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CUTS ON HUMAN BONES PRODUCED BY METAL IMPLEMENTS

ABSTRACT: The intention here is not to catalogue the evidence for metal induced cuts on human bone but to describe the nature of the cuts. Cuts and cut marks produced by the same type of instrument, before death (healed), at the time of death and after death will be examined.

KEY WORDS: Perimortal cuts – Post-mortem bone damage – Sword cuts – Trephination – Defleshing.

It seems useful to document the nature of cuts on human bone that have been made by a metal weapon or instrument. The most distinctive cuts that are generated by metal blades are sustained around the time of death. The edge and strength of the metal blade gives it a penetrating power, lacked by a stone edge, that can cut right through the bone or shave off a thin slice. Serious injury can be inflicted and often proves fatal. Cuts can be determined as having been acquired around the time of death, some time before death when there are signs of healing and a considerable time after death. It is not usually possible, however, to distinguish between a fatal injury and cuts applied immediately after death.

PERIMORTAL CUTS

These are almost invariably made by the blade of a sword or an axe sharpened on both sides and operated with a chopping or slicing action. Death supervenes immediately after or shortly before the cut was inflicted so that no healing process was initiated.

A few examples, involving the skull, the vertebrae and the limb-bones should serve to illustrate the features of blade cuts on membrane, trabecular and cortical bone. Saw and drill cuts are also noted.

The dramatic sword cuts on the skull of a Romano-British soldier from Standwick are clean edged, straight and have penetrated the outer table, diploe and inner table of the cranial bone. That a complete roundel of bone can be removed as a slice by a steel blade is demonstrated by the cut on the frontal, and the effect of a glancing blow which has shaved the surface is seen immediately below (*Figure 1*). It is doubtful if flint or metal inferior in hardness to tempered steel could achieve dissection of this precision. Often the plane of the cut is slightly curved where the blade has scooped the bone, and where the blade has dug into the bone there is chipping and splintering at the limits of the cut. A blade used with a chopping action at right angles to the surface of the bone produced narrow, parallel sided cuts as seen in the cut above the eye. This blade cuts may be

1. a shallow, smooth, regular concavity,
2. acutely asymmetrical with one long plane side and a sharply angled rough side,
3. parallel sided cuts.

Fatal injuries about the face and head of the Pharoah Seqeneuré from the Seventeenth dynasty must be some of the earliest, undoubtedly inflicted by a metal instrument. This is at a time when only bronze, a soft metal, was being worked and it is perhaps significant that the wounds were made by a spear (Bietak & Strouhal 1974). The spear head, operated with propulsive force, was able to penetrate the thin facial bones whereas it is unlikely that a bronze knife could achieve this. The wounds are asymmetrical, short and gaping and contrast with the slicing cuts of steel weapons, but can be compared with the blows induced with a stone-headed axe described by Courville (1967).

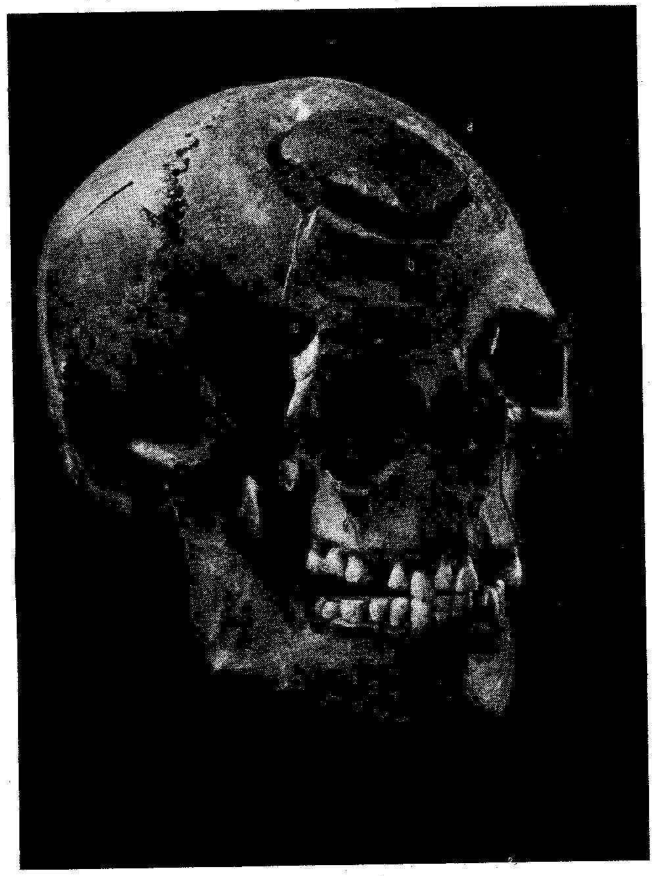

FIGURE l. *A skull of the Romano-British period from Standwick, Yorkshire, displaying sword cuts.*
a) a roundel of bone sliced from the frontal,
b) a thin layer of bone shaved from the forehead,
c) parallel-sided chopping cuts along the brow.

Chop marks, most likely the work of an axe on the cervical vertebrae and rib of a decapitation burial from Poundbury, show the same clean straight edge and flat plane as the blade cuts (*Figure 2*). In other examples of decapitations preliminary superficial cuts close to the main and functional cut have been noted (Harman et al. 1981). Chop marks, whether inflicted by a sword or axe are more likely than slicing cuts to result in splintering or chipping at the end of the cut, when the blade is twisted before removing it from the body. In the above case the trabecular bone of the cervical vertebra is cut cleanly, the edges of the bone are smooth and there is no sign of ripping. The hard, sharp edge of steel does not respond to changes in bone texture or density.

Knife cuts of scalping have been shown by Hamperl & Laughlin (1959) to cut the bone only superficially and can be contrasted with defleshing cuts produced by a non-metal (flint?) implement described by Cook (1988). Stone and metal knife scratch marks are macroscopically very similar and can only be differentiated, if at all, with difficulty.

The surgical cuts on the limb-bones of a foetus from Poundbury were presumably produced by a knife in the performance of an embryotomy since this instrument is advocated for the operation by Soranus (Molleson &

FIGURE 2. *Axe cuts on neck vertebra and rib of a decapitation burial from Romano-British cemetery at Poundbury, Dorset, England.*
a) a thin slice of bone has been shaved from the angle of the right rib,
b) the trabecular bone of the vertebral process is severed cleanly and contrasts with
c) post-mortem irregular damage to the vertebral body.

Cox 1988). The cuts to cervical vertebra, hip bone and femur are surprisingly clean and sever the bone without change of angle (*Figure 3*). This case also illustrates the contrasting ragged and uneven break-line of a natural fracture seen in the humerus (*Figure 3*, left side). Only in brittle bone disease (osteopetrosis) are clean sided breaks seen on fresh bone.

Knife cuts produced during cranial trephination can be straight-sided, intersecting at the corners of a square fenestration. Various types of trepanation cuts have been described and illustrated in detail by Margetts (1967) and by Brothwell et al. (1978). Trephinations should provide an excellent opportunity to compare the characters of different types of instruments, both metal and stone, since the operation has a long history, extending to before the use of metal (Lisowski 1967). Those made with a stone implement often have a shaved appearance and low angle bevel. The operation seems to have been quite common in Neolithic times and there is an impressively high proportion of healed to unhealed examples.

The Amesbury barrow 51 trephination of a robust adult male from the Beaker period (second millenium BC) has been described in detail by Brothwell et al. (1978). The margins left by the removal of a large roundel of bone (diameter 10-11 cms), from the back of the skull, are smooth and there are few cut-marks that extend beyond the immediate margins of the circular incision. This implies the use of well sharpened tools. The roundel was separated from the cranial vault by the gradual development of a circular V-shaped groove - a "push-plough" method of trephination first described by Parry (1923, 1931). Whether this trephination or that of a very similar one from Crichel Down (Brothwell 1967) were executed with a flint point or a bronze knife-dagger has not been determined and Brothwell draws attention

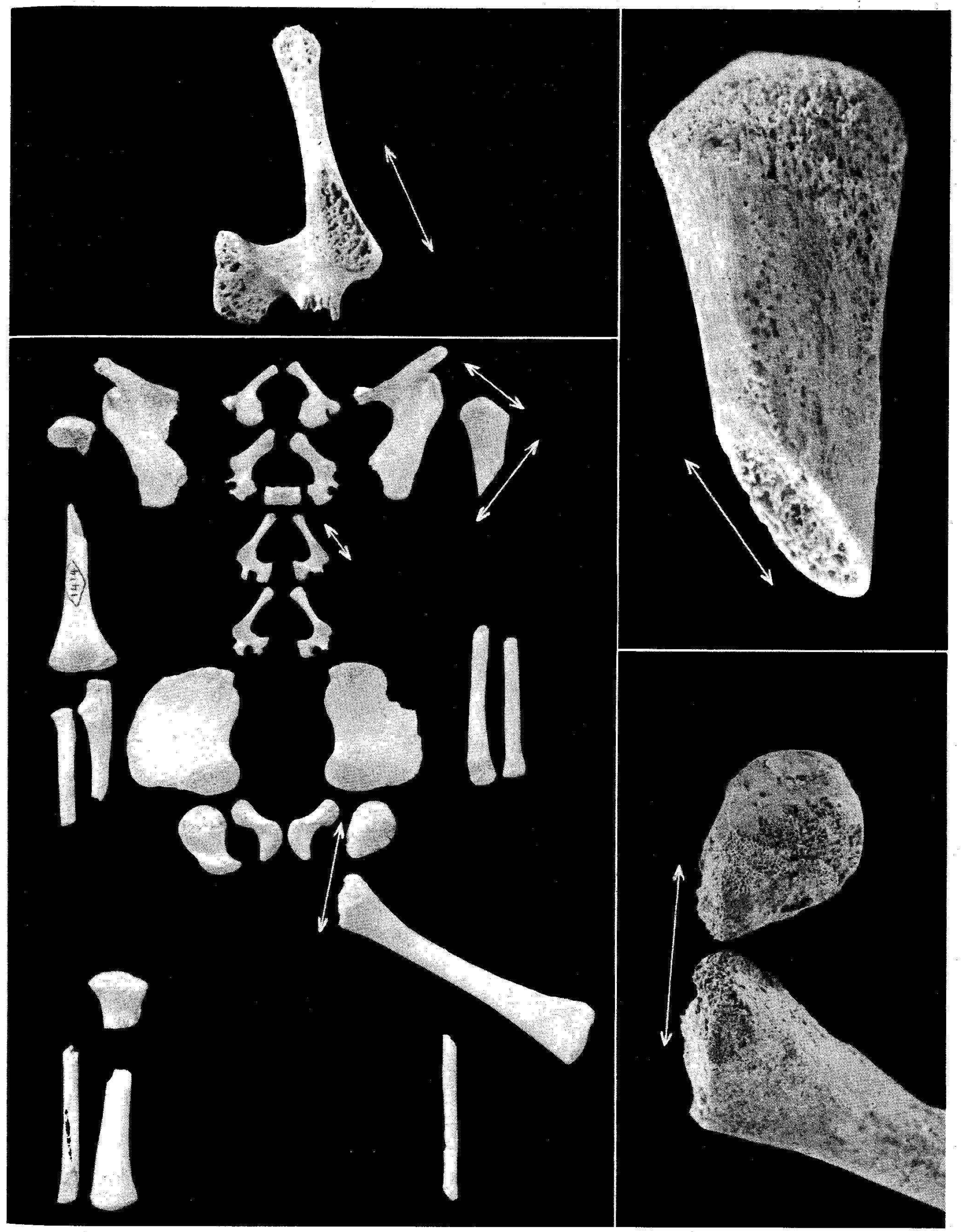

PLATE 3. *Surgical knife cuts on the bone of a foetus from Poundbury cemetery, 4th century. Arrows indicate the straight cuts to vertebra, ilium, humerus and femur and can be contrasted with the natural and probably contemporary fracture of the right humerus.*

to the continuity of surgical technique applied to these operations from Neolithic through to Anglo-Saxon times. Specialist instruments were developed by Roman times.

The effects of cranial trephination using a metal modiolus have been observed on a skull from the Romano-British period and described by Brothwell (1974). The cut is circular with a centrally placed drill hole and, in this case, does not penetrate the bone, perhaps because death intervened. There is no sign of healing and the surface of the bone is described as being smoothly scored.

Saw cuts created on several eighteenth century autopsy cases, recovered from the crypt of Christ Church, Spitalfields had the least regular edge but can be contrasted with the huge trephine on a Neolithic skull from Nordhausen, Germany, described by Ullrich (1964) (*Figure 4*).

FIGURE 4. *Saw cuts on an autopsied skull from Christ Church,, Spitalfields, Eighteenth century. The line of the straight bladed, hand-operated saw can be followed as a series of connecting straight cuts and contrasts with the natural fracture at the back of the skull where the vault was broken off.*

The perforation in cranial bone created by a nineteenth century bullet, from a pistol, is seen in *Figure 5*. The hole is oval, indicating that the angle of entry of the cylindrical bullet was not perpendicular to the surface of the bone. Assuming that the suicide case was right handed and held the pistol slightly forward of his temple, the bone around the perforation is chipped from the outer table of the skull, where the angle of impact was acute, and from the inner table where the angle of impact was obtuse.

HEALED CUTS

The original surface of a cut is altered by healing processes and postmortem degradation. In a glancing cut where the periosteum has been removed exposing the diploe, the area of bone that is deprived of regenerating cells dies leaving a necrotic area of uneven texture surrounded by a smooth cut surface. If the victim

FIGURE 5. *Entry perforation produced by metal bullet fired by a pistol. Christ Church, Spitalfields, CAS 2910.*

survives, healing takes place from this peripheral area. The surface is softened and the sharp distinction between cortical and diploic bone is blurred as new bone is deposited. Many examples of well-healed trephinations (Margetts 1967, Lisowski 1967, Brothwell et al. 1978) and sword cuts have been documented (Molleson 1988). *Figure 6* illustrates initial healing of head injuries sustained by a soldier of the Roman period from Nubia. The healing of the cut to the top of the skull is far advanced and must have been acquired some time before that above the eye (Smith & Derry 1910). This later cut shows, too, the way bone chips in fracturing when levered out of position.

Fully healed cuts will eventually become virtually obliterated by the remodelling process of bone. In the case of a hand amputation from medieval Winchester the severed bone and exposed medulla have been sealed by the growth of new bone. Such repair cannot be confused with post-mortem damage (Molleson 1988).

POST-MORTEM DAMAGE

Damage to fresh bone sustained immediately after death cannot by its nature be distinguished from fatal injury although it may be from its distribution and context. Brothwell (1971) and Marien (1975) have both described the osteological evidence for massacre to be seen in the rampant cuts inflicted to all parts of the skeleton. The marks of defleshing, in contrast, are uncommon presumably because in skilled hands, the bone is seldom damaged. Stone implement induced marks of defleshing have been noted on a humerus bone from Neolithic Tell abu Huyrera (*Figure 7*) and described by Gieseler (1953) and Cook (1988), while the conflict over whether the Engis skull shows signs of defleshing (Russell & LeMort 1986) or damage due to repeated measurement with metal instruments (White & Toth 1988), highlights the difficulty of distinguishing between cutting agents when the damage is superficial.

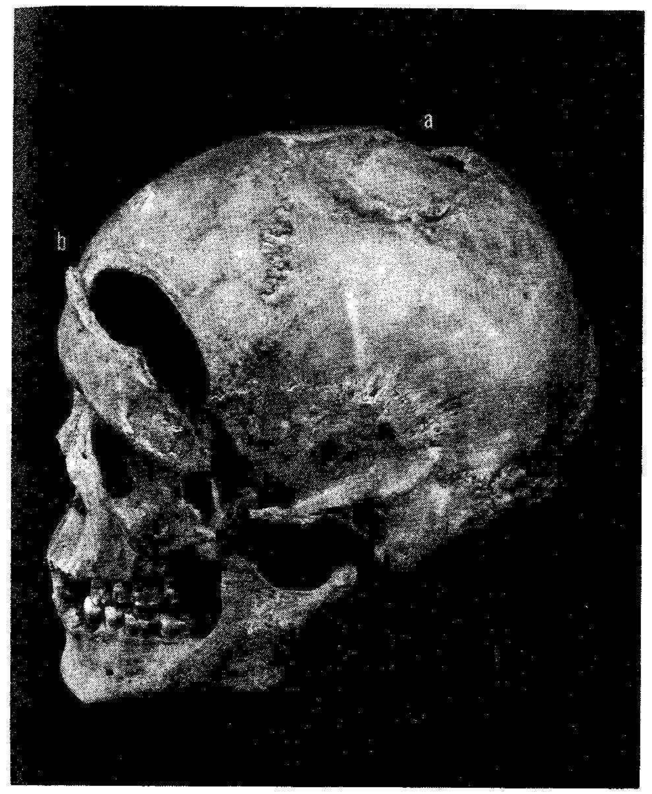

FIGURE 6. *Partly healed sword cuts on the skull of soldier from Nubia, Roman period.*
a) the piece of bone severed from the top of the skull has reunited in a well healed injury. Compare with Figure 1.
b) the edges of the cut above the eye show signs of healing.

FIGURE 7. *Defleshing cuts produced by a non-metal implement on the humerus of a juvenile from Tel abu Hareyra, Syria. Neolithic.*

Certain perforations of bone can also be confusing and have occasionally led to errors of interpretation. Pseudo-trephines due to post-mortem damage or rodent gnawing have been described by Brothwell et al. (1978). The breaks lack the directional continuity or bevelled angle of a metal cut, while gnawing produces an irregular corrugated surface.

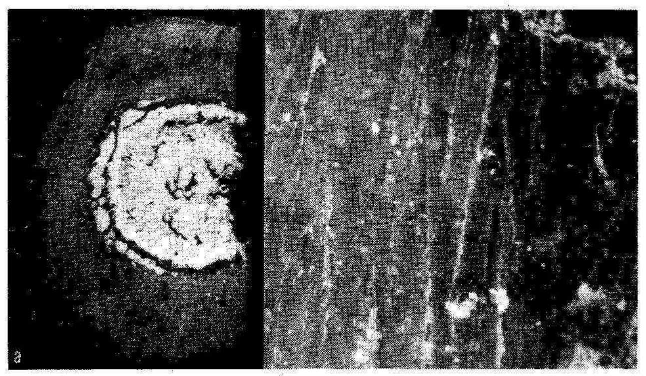

FIGURE 8. *Electric saw cut marks on the surface of a section of excavated bone. Spitalfields. a) × 3, b) × 20.*

Excavation damage to bone due to trawelling or spade work require only that the irregular edge and high angle be pointed out, while, for completeness, the marks of a band saw on an excavated femur sectioned in the laboratory are illustrated in *Figure 8*. Excavated bone tends to be both more brittle and more friable than fresh and only a powerful and sharp cutting edge will overcome the tendency of the bone to fragment.

COMMENTARY

The advent of hardened steel opened up the range of injuries that could be sustained by human beings. Cuts that can be attributed to bronze weapons are few, although some are recorded from Egypt and possibly the trephine on the Bronze Age skull from Crichel Down, England (Brothwell 1967, 430).

From the Iron Age, metal weapons came to be used in violence, in ritual and in surgery giving the distinctive long smooth slices that could shave a fraction of a millimetre from a rib (*Figure 2*) or penetrate clean through skull (*Figure 1*) or limb bone (*Figure 3*).

The ultimate metal defect is seen in the bullet hole in the skull of a suicide case from a nineteenth century London burial (*Figure 5*). That its significance went unappreciated by excavators, anthropologists and pathologists, until a copy of the death certificate had been obtained (Cox et al. 1990) emphasises the difficulty of recognizing the true nature of cuts on human bone.

REFERENCES

BIETAK M., STROUHAL E., 1974: Die Todesumstände des Pharaos Seqeneuré (17. Dynastie). *Ann. Naturhistor. Mus. Wien* 78: 29-52.
BROTHWELL D., 1967: Major congenital anomalies of the skeleton: evidence from earlier populations. In: *Diseases in Antiquity*. Eds. Brothwell D. & Sandison A.T. pp. 423-443. Charles Thomas.
BROTHWELL D. R., 1971: Forensic aspects of the so-called Neolithic skeleton Q1 from Maiden Castle, Dorset. *World Archaeology* 3: 233-241.
BROTHWELL D. R., 1974: Osteological evidence of the use of a surgical modiolus in a Romano-British population: an aspect of primitive technology. *J1 Archaeol. Sci.* 1: 209-212.
BROTHWELL D., POWERS R., DENSTON B., 1978: The human skeletal remains from Amesbury

barrow 51 with special reference to the case of trephination and its position in the history of trephining in Britain. In: Ashbee P. Amesbury Barrow 51: Excavation 1960. *The Wiltsh. Archaeol. Mag.* 70/71: 1-60.

COOK J., 1988: Cut marks on human bones from Gough's Cave, Somerset. *Abstracts of the 12th ICAES Zagreb* Vol. 12, 343.

COURVILLE C. B., 1967: Cranial injuries in Prehistoric Man. In: Diseases in Antiquity, Eds. Brothwell D. & Sandison A.T. pp. 606-622. Charles Thomas.

COX M., MOLLESON T. I., WALDRON A., 1990: *Jl Archaeol. Sci.*, 17: 573.

GIESELER W., 1953: Das jungpaläolithische Skelett von Neuessing. *Aus der Heimat* 61, 7/6: 161-176.

HAMPERL H., LAUGHLIN W. S. 1959: Osteological consequences of scalping. *Hum. Biol.* 31: 80.

HARMAN M., MOLLESON T. I., PRICE J. L., 1981: Burials, bodies and beheadings in Romano-British and Anglo-Saxon cemeteries. *Bull. Br. Mus.* (*Nat. Hist.*) 35: 145-188.

LISOWSKI F. P., 1967: Prehistoric and early historic trepanation. In: *Diseases in Antiquity*, Eds. Brothwell D. & Sandison A.T. pp. 651-672. Charles Thomas.

MARGETTS E. I., 1967: Trepanation of the skull by the Medicine-men of Primitive Cultures, with Particular Reference to Present-day Native East African Practice. In: *Diseases in Antiquity*, Eds. Brothwell D. & Sandison A.T. pp. 673-701. Charles Thomas.

MARIEN M. E., 1975: Massacre et sacrifice humain: deux cas d'interprétation. *Actes Symp. Intern. ser. les religions de la préhistoire*, 253-261.

MOLLESON T., 1988: Urban bones: The skeletal evidence for environmental change. *Actes 3^{emes} Journées Anthrop.* No. 24 CNRS: *143-158.*

MOLLESON T., COX M., 1988: A Neonate with cut bones from Poundbury Camp, 4th century AD, England. *Bull. Soc. Roy. Belge Anthrop. Préhist.* 99: 153-159.

PARRY T. W., 1923: The collective evidence of trephination of the human skull in Great Britain during prehistoric times. *Proc. Third Internat. Cong. Hist. Med.*: 135-141.

PARRY T. W., 1931: Über die Schädelhöhlenöffnung am Lebenden Menschen in der prähistorischen Zeit. *Medizinischen Welt* 5: 1-12.

RUSSELL M. D., LE MORT F., 1986: Cutmarks on the Engis 2 calvaria? *Am. J. phys. Anthrop.* 69: 317-324.

SMITH D. E., DERRY D. E., 1910: Anatomical Report. *Bull. Archaeol. Surv. Nubia* 6: 9-30.

ULLRICH H., 1964: Eine ungewöhnlich grosse Trepanation aus dem Neolithikum Mitteldeutschlands. *Varia archaeologica* 16: 55-61.

WHITE T. D., TOTH N., 1988: Engis Defleshing: a refutation of Russell and Le Mort. *Abstracts 12th ICAES, Zagreb* Vol. 12: 364.

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