less than a few years or even a few decades. An archaeothanatological approach is more efficient because the limits of discrimination are fixed by the length of time needed for the destruction of the most labile joints, that is, those which loosen most quickly during decomposition (Duday 2007: 52). This is generally in the order of a few weeks, but it may fluctuate considerably according to climatic conditions and funerary treatments, and it is not always easy to differentiate between truly simultaneous deposits and those separated by a few days.

The simultaneous inhumation of several subjects in the same place occurred in various chronological contexts, from the Palaeolithic (Klíma 1987, Tillier 2011) to recent periods of history (Adam 2006, Castex *et al.* 2011, Signoli 2006). Although the utility of the archaeological approach no longer needs to be demonstrated as is testified by a good number of studies in recent years, notably concerning epidemics (e.g. Castex, Cartron 2007, Kacki, Castex 2012, Signoli *et al.* 2007), the approach still has its limits. It becomes

ineffective when the poor preservation of the bones and/or when there is a physical separation between skeletons, whatever its nature (wood, cloth, etc.) excludes the identification of contacts between individuals and prevents the recognition of the degree of articulations and the identification of possible displacements of bone fragments. This is also the case when bodies placed simultaneously in a large space are not in contact but lie next to each other. Moreover, it would seem that the simple distinction between collective and multiple burials is insufficient to characterise the complete range of possible behavioural scenarios that led to the inhumation of the dead in the same place. To compensate for the limits of an analysis based on a simple archaeothanatological approach, it would seem judicious when studying certain sites to develop complementary arguments, which could enrich the discussion concerning the simultaneity of the deposits.

We discuss the validity of the criteria commonly used in anthropology to demonstrate the simultaneity of cadaver deposits with an eye to developing various alternative arguments. To this end, we provide several representative examples, from the simplest to the most complex, and from both research and rescue excavations.

The limits of this discussion of the investigation of simultaneity, however complex, exclude the question of the simultaneity of deposits in secondary burials as the simultaneous deposit of disarticulated bones in secondary burials in no way indicates the simultaneity of death (e.g. as in cremations). This also applies to prolonged preservation of soft tissues due to cold, desiccation, etc. This would enable the intact bodies of subjects who died at different moments to be placed in the same place (Duday 2007: 50–51), which can never be demonstrated archaeologically. Certain issues such as determining the veracity of the mortality crises and indentifying their nature, will not be tackled, as this would lead us away from our subject, and these have already been specifically addressed at some of the sites presented.

SIMPLE FORMS OF SIMULTANEOUS BURIALS

The simplest forms of multiple burials are those containing two, three, or four individuals. The site, Les Fédons, Lambesc (Bouches du Rhône), is typical of this type of burial. The complete excavation of this funerary assemblage consisted of 75 individual, 21 double, four triple, and one quadruple grave (Bizot *et al.* 2005). This

was a plague cemetery, as confirmed by historical documents, which was in active use from May to September 1590 (Rigaud 2005).

On the whole, the pits have more or less regular quadrangular contours depending on the number of individuals interred. All the osteological observations indicate that in graves containing several individuals all the bodies were buried simultaneously and decomposed in a sealed space (Moreau *et al.* 2005), as is illustrated by one of the triple graves where the bones of the individuals were in direct contact, without the interposition of sediment (*Figure 1a*). The three individuals were buried supinely, two with their heads to the east and the third superimposed on the other two lying in the opposite direction, i.e. head-to-toe. The order

of the progressive deposition of the different subjects from south to north is clearly shown by analysis of the partial superimposition of the skeletons. This consecutive placement did not lead to disturbance of the bodies already deposited, even in the case of the most labile articulations. Moreover, it can be noted that the first individual (307) was pushed towards the eastern wall, with his head bent to the south, to make room for the head of the second individual (306). In addition, the lower limbs of the first subject reflect a rightward rotation (the right lower limb appears in the centre, the left at the side) undoubtedly because of the presence of the third individual (308) (Duday *et al.* 2005: 89).

This chronology of successive deposits was quite easy to discover in the case of partial superimposition.



FIGURE 1. Two simultaneous burials at Les Fédons (Lambesc, Bouches-de-Rhône): a, example with superposition; b, example with juxtaposition. Photo by P. Reynaud (Inrap).

Where there is no superimposition an indication of the sequence of burial can be deduced from the position of the individuals in the pits (*Figure 1b*), the first body buried generally occupying a greater space in the grave, with the second and third often being squeezed into the remaining empty space. In many other multiple graves at this site, it was possible to reconstruct a similar order of burial, not by the superimposition of the bodies, but rather by the relative posture of each skeleton in the pit. The first body was often extended while the following ones, placed to avoid the first, were more compressed and more or less constrained. In this example, the simultaneity of the deposits in some of the multiple graves can be quite easily argued when there is partial superimposition of the bodies; in others, despite the indication of a single pit contour, the diagnosis of simultaneous deposits comes from the relative position of the individuals within the pit.

Slightly more complex deposits with a greater number of individuals were discovered at the site Ilot Saint-Louis, Boulogne-sur-Mer (Pas-de-Calais). This small funerary assemblage consisted of seven multiple graves dating from the early 18th century, which contained 39 individuals (Belot, Canut 1995). In spite of this small number, the simultaneity of the deposits, the contemporaneity of the structures and the recurrence of phenomena in a limited space allowed us to interpret this site as being the result of a severe mortality crisis. The analysis of the biological "recruitment" of this osteological sample, in addition to epidemiological and historical data relating to the time, suggest a smallpox epidemic (Castex, Réveillas 2007).

In each grave, archaeoanthatological study demonstrated that the deposits were primary, that the cadavers were deposited simultaneously within the pits, and that they decomposed in a sealed space. The limits of the pits could not be perceived with certainty, but seem likely to have been narrow and oval, as suggested by the constrained position of some individuals. Inside each grave all the individuals were placed supinely in a south-west/north-east direction, juxtaposed and/or superimposed in the same direction with the head to the south-west. The lower limbs were almost systematically extended and the upper limbs frequently flexed in various positions. This type of burial is illustrated by a grave that contained the remains of six individuals, two adults, three children, and one newborn infant (*Figure 2*).

The study of the relations between the bone elements of the different subjects allowed a reconstruction of the sequence of the deposits in this grave and established that child No. 1 was deposited first. The body of this child was

then covered partially by that of adult No. 2 onto which was placed newborn No. 3. The deposit of adult No. 2 caused no disturbance to the bones of the first immature subject. The articulations of this adult are generally very well maintained, as shown notably by the foot bones and the patellae (still in place on the femora). On either side of this adult, the immature subjects, No. 4 and 5, have been placed at a higher level and both are covered by adult No. 6 who completes the deposit. At this level, again the articular connections are generally maintained, but some vertical bone displacements can be observed. These displacements are linked to the decay of soft tissues of the individuals on the below, which created empty spaces into which some bone fragments belonging to the individuals above (such as hand and foot bones of the last adult deposited) had migrated, an effect referred

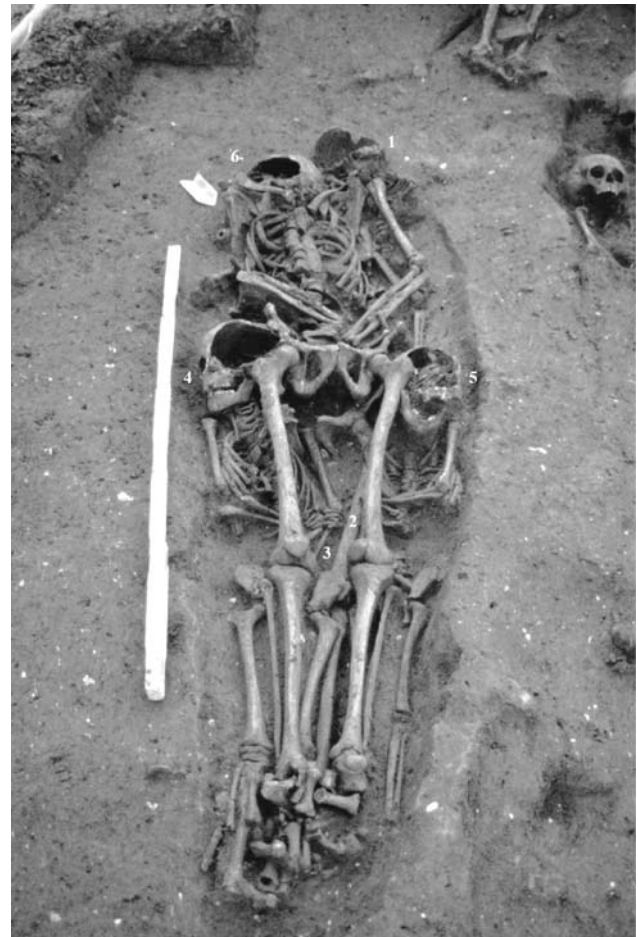


FIGURE 2. General view of one simultaneous burial at Boulogne (Pas-de-Calais). Photo by E. Belot (Boulogne Archaeological Service).

to as "down-draught". We were able to conclude from these observations, together with those from other graves at the site, that there were indeed multiple deposits, that had been relatively well organised. However, no consistent pattern of deposition with respect to the age or sex of the individuals was apparent. The only constant was the simultaneous presence of adults and immature subjects of less than 10 years of age.

Although more complex than the preceding example, the analysis of these graves provides precise arguments in favour of simultaneous deposits, notably because of the maintenance of the articulations of the most labile parts of the skeletons and in spite of minor bone displacements of the individuals above. But here, again, the recognition of the well-organised pattern of the remains tells us that these deposits were made over a short period of time, during one and the same depositional event. In fact, although the youngest individuals are placed both above and below the adults, they provide a clear impression of having been placed to fill the empty spaces left when the first adults were positioned in the most efficient possible manner. The same type of organisation has been demonstrated at other sites linked with a mortality crisis (Castex *et al.* 2011).

It sometimes happens in the case of a superimposition of two individuals in the same grave that, despite an apparent simplicity, there is insufficient evidence to confirm simultaneous deposition. The double grave discovered at the site Théâtre Verdière, La Rochelle (Charente Maritime) perfectly illustrates this difficulty (Souquet-Leroy *et al.* 2011).

The two individuals in this grave are placed one on top of the other in an almost identical position and in an east/west, head to the west orientation. The subject above is placed on the right side of the subject underneath, which lies supinely. The superior right-hand part of the upper skeleton rested against a wall that can no longer be seen (Figure 3). Fragments of wood were found between the two subjects, at chest and hip levels, in direct contact with the bones.

Evidence that could be ascribed to a simultaneous deposit is present: zones of contact are visible from the shoulders to the hips of the two individuals and the left hand of the upper subject is partly displaced into the thorax of the lower subject. It seems clear that the two individuals were placed in the same space because constraint effects are common to both skeletons: the thoracic cage of the upper subject shows a "wall effect", which can also be observed to influence the right humerus of the subject beneath, which would otherwise be in an unstable position. Analysis has shown the

existence of a lateral plank, common to the two bodies, nailed to a plank on the floor of the pit that had been placed on wedges, onto which the first body had been placed. A plank is also present between the two bodies and can be interpreted in two fashions. It could serve as a separation between two corpses suggesting a common container (shelved coffin) and so, a simultaneous burial (Figure 4). But, it could also represent the decomposed and collapsed lid belonging to the coffin of the first body buried, on which a second body was placed, suggesting a later deposit. Although it is difficult to choose between these two hypotheses, this example demonstrates that, besides strictly osteological arguments, the interpretation of a site may need to take into consideration parts of funerary furniture.

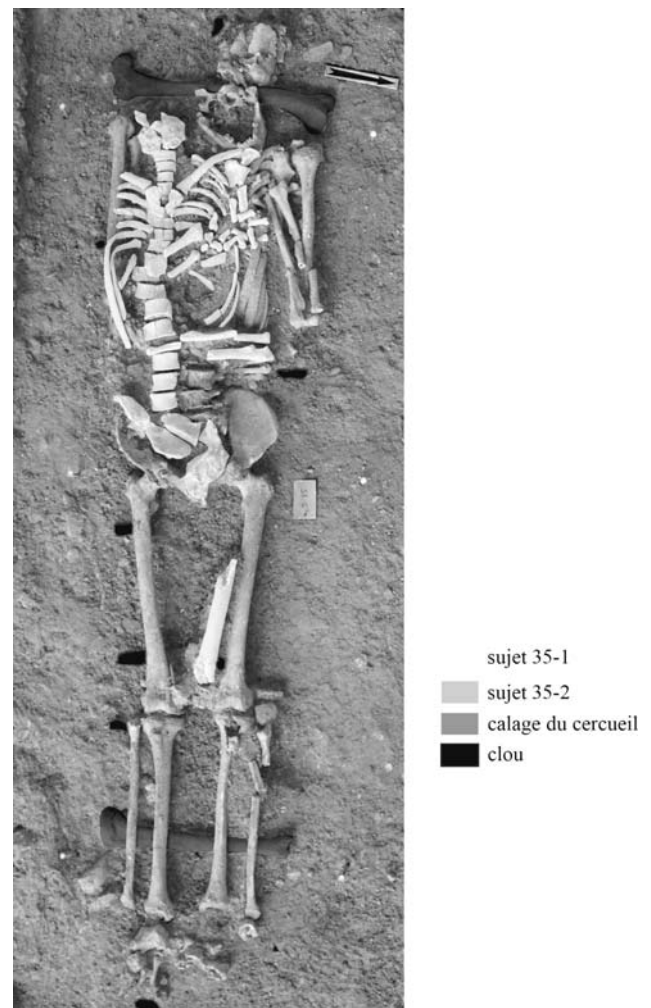


FIGURE 3. The "double burial" of La Rochelle. Photo and DAO by I. Souquet-Leroy (Inrap).

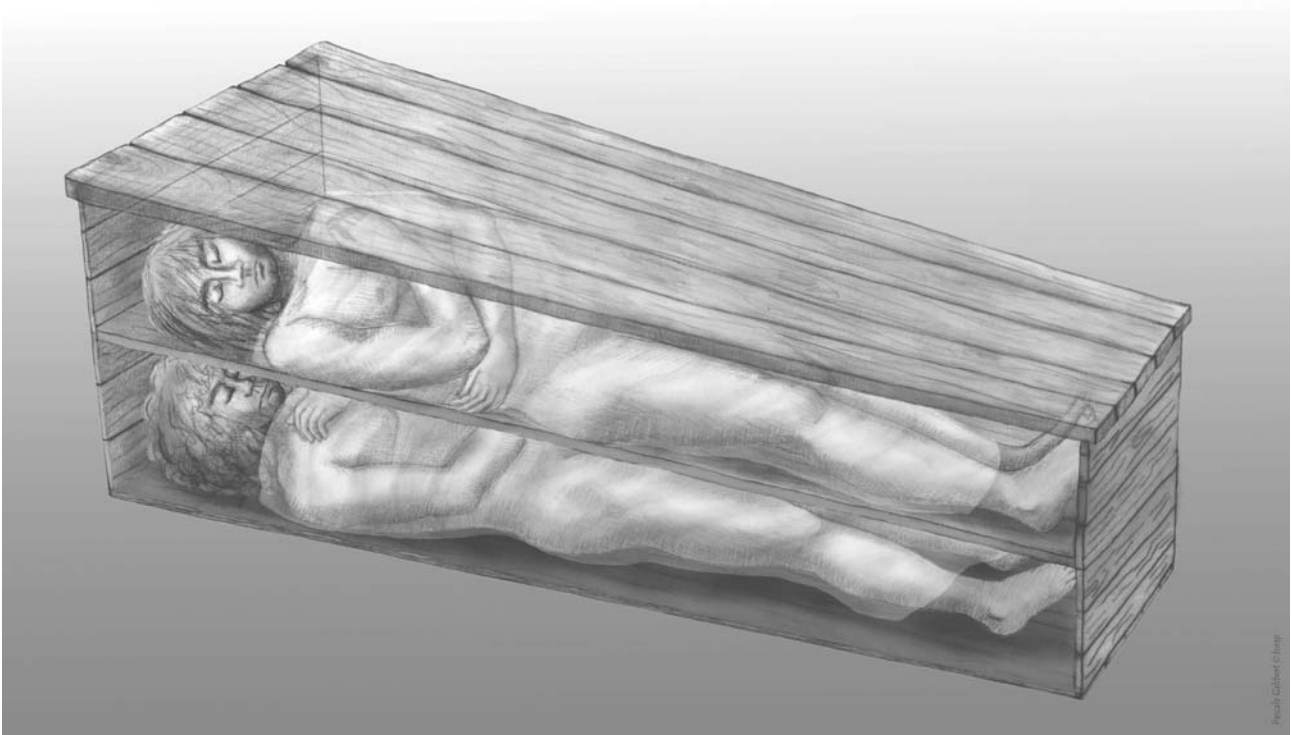


FIGURE 4. Hypothesis of reproduction of the "double burial" at La Rochelle. Drawing by P. Galibert (Inrap).

SYNCHRONIC BODY DECOMPOSITION OF A LARGE NUMBER OF INDIVIDUALS

Bodies juxtaposed in a same structure

The site at Saint-Remy-la-Calonne (south-east of Verdun, Meuse), containing French soldiers from the First World War, is a good example of multiple burial comprised of a large number of individuals (Adam *et al.* 1992). This grave is an imposing four-sided pit (5.20 m by 2.60 m) with a maximum depth of 0.40 m. It contains the remains of 21 individuals lying supinely in two rows, head-to-toe (Figure 5). Study of the positions of these remains revealed that they had been deposited in eight successive layers, which each contained between one and six individuals.

The positions of the bodies were all quite similar although the upper limbs were arranged differently from one subject to another. Apart from these slight variations, the heads of all subjects were aligned with the walls of the pit, and the lower limbs of each individual were in an extended position, lying over or under the chest of the individual facing him. Analysis of the deposits clearly

establishes the primary nature of the burials, the retained connections of the labile articulations implies a short lapse of time between death and burial of the corpse.

Different skeletons were in contact with each other and no displacement was observed linked to the deposition of new cadavers on previously disturbed bodies, which would indicate that this grave was formed over a very brief period. Most of the individuals have their labile articulations maintained, although again the effects of superimposition of piled corpses is evident, as well as filtering of small dislocated bones from subjects above into the lower levels. These, generally vertical movements frequently respect articulations of individuals beneath, whereas the labile articulations of the upper subjects will be disjointed. As previously, the same type of bone displacements linked to the synchronic putrefaction of piled bodies, are found, but on a larger scale.

Some multiple deposits, whose nature is still undetermined (funerary?, ritual?), frequently encountered during the Neolithic, give rise to debate. For example, at the site of Gournier, at Montélimar (Drôme) pit FS66 in



FIGURE 5. Overview of the multiple burial at Saint Rémy La Calonne. Photo by H. Paitier (Afan), DAO by F. Adam.

the Daurelle section (the recent phase of Chasséen) shows that bones of skeletons placed at the top of the pile can be found in unusual positions (Blaizot *et al.* in press) (Figure 6). Arguments in favour of simultaneous deposits are numerous. The bones of the different skeletons lie directly on each other, without intermediary sediment, while, in the zones of direct contact between individuals, the anatomical areas of the underlying skeletons maintain their anatomical connections. Finally, collapse of the piled bodies due to soft tissue decomposition is responsible for the many dislocations of the last skeleton in the sequence (No. 639), in the same way that the movements noted in the skeleton (No. 640) follow decomposition of the underlying body (No. 641). In this pit, it can also be noted that no bones are found outside the body mass contributed by all of these individuals.

The last skeleton placed in the pit (No. 639) is a typical example. The upper half, seen from behind, is anatomically connected, apart from minor dislocations. On the other hand, the lower half reveals several disturbances. The right ilium is found on left side and reveals its inferior posterior aspect because the subject lies face down in its upper half and is separated by 15 cm from the proximal end of the femur. The femur is covered by the left ilium, which is with its lateral aspect

visible. The latter is not in anatomical articulation with the femur, which contacts the anterior part of the left ilium. Long bones of the lower limbs are anatomically connected, knees flexed, but in an awkward position because the feet are dorsiflexed against the torso. The position of this skeleton does not correspond to a position possible when living, as the left foot passes over the sternal ends of the right ribs! The only explanation would be that the left foot and leg were further forward, undoubtedly closer to the right foot and leg, originally, although it can also be supposed that they may have later moved slightly sideways, the foot coming to a stop against the millstone. After the coxo-femoral dislocation, the right femur moved forward about 10 cm. And the knee, originally flexed anteriorly with respect to the torso, has toppled backward. These displacements are due to the position of the body in an unstable equilibrium as well as to its position on top of the parts of three other cadavers: the collapse of the thorax of skeleton No. 634 was responsible for the displacement of the right femur and knee, while the left foot probably rested on the hip of the same skeleton; when the coxal bone of skeleton No. 634 became flattened, the foot slid onto the ribs of the same individual. It is, therefore, the decomposition of individual No. 634 that led to the mass of elements

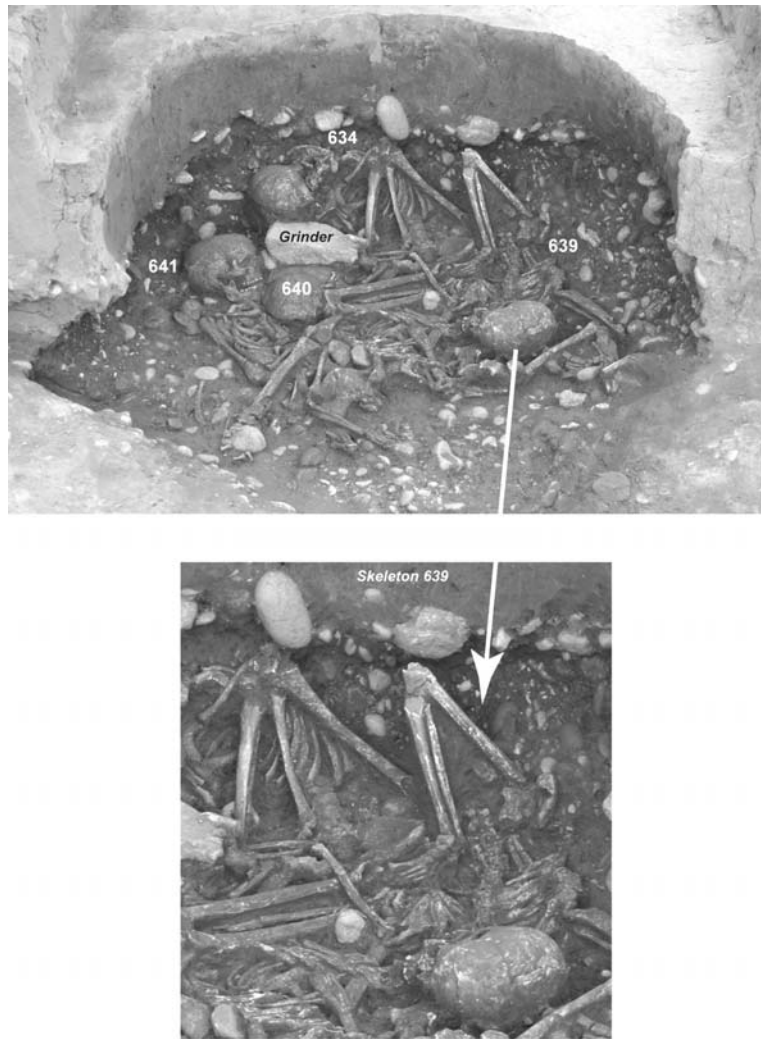


FIGURE 6. The pit FS66 in the Daurelle section at the site of Gournier (Montélimar, Drôme). Photo by F. Blaizot (Inrap).

being in a position of equilibrium (the articulations have been maintained or remain in an anatomically consistent position: right knee, right patella, feet). In conclusion, the body was originally placed squatting against the wall of the pit, the knees bent forward and to the right of the body, with the upper half of the body leaning forward. The feet rested on the pelvis of skeleton No. 634 and the upper third of the body lay on its flexed lower limbs and on the left legs of skeletons Nos. 640 and 641. If the original mass of the bodies is reproduced, taking into account the age at death of the various individuals, the position of subject No. 639 can be clearly envisaged.

This example highlights that, even in the presence of major disarticulations, the hypothesis of a multiple burial

cannot be excluded. The diagnosis of simultaneous deposits should not be based solely on the most obvious bone displacements but must rely on some specific arguments, particularly the maintenance of at least some labile joints.

Bodies superimposed in the same structure

The cemetery of Issoudun (Indre), excavated and studied by *Inrap* (French preventive archaeology institution) in 2002 provides good examples of the effects due to superimposition of corpses (Blanchard *et al.* 2011, Souquet-Leroy *et al.* 2007). This funerary space in its entirety was in use for a long period (12th century to 18th century), but one zone of the cemetery

contains 14 multiple graves dated to the end 17th century and early 18th century. The two distinct chronological phases indicated two distinct events. The first phase includes 12 graves organised in rows north-east/south-west, while the second contains only two pits, placed perpendicular to those of the first phase, that means north-north-west/south-south-east. The graves of the first phase, by their number and the number of their occupants, allow an explicit study of the reactions of a population facing a mortality episode. Apart from one double burial, the graves contained between 11 and 23 individuals, the first evidence of a recruitment conferring an exceptional character to these structures. The taphonomic analysis, which is detailed *infra*, indicated the simultaneity of the deposits within each grave and the decomposition of the bodies in a sealed space. Archaeological and demographic arguments resulting from the biological data have reveal that these graves arose from a clear mortality crisis, an hypothesis reinforced by archival sources which recount several acute phases of mortality during the historic period concerned (Pouille 2007). However, it remains difficult to specify the nature of the crisis which caused the multiple deaths at Issoudun. The most likely hypothesis is that the crisis is due to an, as yet, unclearly identified human pathogen,

perhaps linked with a famine (Souquet-Leroy *et al.* 2012).

We will take the example one particular multiple grave belonging to the first episode of mortality and demonstrate similarities between it and the other pits (Figure 7). The individuals are deposited head-to-toe, with the aim of using the space efficiently, but because of the high mortality requiring the deposition of many individual, the gravediggers were forced to organise the deposits carefully. The recurrence of similar patterns poses questions because the chosen example contains one of the largest numbers of subjects. The pit has the form of a regular rectangle (2.10 m by 1.00 m) and a depth of between 0.50 and 0.55 m. It contains 22 subjects who, because of its narrowness, are deposited in three layers. At first sight, this grave seems complex, the large number of subjects it contains giving it a disorderly appearance. However, when examined more closely, the deposits are relatively well organised. A recurrent pattern of crania, vertebrae, and ribs can be observed, and it can be remarked that, not only are anatomical relationships maintained, but articulations are also more or less maintained, even those of the most labile articulations, such as those of the phalanges. This general "reading" of the skeletons immediately

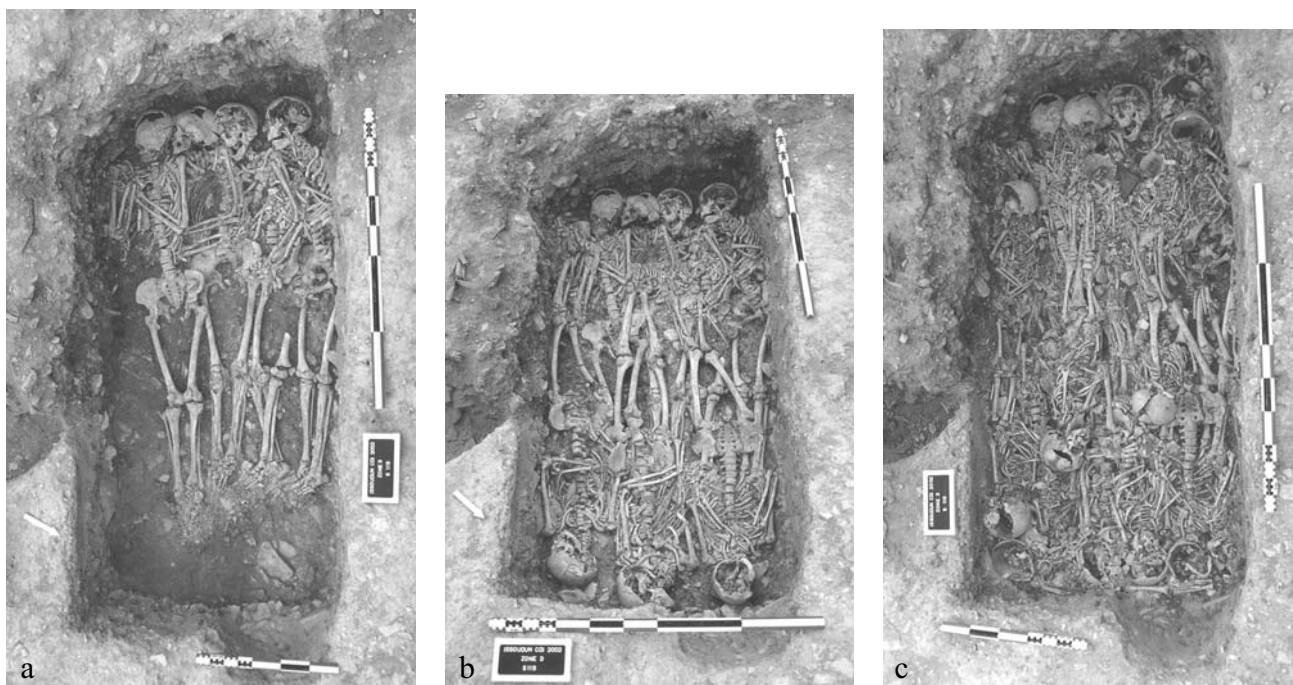


FIGURE 7. One of the fourteen simultaneous burials (S.119) at Issoudun (Indre) containing 22 individuals on three levels of deposits: a, first level; b, second level; c, third level. Photo by F. Porcell (Inrap).

eliminates the hypothesis of an organised ossuary where the bones would be arranged by type (long bones, crania, etc.) and is a fundamental argument confirming the primary deposition of all these individuals.

Taphonomic observations provide additional insight into the general appearance and formation of the grave (Souquet-Leroy 2011), from evidence in favour of simultaneous deposits to the recognition of various funerary actions. In fact, the order in which each subject was placed within the grave was established by the pattern of the deposits; it is based on the relative chronology of each skeletal deposition by simple contact, by overlapping or by partial or total superimposition.

No matter which layer is considered, the individuals are in contact with one another. In the first layer they are placed regularly with overlapping of the thoraces while the lower limbs remain parallel; no disturbance of the bones is noted (*Figure 7a*). In the second layer all skeletons are aligned side-by-side and distributed regularly head-to-toe (*Figure 7b*). As in the preceding layer there is certain constancy in the orientation of the head and upper and lower limbs. In the third layer, the articulations between elements are, on the whole, maintained, but some variations appear in the way in which the bodies have been deposited (*Figure 7c*). This is perceptible in the position of immature subjects because, although they are mostly deposited above and in alignment with the adult subjects, some are placed perpendicular to them, squeezed against the edge of the pit or in the remaining spaces.

There is no doubt that here we are dealing with simultaneous deposits (based on the same basic arguments as in the previous examples), but the phenomenon of down-draught described in the previous example concerning the vertical migration of small bones into the secondary empty spaces of the underlying subjects is amplified because of the number of individuals in each of the layers. The immature subjects situated in the upper layers are closely intermingled with the subjects just underneath, and it is common to find some small bones of subjects in higher layers having fallen due by gravity and, owing to the creation of secondary empty spaces, placed in contact with individuals laid on the floor of the pit. But there are other arguments to justify a simultaneous deposition of cadavers based on the arrangement of the bodies in the pit. Although supine burial is the dominant position, cases of a more lateralised position are also present, and this can be explained by the necessity of placing the greatest possible number of subjects simultaneously in a relatively narrow pit. Two other multiple graves contain

a total of seven individuals lying face down. Could this be a sign of urgency or of inattention? These "accidental" positions, caused by the concealment of a body in a sheet or by the collapse of bodies after their deposition, reinforce the notion of simultaneity. This position preferentially affects the first individuals placed in the pits and often it is the upper part of the skeleton which is lateralised. There is certainly a correlation between the position of the subjects, their level in the pit and its width. On the other hand, for the second series of deposits these constraints no longer apply in the case of immature subjects.

The chronology of the deposits within each grave can clearly be deduced; a type of "organisation" of the subjects by layer, which is found almost systematically in every multiple grave on this site. The first layer, on the floor of the pit, always contains, with a few exceptions, the tallest subjects, placed first in the pit. Biological observations demonstrate that height is the first criterion to influence the order of the deposits; stature must have been taken into account by the gravediggers, but not the age of the individuals. These are grouped in threes or fours by phase, placed tightly, side-by-side supinely or slightly on their sides and with their upper limbs overlapping. The lower limbs are often placed such that individuals are oriented head-to-toe. Younger and, therefore, smaller subjects are almost always placed in upper layers, in empty spaces left between other individuals. The last body is almost always placed against the edge of the pit.

Thus, a simple reality exists beneath the facade of a complex appearance created by the deposition of a large number of individuals in a limited space over a very short period of time. The means by which bodies were deposited escapes us (lowered into the grave? using a mechanical system? dependent on accessible space around the grave?) but in any case there is clear evidence for attention and care in depositing the corpses.

Poorly preserved plural deposits

An example of juxtaposition and superimposition of numerous bodies, combined with very poor preservation of skeletal remains is seen at the multiple burial site discovered at Reichstett-Mundolsheim (Bas-Rhin, Alsace) (*Figure 8*). The archaeo-anthropological study of this assemblage relies on particularly scanty data, but thanks to meticulous recording and analysis, both in the field and in the laboratory, an interpretation of the manner of body deposition could be suggested. At this site, a combination of demographic, archaeological and topographic arguments provide support for an

hypothesised battle that took place in Late Antiquity (Blaizot 1999).

The grave structure takes the form of a heap of bones in a rectangular outline (3.90 m by 2.00 m), without clear organisation. Despite the deplorable state of the bone

remains (each skeleton is incomplete, only crania, long bones, and a few fragments from the trunk and extremities survived), it was possible to reconstruct individual skeletons. The relationships among bone fragments, their side, orientation, and position in the

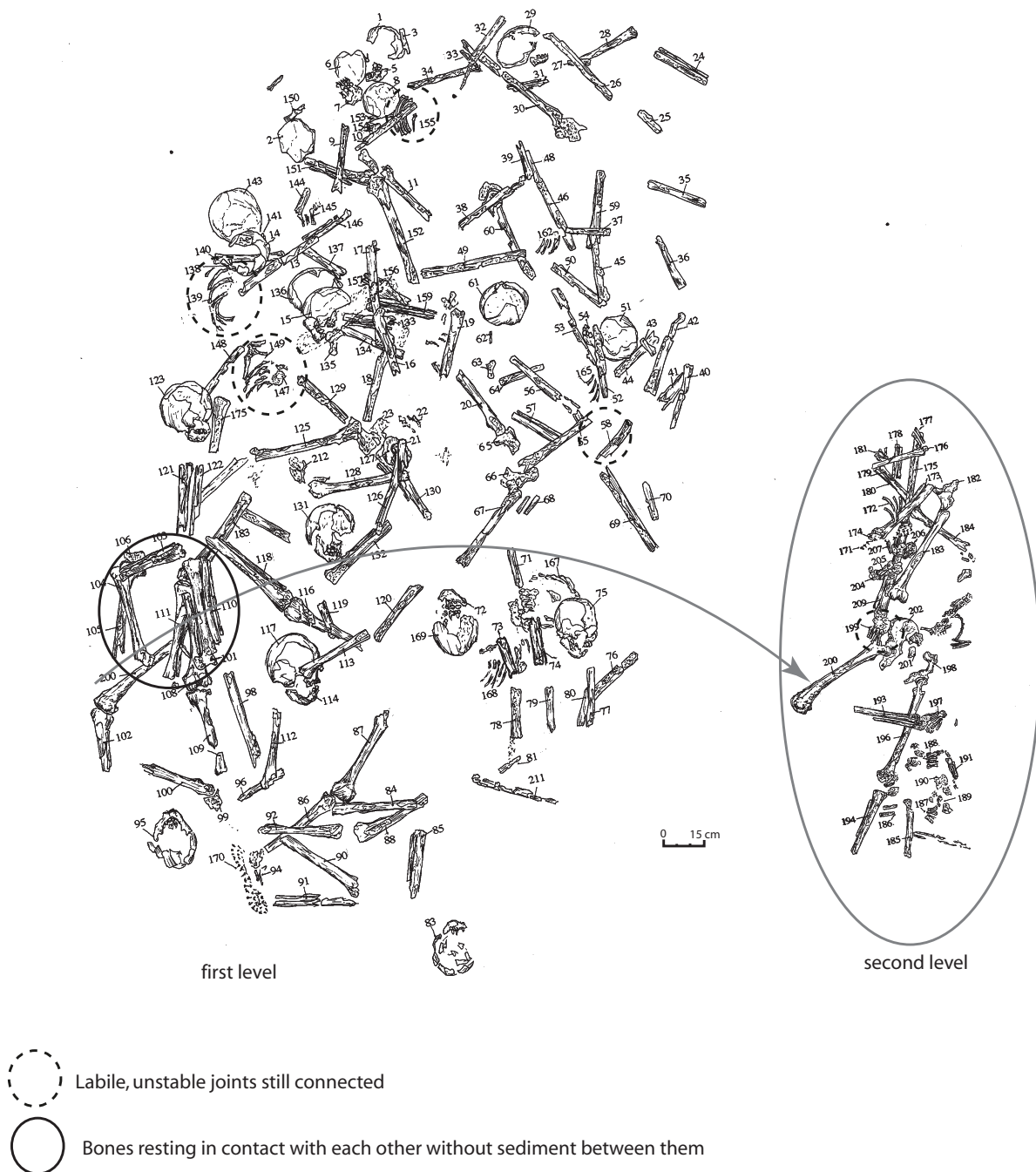


FIGURE 8. Multiple burial at the site of Reichstett-Mundolsheim (Bas-Rhin, Alsace). Drawing by F. Blaizot (Inrap).

grave, were compared to the results obtained by osseous matching based on the appearance, robustness articular congruity. This laborious reconstruction was only possible because each bone fragment was carefully recorded in the field and collected singly on removal from the grave. This initial work demonstrated that, contrary to appearances, this grave did not contain a heap of dislocated bones, but the very poorly preserved remains of about 34 skeletons. In fact, skeletal parts corresponding to labile articulations are in anatomical connection (ribs, clavicles, scapulae; patellae and femora; bones from hands and feet), while other anatomical parts belonging to the same skeleton appear in an anatomical order (e.g. left and right ribs, upper and lower halves) and the deposits can, therefore, be considered as primary.

The analysis of the position of the reconstructed bodies revealed unusual positions indicating that the bodies were not arranged in a consistent orientation in the pit (Figure 9a). Four layers of bodies can be distinguished. In each, the individuals have been placed head-to-toe and perpendicular to that of the preceding layer (Figure 9b). These observations provide evidence

of a sensible organisation, if unusual organisation of the pit (Figure 9c).

The pit itself did not survive, but the distribution of the human remains shows that the deposits took place in a rectangular feature: they show the signs of a continuous linear arrangement on all four sides. All of the deposits were made at the same time; bones belonging to different skeletons- in contact and not separated by earth- lie directly on each other; the arrival of a new skeleton has not disturbed the anatomical connections of the underlying skeletons, including the labile articulations. Finally, the immediate filling of the pit is shown by the unstable position of several elements maintained in anatomical connection above the anatomical region of another individual and by the systematic maintenance of maxillae and mandibles in occlusion. All the bones found in this grave belong to adults, no adolescents or children was identified. Unfortunately, the sex of the individuals could not be determined in due to the poor state of bone preservation (only one coxal bone, from a male, was preserved).

This assemblage can be considered to illustrate a mass mortality event and the fact that the pit contains only adults leads us to envisage a military conflict. Radiocarbon dating indicates a 5th-century date. It is tempting to connect these remains with a textually-attested battle between an autochthonous people and the resident *Alemanni* in 450 AD at Strasbourg. The methodical organisation of the deposits does suggest military origin, but, of course, the relation to this precise episode is no more than plausible.

COMPLEX MULTIPLE DEPOSITS OF CORPSES

Located in south-east Rome, about 3 km from the ancient city, the catacomb of Sts. Peter and Marcellinus is a vast underground funerary site covering approximately three hectares and containing 4.5 km of galleries. It represents concrete evidence of the first Christian communities and their development. In 2004 a chance discovery in the central section revealed a very different organisation to that generally seen in this underground funerary space (i.e. straight galleries excavated into the tuff, fragmental rock consisting of the smaller kinds of volcanic detritus, as ash or cinder, usually more or less stratified, containing *loculi*, *arcosolia*, and *cubicula*) (Guyon 1987). In fact cavities of various dimensions, some of which are connected, were revealed and found to contain several layers of deposits of human skeletal remains (Figure 10). In order

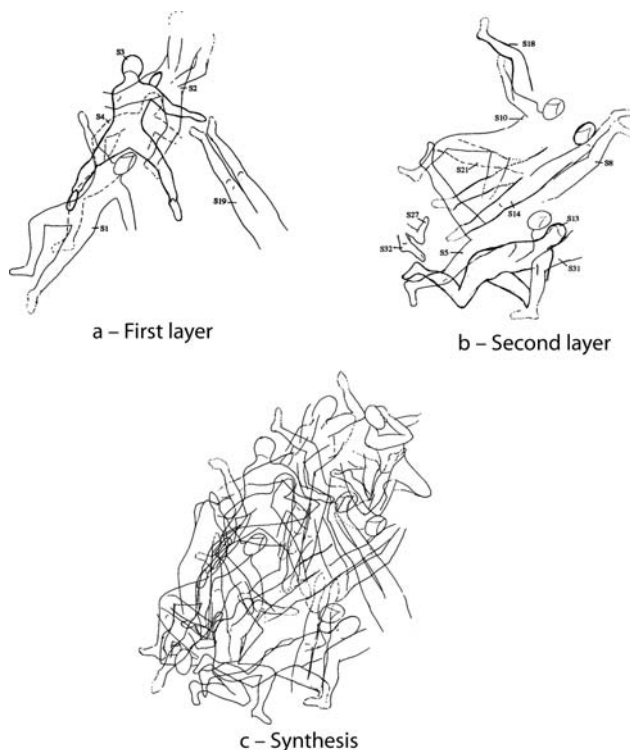


FIGURE 9. Bodies' positions. Reichstett-Mundolsheim (Bas-Rhin, Alsace) site. Drawing by F. Blaizot (Inrap).

to understand the significance of these newly discovered funerary spaces, there have been several archaeological excavations in 2005, 2006, 2008, and 2010 that resulted from a collaborative partnership between several institutions. The first studies on this section of the catacomb demonstrate that some layers contained simultaneous deposits, probably related to an epidemic mortality crisis (Blanchard, Castex 2007, Castex, Blanchard 2011, Castex *et al.* 2011). Excavations reveal a complicated funerary treatment characterised by the application of plaster to the body and employing several other substances as well (amber, resins, cloth, gold thread), has rendered the interpretation of simultaneous deposition a very delicate one.

Some evidence (artefacts, radiocarbon analysis) dates these structures to quite a long timescale, between the late 1st century and early 3rd century, earlier than the first previously known funerary presence in the late 3rd century. In addition to playing a prominent role in one of the earliest interpretations of simultaneous deposits in these catacombs, they also play a large part in contributing to our knowledge of ancient mortality crises. With the aim of clarifying the basis of earlier interpretations, it would seem desirable to present the arguments supporting the diagnosis of simultaneity and to try to understand how each grave was filled with cadavers.

Limits of a classical archaeothanatological approach

Two burial chambers have been thoroughly excavated. The positions of the various remains and

grave inclusions recovered have been scrupulously registered. In each of these chambers it was possible to confirm the primary nature of the body deposition. In fact, for each individual present, a large number of articulations remained in anatomical connection which precludes a hypothesis of dry bone deposition and, consequently, of ossuary-like activity.

Sporadic observations have also shown that some skeletons were perfectly superimposed without intervening sediment and no re-arrangement linked to the laying down of successive deposits was observed (*Figure 11*). Faced with such deposits, it could be legitimately suggested that the placement of some juxtaposed corpses took place within a short period of time. However, the application of a classical archaeothanatological approach, based on the maintenance of labile connections, the most informative when debating a strict contemporaneity of deposits (Duday *et al.* 2005, Duday 2007), seemed insufficient when arguing for the simultaneity of all the corpses deposited. Given the poor preservation of many of the skeletons and the meagre representation of certain individuals, which was variable from one chamber to another as well between different sections of the same grave, the hypothesis of possible disturbance, and indeed bone removals, might have been suspected. In addition, the two chambers studied contained soil strata separating the various layers of cadavers that excluded the possibility of relying on the sequential relationships between individuals found in separate layers to argue for simultaneity of deposition. Finally, the presence of varying grave inclusions (plaster, cloth, etc.) linked to funerary practices considerably complicated the analysis

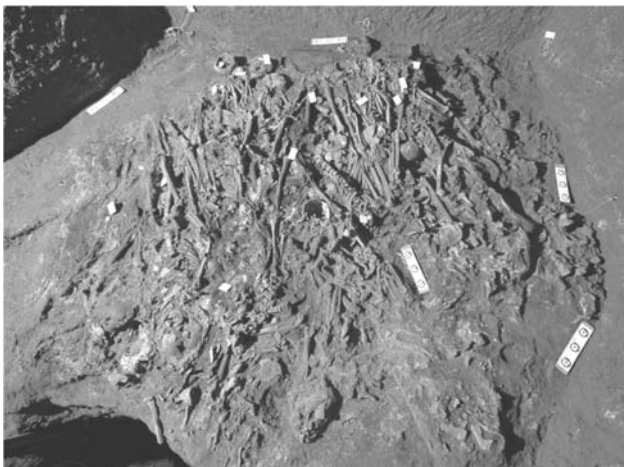


FIGURE 10. An overall view of a tomb in the central sector of the catacomb Sts. Peter and Marcellinus (Rome, Italy). Photo by D. Gliksman (Inrap).



FIGURE 11. Example of an overlaid body showing conservation of articular connections (1, pelvis and femur; 2, humerus, radius and ulna), some labile (3, carpal and metacarpal; 4, patella and femur).

of the relations between bone elements and fragments of bones, several skeletons being disarticulated (*Figure 12*).

Taking into account these factors and the fact that our analysis is founded only on minimal archaeothanatological observations, it seemed risky to conclude definitively that all the deposits were simultaneous and to exclude completely the possibility of corpses being deposited over a longer period of time. The necessity of considering alternative arguments was thus evident.

Development of alternative arguments

In order to consider the simultaneous nature of the deposits more precisely, an *a posteriori* analysis of the data (characteristics of the burial chambers, general disposition of the skeletons, spatial distribution of grave inclusions) registered during their excavation was

undertaken. The exploitation of this data permits certain deductions concerning the pattern of the deposits and their timescale.

Three-dimensional reconstruction of the chambers and their contents

The dimensions and volumes of the two chambers are different. X80 T16 is rectangular and measures 1.22×2.05 m with a height of 2.97 m (i.e. volume 7.4 m³), whereas X82 T18 is quadrangular, measuring 2.50×2.80 m with a height of 1.20 m at the northern wall rising to 2.10 m at the southern wall (i.e. volume 10.1 m³). In view of the large number of subjects found in each chamber, the possibility of simultaneous deposit of all the individuals was raised.

In response to this issue, a 3-D reconstruction of the two chambers and a reconstruction of the body volumes of the subjects was realised within the scope of a doctoral thesis by one of us (Sachau-Carcel 2012). This work consisted of a detailed modelling of each chamber and its content derived from the spatial co-ordinates recorded *in situ* and pre-existing models of bodies in three dimensions (cf. Sachau-Carcel 2014). It was possible to simulate each individual. The results of this simulation excluded the hypothesis of simultaneous deposition of fully fleshed and complete corpses, the total volume of the bodies greatly exceeding the available space in the burial chambers (*Figure 13a, b*). We were thus able to conclude that in each grave, different depositional phases were responsible for the placement of the bodies of the dead in the two graves, taking into account the topography of the chambers (e.g. significant irregularities of the floor and walls of grave X82 T18), the respective position of bodies and the fact that the phases were separated by intervals of an unknown length of time, but long enough for the, at least partial, decomposition of the corpses.

Methods of body arrangements

As seen earlier, another fundamental point of debate when establishing a diagnosis of simultaneous burial deposition resides in the way in which individuals are arranged in the grave. In the case of cadaver deposits spread out over time, this pattern is influenced by the manipulation of bones, by emptying, by the gathering together of bone fragments in one or several sections of the grave, or by moving them to the peripheral zone during the deposition of subsequent bodies.

This type of use is more commonly seen in megalithic Neolithic, Chalcolithic, and Bronze Age



FIGURE 12. Body coated with plaster and plaster halo around the head of an individual in grave X84. Sts. Peter and Marcellinus (Rome, Italy). Photo by H. Réveillas (Inrap).

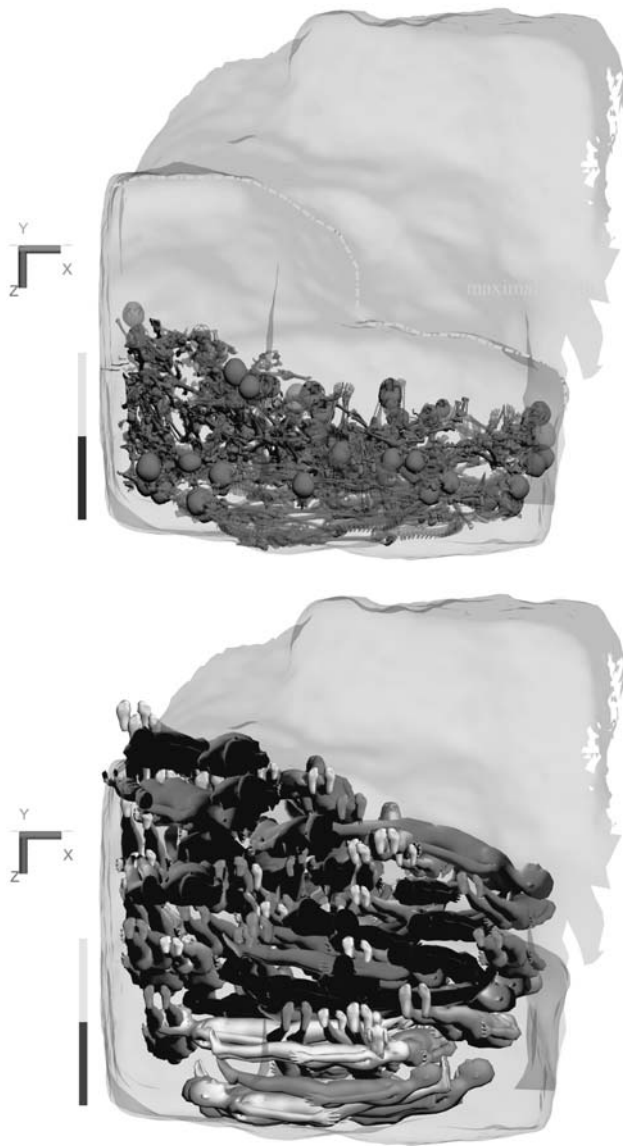


FIGURE 13. Tomb X80 T16: a, reconstruction of the layers of skeletons; b, reconstruction of body volumes. Performed by G. Sachau-Carcel.

barrows (e.g. Duday *et al.* 2011) but similar manipulations of the deceased are also observed in the case of re-use of sarcophagi during the Early Middle Ages (Blaizot 1996, Gleize 2006) or in the management of medieval and modern period burial vaults (Gleize 2007). On the other hand, as we have seen in a number of cases (cf. *supra*), the management of bodies within a multiple grave often consists in placing them in an orderly and rational manner so as to manage the

deposition of a large number of cadavers in a given place (Castex, Kacki 2013). In the case of the Sts. Peter and Marcellinus catacomb, the arrangement of the skeletons demonstrates, once again, a rationalisation of the space available compatible with this hypothesis; the individuals are frequently placed head-to-toe so as to lay the greatest possible number of bodies on a small surface. However, it is worth noting that the same type of body arrangement can be found in some collective burials (Blaizot 2012). These positioning methods find numerous analogies in multiple burials from other chrono-cultural contexts (Castex *et al.* 2008). Furthermore, immature subjects of small body size have been placed along the walls or between the bodies of adults, filling the spaces left empty after their deposition. Once more, numerous examples of multiple burials related to mortality crises show similar positioning of the bodies of children (Castex, Réveillas 2007). The characteristics of the disposition of the bodies seem, therefore, to show a desire to optimise the space available for the inhumations, which tends to support the hypothesis of bodies deposited over a relatively brief period of time.

Taphonomic evolution of cadaver strata

In order to define the pattern of the deposits more clearly, we have endeavoured to characterise the taphonomic changes of the deposits, not by studying each skeleton alone, but by assimilating the layers of bodies as stratigraphic entities. In other words, the morphological characteristics (thickness, profile, inclination) of each level of skeletons and the relations maintained between different levels were studied. To this end, altimetric data recorded during the excavations, as well as the 3-D reconstructions of the skeletons, were exploited and allowed new *a posteriori* observations.

This approach has drawn attention to certain anomalies of the profiles of the skeletal layers. At some levels of the burial fills, the layers adopt the shape of a basin, the bones of the thoraco-abdominal and pelvic regions resting at a level below that of the crania and the extremities of the lower limbs. Moreover, the incongruities noted in the skeleton layers, in numerous cases, reflect positions of skeletal remains counter to the physiological capacities of flexion of the articulations. Consequently, the situation of the skeletal remains cannot faithfully reflect the initial position of the bodies and the inclinations identified demonstrate, in all likelihood, the taphonomic alterations have affected the deposits. The basin profiles brought to light can justly be interpreted as resulting from "down-draught" generated by the body decomposition from the underlying layers.

This result argues for an interpretation for the synchronic decomposition of bodies belonging to different successive layers.

When considering the profiles of the different strata of the two chambers, which were thoroughly excavated in detail, certain hypotheses can be suggested about the pattern of their filling. In chamber X82 T18, the skeletons belonging to the first layers deposited show little or no inclination, which excludes *a priori* a synchronic decomposition of numerous juxtaposed individuals. On the contrary, the upper levels are characterised by clear basin effects, testifying to an accelerated rhythm of deposition during the final period of burial deposition. Conversely, the lower strata of grave X80 T16 show clear basin profiles, while the levels halfway up and above the final layer have flatter profiles. In the case of this grave, the deposits would have closely followed one another during the earlier period of use, becoming more widely spaced afterwards.

Spatial distribution of subjects according to age

A final important aspect to consider concerns the spatial distribution of the subjects according to certain biological criteria. A study of the age distribution of the individuals within the stratigraphic sequences permits discussion of the placement of individuals during the period of grave use.

In chamber X82 T18, the dead aged under 20 seem to have been distributed randomly throughout the different levels, the only exception being older adolescents which more frequently in the first phases of deposition. This result must be considered with prudence, however, as the very poor state of conservation of the skeletons found at the bottom of the profile rendered age estimation difficult, or impossible, based on criteria other than the robusticity of and bone dimensions. On the other hand, in chamber X80 T16 the distribution of immature individuals is not homogeneous throughout the different levels. Apart from one individual, all children identified as being under ten years of age at death were located in the earliest five levels of the deposits, where all the adolescents are also located (Figure 14). In the absence of significant rearrangements, involving the displacement of bones between different levels, this spatial distribution seems hardly compatible with the hypothesis of a collective grave, assembled over a long period. In this case, as time passed, the chambers, in theory, would have received deceased individuals at a rhythm of natural mortality and, consequently, immature subjects should be found in similar proportions throughout the levels. The

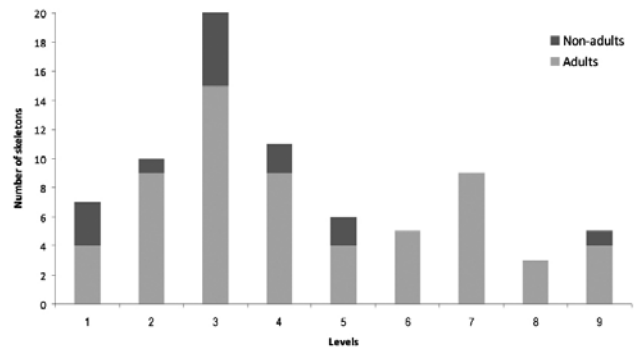


FIGURE 14. X80 T16: Distribution of individuals by age groups in each layer of skeletons. The level No. 1 is the lowest.

accumulation of young individuals in the earliest levels reflects more what would be expected in the case of deaths linked to an epidemic mortality crisis; certain age groups, particularly the youngest, are more likely to be affected earlier in such outbreaks (Castex 2008, 2009). In the case of several resurgences of the same epidemic, the groups of individuals dying at different times are thus apt to present different demographic profiles. Here, it is interesting to note that a large majority of the immature subjects found in grave X80 T16 belong to the levels which could correspond to the first phase of the filling of the chamber (cf. the paragraph on the 3-D reconstruction of body volumes). Such an interpretation could be posited for the Sts. Peter and Marcellinus catacomb, but this must be further supported by the results of palaeobiochemical analyses to detect the possible presence of DNA fragments for one or several pathogens.

CONCLUSIONS

Through several examples of archaeological plural burials, we have tried to illustrate the difficulties sometimes encountered by anthropologists when interpreting the simultaneity of deposits. Such a discussion is essential to answer questions raised in funerary archaeology and, more broadly, by historical discourse, to distinguish between successive funerary deposits made over a long time and deposits resulting from a mortality crisis. We sought to demonstrate more clearly the complexity of graves containing a large number of skeletons and, in particular, when their state of preservation permits only limited observation of the taphonomy of the cadavers. Many examples reported

here highlight the potential usefulness of some specific sources of information, other than archaeothanatological ones, in the differential diagnosis of collective and multiple graves. We presented the case of the catacomb of Sts. Peter and Marcellinus in greater detail because it is particularly representative of the problems encountered. The complexity of the skeletal assemblages recovered here led us to a critical assessment of the reliability of classic simultaneity arguments. In this case, in view of the limited number of observations concerning contact between skeletons, it would have been easy to conclude a strict contemporaneity in the cadaver deposits. The integration of diverse alternative approaches in the debate clearly demonstrates, in fact, a more complex situation. Although the organisation of the deposits and the reconstruction of the taphonomic changes of the various layers of cadavers reveal the deposition of numerous individuals over a short period of time, the reconstruction of the body volumes and their correlation with the dimensions of the burial chambers excludes the possibility of a strict contemporaneity in the deposition of these individuals in their totality. The arrangement of these burial chambers would seem to illustrate a relatively long working life, during which several episodes of simultaneous depositions succeeded one another.

The formulation of this hypothesis has required varied criteria, some of which only appeared pertinent to the interpretation of these deposits after excavation of the remains. For this reason, the importance of the methods chosen during the excavation to record the deposits must be emphasised. Without methodical and precise recording of the horizontal and vertical position of each skeletal element, it would have been impossible to evaluate the relationships between the different individuals *a posteriori*.

Without over-emphasising the usefulness of an archaeothanatological approach, the results of the present study emphasise the importance of a prudent interpretation of the results. Although these observations are indisputable in the case of graves containing well-preserved skeletons possessing multiple contacts with one another, the generalisation of occasional observations to entire deposits of plural burials containing fragmented skeletons introduces a potential interpretative bias. In this case, it seems indispensable to join certain alternative arguments, whose nature and pertinence must be evaluated case-by-case, to the archaeothanatological approach, according to the chronological context (funerary practices known elsewhere at the time under consideration) and the nature

of the site of inhumation (pit, cavity, funeral chamber) amongst other factors.

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Dominique Castex
Sacha Kacki
Géraldine Sachau-Carcel
Henri Duday
UMR 5199 – PACEA
Anthropologie des populations passées
et présentes
Université Bordeaux 1
Bâtiment B8
Avenue des Facultés
33405 Talence Cedex
France
E-mail: d.castex@pacea.u-bordeaux1.fr
E-mail: s.kacki@pacea.u-bordeaux1.fr
E-mail: g.sachau@wanadoo.fr
E-mail: h.duday@pacea.u-bordeaux1.fr

Hélène Réveillas
UMR 5199 – PACEA
Anthropologie des populations passées
et présentes
Université Bordeaux 1
Bâtiment B8
Avenue des Facultés
33405 Talence Cedex
France

Inrap
10 rue d'Altkirch
67100 Strasbourg
France
E-mail: helene.reveillas@inrap.fr

Isabelle Souquet-Leroy
UMR 5199 – PACEA
Anthropologie des populations passées
et présentes
Université Bordeaux 1
Bâtiment B8
Avenue des Facultés
33405 Talence Cedex
France

Inrap GSO
Base archéologique de Pessac
Centre d'activité "Les Echoppes"
156 avenue Jean Jaurès
33600 Pessac
France
E-mail: isabelle.souquet-leroy@inrap.fr

Frédérique Blaizot
UMR 5199 – PACEA
Anthropologie des populations passées
et présentes
Université Bordeaux 1
Bâtiment B8
Avenue des Facultés
33405 Talence Cedex
France

Inrap Rhône-Alpes-Auvergne
12-16 rue Louis Maggiorini
69500 Bron
France
E-mail: frederique.blaizot@inrap.fr

Philippe Blanchard
UMR 5199 – PACEA
Anthropologie des populations passées
et présentes
Université Bordeaux 1
Bâtiment B8
Avenue des Facultés
33405 Talence Cedex
France

INRAP CIF
Base archéologique INRAP Tours
148 avenue Maginot
37100 Tours
France
E-mail: philippe.blanchard@inrap.fr