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Palaeopathology and Archaeothanatology

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Introduction

Sir Marc Armand Ruffer (1859–1917)[1], the eminent physician and pioneer in palaeopathological mummy studies, defined palaeopathology as »the science of diseases which can be demonstrated in human and animal remains of ancient times«[2]. Palaeopathology uses methods and knowledge of medicine, biology (physical anthropology), and archaeology[3]. All these scientific disciplines can contribute to writing ›osteobiographies‹ (see below). Human remains are first class »biohistorical documents«, as the Austrian anthropologist Ämilian Kloiber (1910–1989) put it[4]. Human remains should be carefully studied, using all techniques available, while keeping ethical considerations firmly in mind[5], including repatriation[6] – where applicable.

The careful examination of human bones on different levels (see below) can reveal not only traces of pathological alterations, but can also locate fine traces caused by post-mortem body treatment. This will be an aspect of archaeothanatology.

Archaeothanatology – A Short Introduction

As early as the 18th and 19th centuries, burials were differentiated between inhumations and cremations. The famous watercolours by Isidor Engel from the prehistoric necropolis at the eponymous site Hallstatt in upper Austria are a wonderful example: Engel recorded the accumulations of cremated remains as well as the inhumations of the late Bronze and early Iron Age people of Hallstatt in the middle of the 19th century[7].

The position of the human corpse in inhumation burials was noted by the first archaeologists. Supine burials are often characteristic in the last two millennia, while burials in a flexed position are quite typical for several prehistoric cultures[8]. Prone burials are often interpreted as deviant[9].

Also, the position of the arms and hands as well as the position of the lower extremities were often routinely recorded[10].

The term ›archaeothanatology‹ was first introduced by the physician and physical anthropologist Henri Duday from the Université de Bordeaux in the late 1970s[11].

In an overview, published in 1990 together with colleagues from Bordeaux, he differentiated between primary, secondary, multiple, and collective burials[12]. With the term ›anthropologie de terrain‹ (field anthropology) he describes a methodology which documents and analyses the position of the skeletal remains and the taphonomy of the corpse.

1 Sandison 1967; Buikstra – Roberts 2012, 106–110 (reprint of Sandison 1967).
2 Ruffer 1913, 149.
3 For a global, but patchy history of palaeopathological research see Buikstra – Roberts 2012.
4 Kloiber 1957, 21.
5 Cf. Turner et al. 2018.
6 If called for by the respective community. For repatriation in the USA cf. Kakaliouras 2008 (with many references).
7 Cf. Pauli 1975, pl. 2 (burials 909–912).
8 Parker Pearson 1999.
9 E. g. Arcini 2009.
10 E. g. Kinne 2013, 64.
11 Duday 1978.
12 Duday et al. 1990; see also Duday 2012.

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He summarises his approach as follows: »The chronology of articulations dislocated during the decomposition of the body serves as a basis for demonstrating the nature and evolution of burials. It is the aim of field anthropology to reconstruct the original position of the body, the arrangement of any pieces of clothing, ornament or other furnishings. Furthermore, it is the field anthropologist who must define the architecture of the tomb and the precise nature and circumstances of decomposition. This requires the reconstruction of the burial itself in terms of the conditions surrounding the body, e. g. if it was directly covered by soil or surrounded by effective space, in order to identify effects these contribute to the position of skeletal remains. In addition, we discuss the criteria for the identification of secondary burials, consecutive burials and re-burials in the same tomb and specific methods for the analysis of multiple and collective burials.«[13]

Duday expanded his approach extensively in a book called »Archeotanatologia«, a series of lectures given at the École française de Rome in autumn 2004[14]. It was later translated into English[15] and has been widely cited in (funerary) archaeology[16].

The present state of archaeothanatology is outlined by Christopher J. Knüsel and Eline M. J. Schotsmans[17] from the Université de Bordeaux in the introduction to their »Routledge Handbook of Archaeothanatology«[18]. In German funerary archaeology, this field of research is underdeveloped. Only in the last decade has it received more attention. Of particular importance is the new cluster 3 »Body & Death« (Körper & Tod) of the German Archaeological Institute, headed by the prehistorian Alexander Gramsch (Frankfurt), the palaeopathologist Julia Gresky (Berlin), and the classical archaeologist Norbert Zimmermann (Rome).

The basis for an archaeothanatological analysis is a detailed documentation of the burial in the field, both with photographs (today Structure from Motion – SfM), drawings, and careful description. In particular Duday's drawings are very instructive and also have an aesthetic value.

In the context of the present paper, it has to be stressed that Duday and colleagues dedicated a sub-chapter to palaeopathology[19]. Pathological alterations like clump feet or paralyses leave traces in the position of the body in the grave.

Levels of Insight – Palaeopathological Analyses in the Field and in the Lab – And Casual Findings in Respect of Body Treatment

The *first level* is macroscopic investigation of skeletal remains. During the NekroPergEol project[20] all primary palaeopathological analyses were carried out ›in the field‹[21], which includes work in the excavation houses. This is quite different from lab work, where for instance reference skeletons, microscopes, and a library are available. Field work depends in particular on the experience of the researcher(s) involved. Field work includes recording all macroscopic and small-scale microscopic[22] observations of morphological data (including metrics) on special recording forms. For an adult individual, in the NekroPergEol project there are up to 22 recording forms[23], depending on the state of preservation.

On these forms, all data are recorded by hand. Later, these forms are scanned and transferred into

13 Duday et al. 1990, 29.
14 Duday 2006.
15 Duday 2009.
16 More than 800 citations in <https://scholar.google.com> in June 2024.
17 Knüsel – Schotsmans 2022a.
18 Knüsel – Schotsmans 2022b.
19 »Les informations d'ordre paléopathologique« (Duday et al. 1990, 42).
20 See the introduction by Felix Pirson and Stéphane Verger (in this volume).
21 See Teegen 2011a; Teegen 2011b; Teegen 2015; Teegen 2017; Teegen 2019.
22 Up to 10 ×.
23 General data include the preserved skeletal elements (1), general observations (1), sex (1) and age determination (1), skull (2) and postcranial measurements (5), and epigenetic traits (2). Palaeopathological data include alterations of the skull (1), teeth (3), postcranial skeleton (1), large (1) and small body joints (2), and spine (1). Recorded data correspond to the Global Health Code Book (see Appendix in Steckel et al. 2018). For infants and children specific forms are prepared and less forms are needed.

a database. The descriptions are supplemented by drawings and in particular, photos[24] – including those for Structure from Motion (SfM)[25]. This is the primary documentation on the first, macroscopic level.

Certain forms of body treatment can sometimes be observed while checking the bones for pathological alterations. This is true for cut marks and traces of defleshing on human bones. These traces resemble those on animal bones[26]. Sometimes, however, it is difficult to differentiate them from traces originating from the excavation process. Therefore, no iron tools should be used during excavation of a burial, only those made of organic materials[27]. Defleshing, with burying the flesh and intestines at the site of death[28], is a treatment well known from the European Middle Ages[29], when people of rank died away from their homeland. This was so typical for German speaking countries that it was called *a more teutonico* – »by German custom«. The cleaned bones of the deceased were then brought home and buried in the family tomb[30].

Recently, John Robb and co-workers have identified several traces of defleshing on bones of Neolithic people, buried in the Scaloria Cave in northern Apulia, Italy[31]. They have interpreted their findings as »cleaning the dead« before depositing their bones.

Sometimes, traces of resins and oils can be discovered on ancient bones. The custom to cover the body and/or the shroud with (precious) resins and oils is not only known from ancient Egypt or the Near East, but also from the late Roman west[32].

The *second level* is still on the macroscopic level, but gets insight into the structures themselves. It includes radiographs and CT scans. At Bergama it was possible to do X-rays at least, thanks to a local radiologist[33], while the nearest CT scanners were only available at several university hospitals in Izmir, a hundred kilometres away. Only recently, CT scans will be possible in the local hospital[34]. The number of features studied on each level gradually diminishes.

1 Pergamon, İlyas Tepe, main burial. Male, (55) 65–75 years. Marrow cavity of a femur fragment. Well visible are the tar-like carbon layers. Original magnification 5×. Scale 0.5 cm

The *third level* is the microscopic level, and includes histology and scanning electron microscopy[35] – but also microCT investigations. Michael Schultz has done light and scanning electron microscopic analyses of mostly Byzantine skeletons from Pergamon and other sites in Asia Minor[36]. For the NekroPergEol project they are in preparation.

Microscopic investigations of thin sections can also indicate special treatment of a corpse. This is the case with the élite burial from İlyas Tepe: Morphological inspection of the bones by the author revealed a black layer on several bones, possibly fungus induced[37]. Microscopic investigation by Michael Schultz and Jan Nováček showed, however, that carbon was distributed throughout the bone as well as in the marrow cavity[38]. A new low power microscopic inspection of the marrow cavity shows clearly a tar-like substance (fig. 1). This supports Schultz's hypotheses of a smoke conservation of a body on low heat. Conservation by smoke with its black carbon layers can be traced back to the early Neolithic at Çatal Hüyük[39].

24 See several examples in my paper (in this volume).
25 Cf. Teegen (in this volume), p. 259 fig. 23.
26 E. g. Merritt 2017, 130 fig. 12.
27 Knüsel – Robb 2016.
28 A famous example is German Emperor Frederick I Barbarossa (1122–1190) who drowned on the Third Crusade in the river Saleph/Göksu in southeastern Asia Minor. His intestines were buried in Tarsos, his flesh in Antiochia, and his bones presumably in the cathedral of Tyros.
29 Schäfer 1920.
30 An osteoarchaeological example from Germania Slavica: Teegen – Schultz 2012.
31 Robb et al. 2015.
32 E. g. Augusta Treverorum/Trier: Reifarth 2013; Reifarth et al. (in press). – Britain: Brettell et al. 2015.
33 The author is grateful to Dr. İdris Yavuzyilmaz, Bergama, for several X-rays.
34 Pers. comm. by Dr. Mehmet Baran Düzgün, Aliağa, September 2023.
35 See e. g. Schultz 2011; Stojanowski – Duncan 2017 (each with further references).
36 Schultz – Schmidt-Schultz 1991; Schultz – Schmidt-Schultz 1994.
37 Teegen 2011b, 147.
38 Schultz – Nováček 2011, 175 f.
39 Andrews et al. 2005.

Michael Schultz and Tyede Schmidt-Schultz observed a similar technique to the one used at Pergamon in archaic Miletos[40]. This kind of ›conservation technique‹ was presumably used when an eminent person died far from home and had to be buried at home.

Microscopic investigations of thin sections lead also to the discovery of mummification processes in Bronze Age Britain. In burials from northern[41] and southern Britain no tunnelling by microorganisms was observed and interpreted by the authors as conclusive for mummification.

The *fourth level* is the molecular level and includes isotope analyses (including radiocarbon dating)[42], palaeogenetics (including molecular palaeopathology)[43], and proteomics[44].

Regarding the NekroPergEol project, all of these analyses of the third and fourth level were (or will be) carried out in Germany (stable isotope analysis) and the Netherlands (radiocarbon dating). Since 2020, radiocarbon dating and stable isotope analyses are carried out at the Tübitak Isotope Laboratory in Gebze (Kocaeli)[45]. A pilot study on the palaeogenetics of skeletons from Pergamon is currently in progress, led by Mehmet Somel at Middle East Technical University at Ankara[46].

Osteo-Biography

A term first used by F. P. Saul in 1972, while analysing the Maya skeletons from the site Altar de los Sacrificios[47] in Mexico, is osteo-biography. Only the human remains are still the real ›mirror of life‹, while the question of »burials as mirrors of life«[48] is strongly contested[49]. In the last decade, the osteo-biographical approach has been flourishing[50].

Funerary Archaeology and Palaeopathology

The palaeopathological record should be seen in the funerary archaeological context. This is still a neglected field in funerary archaeology. It consists of several levels: 1) the deceased itself (see the contribution by William Van Andringa in this volume), 2) the burial container[51], 3) the reuse of the container, 4) the location of the burial, 5) the chronology, and 6) the social status.

1) The burial. The positions of the arms of the deceased could give some indications for the individual's body constitution. It could be cachectic, slender, or even obese. When the arms are lying parallel to the trunk a slender or cachectic person seems more likely than the contrary. When the arms are positioned in an angle of below 180°, the possibility that the person was obese should at least be taken into consideration. Measurements in the field at crucial points (breadth between shoulders, elbows, hip, knees and ankles) could be helpful for reconstructing the physical constitution of the deceased. In this context, the position of the skeleton and in particular the extremities (»gestes funéraires«) also have to be considered. Personal items like a belt can further contribute to a constitutional statement: the belt's length is clearly dependent on the body's circumference.

40 Schultz – Schmidt-Schultz 1991.
41 Booth et al. 2015.
42 Propstmeier et al. 2017 (stable isotopes); Teegen 2015 (radiocarbon dating). See also Teegen (in this volume) p. 249 fig. 1; Appendix 1, p. 260 f.
43 Palaeoproteomic work is still lacking for the Aiolis.
44 For pathogens: Schmidt-Schultz – Schultz 2015. – For milk consumption: Hendy et al. 2018.
45 Cf. Teegen – Doğan 2021; Teegen – Doğan 2022; Teegen – Doğan 2024.
46 First results from palaeogenomics for population genetics and molecular palaeopathology were presented by N. Ezgi Altınışık and Mehmet Somel in an internal meeting in May 2024.
47 Saul 1972; Saul 1976.
48 A well-known study by Alfred Haffner 1989 is paradigmatically called »Gräber – Spiegel des Lebens«.
49 Härke 2000.
50 Schultz 2011; Pfeiffer 2021 (with references).
51 This is highly status-dependent.

2) The container[52]. The dimensions of the deceased's container are often a mirror of its body height. Generally, infants and children are buried in much smaller containers than adults. Due to bad bone preservation or absence of bones in sarcophagi, their dimensions could be an important source for palaeodemography. This can be seen in another contribution in this volume regarding survey data from Aigai's necropolis[53].
3) The container's reuse. Free-standing sarcophagi were often used as places for the illegal disposing of other corpses, as can be concluded from ancient reports and laws[54]. A reuse has, however, also to be considered for other types of burials. This was demonstrated within the NekroPergEol project by radiocarbon dating for tombs from Aigai (cist burials)[55] and Elaia (rock cut tombs)[56]. In these cases it is more likely that one finds an individual of lower rank in a more elaborate tomb[57].
4) The location. The location of a burial is of eminent importance for its interpretation. At Pergamon, the monumental tumulus Yiğma Tepe, and the smaller Tumuli II and III, or İlyas Tepe, are at least in part visible from the city and the chora[58]. Due to their visibility they are important parts of the funerary landscape[59] of Pergamon[60].
   However, also when considered on a lesser scale, the position of the burial within a cemetery could have a particular significance. The six plus three burials in the circular building at the entrance to Aigai's main necropolis have a singular position[61]. Later, this was underlined by the construction of a circular building in late Hellenistic/early Roman times.
   From a palaeopathological point of view, pathologies should be checked against the location of the tomb, for example[62]. A separation from other burials due to an infectious disease could be possible, but, also other causes might also be evaluated.
   The location of a certain tomb can also be a sign for inclusion, exclusion or marginalisation in the cemetery population, and probably also in the contemporaneous society. Such a case is known from the late Byzantine cemetery in the ancient sanctuary of Egyptian Gods at Priene. The tomb of a young female is located at the margin of the cemetery[63]: She died presumably during giving birth to twins. Furthermore, she herself showed several malformations of the skull and the postcranial skeleton, which gave her a very particular physiognomy. In life, she was presumably very special, but also in death. These findings cannot be generalised, however, but should be considered for the cemetery studied.
5) The chronology is often neglected in palaeopathological studies[64]. Burials can often provide exact dating by careful analysis of the grave goods and/or scientific dating (e. g. radiocarbon dating). This should be considered more regularly in the future. Scientific dating can lead to deeper insights into the archaeological record. Funeral monument 7 of the Roman South-East necropolis at Pergamon shows this: The oldest radiocarbon dating goes back to late Hellenistic/Augustean times. Between the finds, a tiny fragment of an ACO beaker[65] was found. Firstly, it was classified as an intruding sherd. Knowing the date, it is probably the only remainder of the grave goods of the first inhumation[66].
6) The social status can sometimes be reconstructed by the burial container and the grave goods. The type of burial container, e. g. a sarcophagus, a stone cist or a funerary shaft in a grave monument, could give a first indication for social status: in these examples, it could indicate the person was of an elevated status[67]. The prestige character of a funeral monument could correspond with the social status, but a direct relationship is unclear and should be studied carefully[68].

52 See point 5 below.
53 See Teegen (in this volume), Appendix 2.
54 See Borg 2013, 146–152 for legal, and 153–157 for illegal reuse. Discussion of the topic also at the Sarcophagus Meeting in June 2018 at DAI Istanbul.
55 See Teegen (in this volume), Appendix 1.
56 See Teegen (in this volume).
57 This should be considered in the social interpretation e. g. of the pathological findings.
58 For details see the contribution by Felix Pirson on funeral landscapes (in this volume).
59 Daróczi 2012.
60 Pirson – Ludwig 2024.
61 See Teegen (in this volume), Appendix 1.
62 The same should be done with points 1–2) and 4–6).
63 Teegen 2011a.
64 Often, quite large dating spans are used, e. g. 1st to 4th cent. AD (cf. Bourbou 2018, tab. 7.1).
65 Pers. comm. by Sarah Japp, Berlin.
66 Teegen 2015.
67 In the social interpretation of palaeopathological and other data from sarcophagus burials, illegal deposition of corpses and reuse (see part 3) should at least be taken into consideration.
68 Pers. comm. by Felix Pirson, DAI Istanbul (June 2022).

Probably an elevated social status could better be reconstructed by osteoarchaeological analyses (e. g. a low degree of physical stress). Stable isotope analyses for diet reconstruction can provide (additional) data. A high degree of protein consumption in the form of animal protein (terrestrial and/or marine) is often linked to an elevated social position[69].

Conclusions

Palaeopathology and archaeothanatology are often related in funerary archaeology due to the fact that, for example, low power microscopic examination of bone surfaces will reveal not only traces of pathological alterations but also of (post mortem) manipulations. Four different levels of insight allow views from different perspectives on the pathologically altered bone. First level: macroscopy and low power microscopy, second level: radiology, third level: microscopy and SEM, fourth level: molecular, regarding both stable isotope as well as DNA investigations, including genomics. Microscopy also allows different insights into post mortem manipulation of the body, e. g. by tracing cutting and/or de-fleshing.

The palaeopathological record should be seen in the funerary archaeological and, therefore, in an archaeothanatological context. This is still a quite neglected field in funerary archaeology – and in palaeopathology as well. It consists of several levels. First level: the deceased itself, second level: the burial container, third level: the reuse of the container, fourth level: the location of the burial, fifth level: the chronology, and sixth level: the social status of the deceased.

Abstract

Palaeopathology and archaeothanatology are often related due to the fact that, for example, low power microscopic examination of bone surfaces will reveal not only traces of pathological alterations but also of (post mortem) manipulations. Four different levels of insight allow views from different perspectives on the pathologically altered bone. First level: macroscopy and low power microscopy, second level: radiology, third level: microscopy and SEM, fourth level: molecular. This also allows different insights into post mortem manipulation of the body.

The palaeopathological record should be seen in the funerary archaeological context. This is still a quite neglected field in funerary archaeology. It consists of several levels: 1) the deceased itself, 2) the burial container, 3) the reuse of the container, 4) the location of the burial, 5) the chronology, and 6) the social status.

Keywords: Anthropology, Archaeothanatology, Palaeopathology, Taphonomy

Illustration Credits

Fig. 1 W.-R. Teegen, LMU Munich

69 Purcell 2003 (meat); Wilkins 1993 (fish). For the Roman empire in general see Erdkamp – Holleran 2018. For general remarks on the results of stable isotope analyses in the NekroPergEol project see the contribution by Wolf-Rüdiger Teegen (in this volume).