



This is a repository copy of *Faunal remains*.

White Rose Research Online URL for this paper:
<http://eprints.whiterose.ac.uk/169068/>

Version: Published Version

Book Section:

Halstead, P. orcid.org/0000-0002-3347-0637 (2020) Faunal remains. In: Wright, J.C. and Dabney, M.K., (eds.) *The Mycenaean Settlement on Tsoungiza Hill. Nemea Valley Archaeological Project (III)*. American School of Classical Studies at Athens, Princeton, New Jersey, pp. 1077-1158. ISBN 9780876619247

Copyright © 2020 American School of Classical Studies at Athens, originally published in *The Mycenaean Settlement on Tsoungiza Hill (Nemea Valley Archaeological Project III)*, by James C. Wright and Mary K. Dabney. This offprint is supplied for personal, noncommercial use only.

Reuse

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.



eprints@whiterose.ac.uk
<https://eprints.whiterose.ac.uk/>

NEMEA VALLEY
ARCHAEOLOGICAL PROJECT

VOLUME III



THE MYCENAEAN SETTLEMENT
ON TSOUNGIZA HILL

Copyright © 2020 American School of Classical Studies at Athens, originally published in *The Mycenaean Settlement on Tsoungiza Hill (Nemea Valley Archaeological Project III)*, by James C. Wright and Mary K. Dabney. This offprint is supplied for personal, noncommercial use only.

NEMEA VALLEY ARCHAEOLOGICAL PROJECT

VOLUME III

THE MYCENAEAN SETTLEMENT ON TSOUNGIZA HILL

PART 2: SPECIALIST STUDIES

BY

JAMES C. WRIGHT AND MARY K. DABNEY

With contributions by

Phoebe Acheson, Susan E. Allen, Kathleen M. Forste, Paul Halstead,
S. M. A. Hoffmann, Anna Karabatsoli, Konstantina Kaza-Papageorgiou,
Bartłomiej Lis, Rebecca Mersereau, Hans Mommsen, Jeremy B. Rutter,
Tatiana Theodoropoulou, and Jonathan E. Tomlinson



AMERICAN SCHOOL OF CLASSICAL STUDIES AT ATHENS
PRINCETON, NEW JERSEY

2020

*Publication of this book has been aided by
the Publications Fund and the Alwin C. Carus,
Elizabeth Carus, and Christine Carus Fund of the
Department of Classical & Near Eastern Archaeology,
Bryn Mawr College*

© AMERICAN SCHOOL OF CLASSICAL STUDIES AT ATHENS, 2020

Library of Congress Cataloging-in-Publication Data

Names: Wright, James C., 1946– author. | Dabney, Mary K., 1954– author.
Title: The Mycenaean settlement on Tsoungiza Hill / by James C. Wright and
Mary K. Dabney ; with contributions by Phoebe Acheson, Susan E. Allen, Kath-
leen M. Forste, Paul Halstead, S. M. A. Hoffmann, Anna Karabatsoli, Konstan-
tina Kaza-Papageorgiou, Bartłomiej Lis, Rebecca Mersereau, Hans Mommsen,
Jeremy B. Rutter, Tatiana Theodoropoulou, and Jonathan E. Tomlinson.
Description: Princeton, New Jersey : American School of Classical Studies at Ath-
ens, 2020. | Series: Nemea Valley Archaeological Project ; Volume 3 | Includes
bibliographical references and index.
Identifiers: LCCN 2019036328 | ISBN 978-0-87661-924-7 (cloth)
Subjects: LCSH: Mycenae (Extinct city) | Civilization, Mycenaean. | Nemea Region
(Greece)—Antiquities. | Greece—Antiquities. | Bronze age—Greece—Nemea
Region. | Excavations (Archaeology)—Greece—Nemea Region. | Nemea Val-
ley Archaeological Project.
Classification: LCC DF221.M9 W75 2020 | DDC 938/.7—dc23
LC record available at <https://lcn.loc.gov/2019036328>

CONTENTS

LIST OF ILLUSTRATIONS	ix
LIST OF TABLES	xxi
BIBLIOGRAPHY AND ABBREVIATIONS	xxv

PART 1: CONTEXT STUDIES

1. INTRODUCTION <i>by Mary K. Dabney and James C. Wright</i>	3
2. TOPOGRAPHY <i>by James C. Wright</i>	29
3. SURFACE POTTERY <i>by Phoebe Acheson</i>	45
4. PHASES OF OCCUPATION <i>by Mary K. Dabney and James C. Wright</i>	85
5. DESCRIPTION OF EXCAVATIONS AND FINDS <i>by Mary K. Dabney and James C. Wright, with a contribution by Konstantina Kaza-Papageorgiou</i>	89
6. THE EXCAVATIONS ON TSOUNGIZA IN 1926–1927 CONDUCTED BY JAMES PENROSE HARLAND <i>by James C. Wright and Mary K. Dabney</i>	303
7. CONCLUSIONS <i>by Mary K. Dabney and James C. Wright</i>	347

PART 2: SPECIALIST STUDIES

8. BUILDING MATERIALS AND TECHNIQUES <i>by Rebecca Mersereau</i>	373
9. MIDDLE HELLADIC III–LATE HELLADIC II POTTERY GROUPS <i>by Jeremy B. Rutter</i>	473
10. INSTRUMENTAL NEUTRON ACTIVATION ANALYSES <i>Procedures, Analysis, and Initial Commentary, by S. M. A. Hoffman and Jonathan E. Tomlinson</i> <i>Evaluation with Bonn Statistical Program, by Hans Mommsen</i> <i>Final Commentary and Conclusions, by Jeremy B. Rutter</i>	819
11. LATE BRONZE AGE COOKING VESSELS <i>by Bartłomiej Lis</i>	853
12. CHIPPED STONE PRODUCTION <i>by Anna Karabatsoli</i>	901
13. GROUND STONE TOOLS <i>by James C. Wright</i>	967
14. TOOLS, WEAPONS, FIGURINES, AND PERSONAL ORNAMENTS <i>by Mary K. Dabney and James C. Wright</i>	1023
15. ARCHAEOBOTANICAL REMAINS <i>by Susan E. Allen and Kathleen M. Forste</i>	1029
16. AQUATIC FAUNAL REMAINS <i>by Tatiana Theodoropoulou</i>	1063
17. FAUNAL REMAINS <i>by Paul Halstead</i>	1077
CONCORDANCE OF STRATIGRAPHIC UNITS	1159
CONCORDANCE OF NVAP INVENTORY NUMBERS AND CATALOGUE NUMBERS	1173
GENERAL INDEX	1183

BIBLIOGRAPHY AND ABBREVIATIONS

- Adam, W. 1960. *Faune de Belgique: Mollusques I. Mollusques terrestres et dulcicoles*, Brussels.
- Adams, J. 2014. *Ground-Stone Analysis: A Technological Approach*, 2nd ed., Salt Lake City.
- Agora = *The Athenian Agora: Results of Excavations Conducted by the American School of Classical Studies at Athens*, Princeton
- XII = B. A. Sparkes and L. Talcott, *Black and Plain Pottery of the 6th, 5th, and 4th Centuries B.C.*, 1970.
- XIII = S. A. Immerwahr, *The Neolithic and Bronze Ages*, 1971.
- Åkerström, Å. 1968. "A Mycenaean Potter's Factory at Berbati near Mycenae," in *Atti e memorie del primo Congresso internazionale di Micenologia (Incunabula Graeca 25)*, Rome, pp. 48–53.
- . 1987. *Berbat 2: The Pictorial Pottery*, Stockholm.
- Alden, M. 2000. *Well Built Mycenae: The Helleno-British Excavations within the Citadel at Mycenae, 1959–1969 7: The Prehistoric Cemetery*, Oxford.
- Allen, S. E. 2005. "A Living Landscape: The Palaeoethnobotany of Sovjan, Albania" (diss. Boston Univ.).
- . In press. "Landscape, Vegetation, and Plant Use at the Bonjakët Sanctuary: Macrobotanical Remains from Illyrian Apollonia," in *A Sanctuary in the Hora of Illyrian Apollonia: Excavations at the Bonjakët Site (2004–2006)*, ed. J. L. Davis, I. Pojani, V. Dimo, and S. Stocker, London, pp. 127–139.
- Alt-Ägina* = *Alt-Ägina*, Mainz.
- III = H. Walter and F. Felten, *Die vorgeschichtliche Stadt*, 1981.
- IV.1 = S. Hiller, *Mykenische Keramik*, 1975.
- IV.2 = H. B. Siedentopf, *Matbemalete Keramik der Mittleren Bronzezeit*, 1991.
- IV.3 = I. Kilian-Dirlmeier, *Das mittelbronzezeitliche Schachtgrab von Ägina*, 1997.
- Anderson, P. C., and M.-L. Inizan. 1994. "Utilisation du tribulum au début du III^e millénaire: Des lames 'cananéennes' lustrées à Kutan (Ninive V) dans la région de Mossoul en Iraq," *Paléorient* 20, pp. 85–103.
- Aravantinos, V., and A. Vasilogamvrou. 2012. "The First Linear B Documents from Ayios Vasileios (Laconia)," in *Études mycéniennes 2010. Actes du XIII^e Colloque international sur les textes égéens, Sèvres, Paris, Nanterre, 20–23 septembre 2010*, ed. P. Carlier, C. de Lamberterie, M. Egetmeyer, N. Guilleux, F. Rougemont, and J. Zurbach, Pisa, pp. 41–54.
- Aschenbrenner, S. E. 1992. "Late Helladic Settlement: Stratigraphy and Architecture. The SE Quadrant," in McDonald and Wilkie 1992, pp. 433–443.
- Ash, S. 1992. "A Provenance Study of 173 Samples Thought to Originate from Aegina" (3rd year project for BSc degree, Univ. of Manchester).
- Asouti, E. 2003. "Wood Charcoal from Santorini (Thera): New Evidence for Climate, Vegetation, and Timber Imports in the Bronze Age," *Antiquity* 77, pp. 471–484.
- Åström, P. 1977. *The Cuirass Tomb and Other Finds at Dendra (SIMA 4)*, Göteborg.
- Åström, P., and D. S. Reese. 1990. "Triton Shells in East Mediterranean Cults," *JPR* 4, pp. 3–4, 5–14.
- Atherden, M., J. Hall, and J. C. Wright. 1993. "A Pollen Diagram from the Northeast Peloponnesos, Greece: Implications for Vegetation History and Archaeology," *The Holocene* 3, pp. 351–356.
- Atkinson, T. D., R. C. Bosanquet, C. C. Edgar, A. J. Evans, D. G. Hogarth, D. Mackenzie, C. Smith, and F. B. Welch. 1904. *Excavations at Phylakopi in Melos Conducted by the British School at Athens*, London.
- Avila, R. A. J. 1983. *Bronzene Lanzen- und Pfeilspitzen der griechischen Spätbronzezeit (Prähistorische Bronzefunde 5.1)*, Munich.
- Bachelard, G. 1964. *The Poetics of Space*, trans. M. Jolas, New York.
- Baker, J., and D. Brothwell. 1980. *Animal Diseases in Archaeology (Studies in Archaeological Science)*, New York.
- Banks, E. C. 1967. "The Early and Middle Helladic Small Objects from Lerna" (diss. Univ. of Cincinnati).
- Banks, E. C., with R. Janko. 2008. "The Middle Helladic Small Finds, Including the Linear A Inscription," in Taylor and Janko 2008, pp. 417–444.
- Barber, R. L. N. 1992. "The Origins of the Mycenaean Palace," in *Philolakon: Lakonian Studies in Honour of Hector Catling*, ed. J. M. Sanders, London, pp. 11–23.
- Barnard, K. A., and T. M. Brogan. 2003. *Mochlos IB: Period III. Neopalatial Settlement on the Coast: The Artisans' Quarter and the Farmhouse at Chalinomouri. The Neopalatial Pottery (Prehistory Monographs 8)*, Philadelphia.
- Bartosiewicz, L., W. van Neer, and A. Lentacker. 1997. *Draught Cattle: Their Osteological Identification and History (Annales Sciences Zoologiques 281)*, Tervuren.
- Batsiou-Efstathiou, A. 1985. "Μυκηναϊκά από τη Νέα Ιωνία Βόλου," *ArchDelt* 40, A', pp. 17–70.
- Baumgartner, P. O. 1985. *Jurassic Sedimentary Evolution and Nappe Emplacement in the Argolis Peninsula (Peloponnesus, Greece) (Denkschriften der Schweizerischen Naturforschenden Gesellschaft 99)*, Basel.
- Beck, H. C. 1928. "Classification and Nomenclature of Beads and Pendants," *Archaeologia* 77, pp. 1–76.

- Becker, C. 1986. *Kastanas: Ausgrabungen in einem Siedlungshügel der Bronze- und Eisenzeit Makedoniens 1975–1979. Die Tierknochenfunde* (Prähistorische Archäologie in Südosteuropa 5), Berlin.
- Beier, T., and H. Mommsen. 1994. “Modified Mahalanobis Filters for Grouping Pottery by Chemical Composition,” *Archaeometry* 36, pp. 287–306.
- Bennet, J. 2007. “The Aegean Bronze Age,” in *The Cambridge Economic History of the Greco-Roman World*, ed. W. Scheidel, I. Morris, and R. Saller, Cambridge, pp. 175–210.
- . 2008. “Palace™: Speculations on Palatial Production in Mycenaean Greece,” in *Vitreous Materials in the Late Bronze Age Aegean* (Sheffield Studies in Aegean Archaeology 9), ed. C. M. Jackson and E. C. Wager, Oxford, pp. 151–172.
- Benzi, M. 1975. *Ceramica micenea in Attica*, Milan.
- Berg, I. 2004. “The Meanings of Standardization: Conical Cups in the Late Bronze Age Aegean,” *Antiquity* 78, pp. 74–85.
- Betancourt, P. P. 1980. *Cooking Vessels from Minoan Kommos: A Preliminary Report* (UCLAPap 7), Los Angeles.
- . 1985. *The History of Minoan Pottery*, Princeton.
- Betancourt, P. P., V. Karageorghis, R. Laffineur, and W.-D. Niemeier, eds. 1999. *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener as He Enters His 65th Year* (Aegaeum 20), Liège.
- Bevan, A. 2007. *Stone Vessels and Values in the Bronze Age Mediterranean*, Cambridge.
- Bevan, A., E. Kiriati, C. Knappett, E. Kappa, and S. Papa-christou. 2002. “Excavation of Neopalatial Deposits at Tholos (Kastri), Kythera,” *BSA* 97, pp. 55–96.
- Biers, W. R. 1969. “Excavations at Phlius, 1924: The Prehistoric Deposits,” *Hesperia* 38, pp. 443–458.
- . 1971. “Excavations at Phlius, 1970,” *Hesperia* 40, pp. 424–447.
- Binford, L. R. 1978. *Nunamiut Ethnoarchaeology*, New York.
- . 1981. *Bones: Ancient Men and Modern Myths*, New York.
- Birtacha, K., E. Asouti, A. Devetzi, D. Mylona, A. Sarpaki, and K. Trantalidou. 2008. “Cooking’ Installations in LC IA Akrotiri on Thera: A Preliminary Study of the ‘Kitchen’ in Pillar Shaft 65,” in *Horizon/Opίζωv: A Colloquium on the Prehistory of the Cyclades*, ed. N. Brodie, J. Doole, G. Gavalas, and C. Renfrew, Cambridge, pp. 349–376.
- Blegen, C. W. 1921. *Korakou: A Prehistoric Settlement near Corinth*, Boston.
- . 1925. “The American Excavation at Nemea, Season of 1924,” *Art and Archaeology* 19, pp. 175–184.
- . 1926. “The December Excavations at Nemea,” *Art and Archaeology* 22, pp. 127–134.
- . 1927. “Excavations at Nemea 1926,” *AJA* 31, pp. 421–440.
- . 1928. *Zygouries: A Prehistoric Settlement in the Valley of Cleonae*, Cambridge, Mass.
- . 1937. *Prosymna: The Helladic Settlement Preceding the Argive Heraeum*, Cambridge, Mass.
- . 1975. “Neolithic Remains at Nemea: Excavations of 1925–1926,” *Hesperia* 44, pp. 251–279.
- Blitzer, H. 1990. “Κορωνέϊκα: Storage-Jar Production and Trade in the Traditional Aegean,” *Hesperia* 59, pp. 675–711.
- . 1991. “Middle to Late Helladic Chipped Stone Implements of the Southwest Peloponnese: Part I. The Evidence from Malthi,” *Hydra* 9, pp. 1–73.
- . 1992. “The Chipped Stone, Ground Stone, and Worked Bone Industries,” in McDonald and Wilkie 1992, pp. 712–756.
- Boardman, S., and G. Jones. 1990. “Experiments on the Effects of Charring on Cereal Plant Components,” *JAS* 17, pp. 1–11.
- Boessneck, J., H.-H. Müller, and M. Teichert. 1964. “Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* Linné) und Ziege (*Capra hircus* Linné),” *Kühn-Archiv* 78, pp. 1–129.
- Bogaard, A. 2004. *Neolithic Farming in Central Europe: An Archaeobotanical Study of Crop Husbandry Practices*, London.
- . 2005. “‘Garden Agriculture’ and the Nature of Early Farming in Europe and the Near East,” *WorldArch* 37, pp. 177–196.
- Borojevic, K. 2011. “Interpreting, Dating, and Reevaluating the Botanical Assemblage from Tell Kedesh: A Case Study of Historical Contamination,” *JAS* 38, pp. 829–842.
- Brain, C. K. 1981. *The Hunters or the Hunted?* Chicago.
- Brecoulaki, H. 2014. “‘Precious Colours’ in Ancient Greek Polychromy and Painting: Material Aspects and Symbolic Values,” *RA* 2014, pp. 1–35.
- Brecoulaki, H., A. Andreotti, I. Bonaduce, M. P. Colombini, and A. Lluveras. 2012. “Characterization of Organic Media in the Wall-Paintings of the ‘Palace of Nestor’ at Pylos, Greece: Evidence for a Secco Painting Techniques in the Bronze Age,” *JAS* 39, pp. 2866–2876.
- Brogan, T. M., and E. Hallager, eds. 2011. *LM IB Pottery: Relative Chronology and Regional Differences. Acts of a Workshop Held at the Danish Institute at Athens in Collaboration with the INSTAP Study Center for East Crete, 27–29 June 2007* (Monographs of the Danish Institute at Athens 11), Athens.
- Brogan, T. M., R. A. K. Smith, and J. S. Soles. 2002. “Mycenaean at Mochlos? Exploring Culture and Identity in the Late Minoan IB to IIIA1 Transition,” *Aegean Archaeology* 6, pp. 89–118.
- Bronk Ramsey, C. 2009. “Bayesian Analysis of Radiocarbon Dates,” *Radiocarbon* 51, pp. 337–360.
- Broodbank, C., E. Kiriati, and J. Rutter. 2005. “From Pharaoh’s Feet to the Slave Women of Pylos? The History and Cultural Dynamics of Kythera in the Third Palace Period,” in *Autochthon: Papers Presented to O. T. P. K. Dickinson on the Occasion of His Retirement* (BAR-IS 1432), ed. A. Dakouri-Hild and S. Sherratt, Oxford, pp. 70–96.
- Bryan, N. D., S. M. A. Hoffmann, V. J. Robinson, and E. B. French. 1997. “Pottery Sources in Bronze Age Cyprus: A Provenance Study by Neutron Activation,” *RDAC* 1997, pp. 31–64.
- Bull, G., and S. Payne. 1982. “Tooth Eruption and Epiphyseal Fusion in Pigs and Wild Boar,” in Wilson, Grigson, and Payne 1982, pp. 55–71.
- Çakırlar, C. 2009a. *Mollusk Shells in Troia, Yenibademli, and Ulucak: An Archaeomalacological Approach to the Environment and Economy of the Aegean* (BAR-IS 2051), Oxford.
- . 2009b. “To the Shore, Back and Again: Archaeomalacology at Troia,” *Studia Troica* 18, pp. 59–86.
- Cappers, R. T. J., R. Neef, and R. Bekkers. 2009. *The Digital Atlas of Economic Plants*, Groningen.
- Cappers, R. T. J., R. Neef, R. Bekkers, and L. Boulos. 2012. *The Digital Atlas of Economic Plants in Archaeology*, Groningen.

- Carter, T. 2003. "The Chipped Stone and Ground Stone," in *The Asea Valley Survey: An Arcadian Mountain Valley from the Paleolithic Period until Modern Times (ActaAth 4^o, 51)*, ed. J. Forsén and B. Forsén, Stockholm, pp. 129–157.
- . 2004. "A Second Report on the Chipped Stone from Geraki (1999–2001)," *Pharos: Journal of the Netherlands Institute in Athens* 10 (2002), pp. 33–43.
- . 2011. "The Chipped Stone," in *Mochlos IIC: Period IV, The Mycenaean Settlement and Cemetery. The Human Remains and Other Finds* (Prehistory Monographs 32), ed. J. Soles and C. Davaras, Philadelphia, pp. 92–123.
- . 2013. "The Chipped Stone," in *Fouilles exécutées à Malia: Le quartier Mu V. Vie quotidienne et techniques au Minoen Moyen II (ÉtCrét 34)*, ed. J.-C. Poursat, Athens, pp. 5–26.
- Caskey, J. L. 1956. "Excavations at Lerna, 1955," *Hesperia* 25, pp. 147–173.
- . 1957. "Excavations at Lerna, 1956," *Hesperia* 26, pp. 142–162.
- . 1964. "Excavations in Keos, 1963," *Hesperia* 33, pp. 314–335.
- . 1972. "Investigations in Keos: Part II. A Conspectus of the Pottery," *Hesperia* 41, pp. 357–401.
- Caskey, L. D. n.d. "Lexikon of Architectural Terms" (unpublished manuscript, Blegen Library, American School of Classical Studies at Athens).
- Casselmann, C., M. Fuchs, D. Ittameier, J. Maran, and G. Wagner. 2004. "Interdisziplinäre landschaftsarchäologische Forschungen im Becken von Phlious, 1998–2002," *AA* 2004, pp. 1–57.
- Catling, H. W. 1977. "Excavations at the Menelaion, Sparta, 1973–1976," *AR* 23, pp. 24–42.
- . 1981. "Archaeology in Greece, 1980–81," *AR* 27, pp. 1–48.
- . 1982. "Archaeology in Greece, 1981–82," *AR* 28, pp. 3–62.
- . 1989. *Some Problems in Aegean Prehistory c. 1450–1380 B.C.* (J. L. Myres Memorial Lecture 14), Oxford.
- . 2009. *Sparta: Menelaion I: The Bronze Age (BSA Suppl. 45)*, London.
- Cavanagh, W., and C. Mee. 1998. *A Private Place: Death in Prehistoric Greece (SIMA 125)*, Jonsered.
- Chadwick, J. 1976. *The Mycenaean World*, Cambridge.
- Cherry, J., and J. Davis. 2001. "Under the Sceptre of Agamemnon: The View from the Hinterlands of Mycenae," in *Urbanism in the Aegean Bronze Age* (Sheffield Studies in Aegean Archaeology 4), ed. K. Branigan, New York, pp. 141–159.
- Cherry, J. F., J. L. Davis, A. Demitrac, E. Mantzourani, T. F. Strasser, and L. E. Talalay. 1988. "Archaeological Survey in an Artifact-Rich Landscape: A Middle Neolithic Example from Nemea, Greece," *AJA* 92, pp. 159–176.
- Cherry, J. F., J. L. Davis, and E. Mantzourani, eds. 1991. *Landscape Archaeology as Long-Term History: Northern Keos in the Cycladic Islands from Earliest Settlement to Modern Times* (Monumenta Archaeologica 16), Los Angeles.
- . 2000. *The Nemea Valley Archaeological Project Archaeological Survey: Internet Edition*, <http://classics.uc.edu/NVAP/>.
- Chesterman, C. W. 1979. *National Audubon Society Field Guide to North American Rocks and Minerals*, New York.
- Claassen, C. 1998. *Shells* (Cambridge Manuals in Archaeology), Cambridge.
- Clason, A. T., and W. Prummel. 1977. "Collecting, Sieving, and Archaeozoological Research," *JAS* 4, pp. 171–175.
- Cline, E. H. 1994. *Sailing the Wine-Dark Sea: International Trade and the Late Bronze Age Aegean (BAR-IS 591)*, Oxford.
- Coldstream, J. N., and G. L. Huxley, eds. 1972. *Kythera: Excavations and Studies Conducted by the University of Pennsylvania Museum and the British School at Athens*, London.
- Corinth = Corinth. *Results of Excavations Conducted by the American School of Classical Studies*, Princeton
- XIII = C. W. Blegen, H. Palmer, and R. S. Young, *The North Cemetery*, 1964.
- XX = C. K. Williams II and N. Bookidis, eds., *Corinth, the Centenary: 1896–1996*, 2003.
- Cosmopoulos, M. B. 2014. *The Sanctuary of Demeter at Eleusis: The Bronze Age*, 2 vols. (Archaeological Society of Athens Library 295–296), Athens.
- Costin, C. L. 1991. "Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production," *Archaeological Method and Theory* 3, pp. 1–56.
- Counihan, C. M. 1999. *The Anthropology of Food and Body: Gender, Meaning, and Power*, London.
- Courty, M. A., and V. Roux. 1995. "Identification of Wheel Throwing on the Basis of Ceramic Surface Features and Microfabrics," *JAS* 22, pp. 17–50.
- Coy, J. 1986. "The Faunal Remains from Period V," in *Keos V*, pp. 109–111.
- Cumming, K. S. 1999. *Freshwater Mussel (Unionida) Genera of the World*, <http://www.freshwatermussels.inls.uiuc.edu>.
- Dabney, M. K. 1997. "Craft Product Consumption as an Economic Indicator of Site Status in Regional Studies," in *TEXNH: Craftsmen, Craftswomen, and Craftsmanship in the Aegean Bronze Age (Aegaeum 16)*, ed. R. Laffineur and P. P. Betancourt, Liège, pp. 467–471.
- . 1999. "Locating Mycenaean Cemeteries," in Betancourt et al. 1999, pp. 171–175.
- . 2016a. "Consumerism, Debt, and the End of the Bronze Age Civilisations in the Eastern Mediterranean," in *RA-PI-NE-U: Studies on the Mycenaean World Offered to Robert Laffineur for His 70th Birthday* (Aegis 10), ed. J. Driessen, Louvain-la-Neuve, pp. 95–107.
- . 2016b. "Mycenaean Funerary Processions as Shared Ritual Experiences," in *Metaphysis: Ritual, Myth, and Symbolism in the Aegean Bronze Age (Aegaeum 39)*, ed. E. Alram-Stern, F. Blakolmer, S. Deger-Jalkotzy, R. Laffineur, and J. Weilhartner, Liège, pp. 229–234.
- Dabney, M. K., S. E. Allen, A. Kugler, A. Paphanasiou, and J. C. Wright. 2020. "The Neolithic Settlement on Tsoungiza at Ancient Nemea," *Hesperia* 89, pp. 1–65.
- Dabney, M. K., P. Halstead, and P. Thomas. 2004. "Mycenaean Feasting on Tsoungiza at Ancient Nemea," *Hesperia* 73, pp. 197–215.
- Dabney, M. K., and J. C. Wright. 2013. "Μεσοελλαδικός και μυκηναϊκός οικισμός στην Τσούγκιζα της Αρχαίας Νεμέας," in Kissas and Niemeier 2013, pp. 351–361.
- Dakouri-Hild, N. 2001. "The House of Kadmos in Mycenaean Thebes Reconsidered: Architecture, Chronology, and Context," *BSA* 96, pp. 81–122.
- Damm, U. 1997. "Die spätbronzezeitlichen Miniaturgefäße und Hohlgeformten Stiere von Tiryns: Ein Analyse der Form und Funktion" (diss. Rheinische Friedrich-Wilhelms-Universität zu Bonn).
- D'Angelo, G., and S. Gargiullo. 1978. *Guida alle conchiglie mediterranee: Conoscerle, cercarle, collezionarle*, Milan.

- Darcque, P. 2005. *L'habitat mycénien: Formes et fonctions de l'espace bâti en Grèce continentale à la fin du II^e millénaire avant J.-C.* (BÉFAR 319), Athens.
- Davey, N. 1971. *A History of Building Materials*, New York.
- Davis, E. N. 1977. *The Vapheio Cups and Aegean Gold and Silver Ware*, New York.
- Davis, J. L. 1978. "The Mainland Panelled Cup and Panelled Style," *AJA* 82, pp. 216–222.
- . 1979. "Late Helladic I Pottery from Korakou," *Hesperia* 48, pp. 234–263.
- . 1988. "If There's a Room at the Top What's at the Bottom? Settlement and Hierarchy in Early Mycenaean Greece," *BICS* 35, pp. 164–165 (abstract).
- Davis, J. L., and H. B. Lewis. 1985. "Mechanization of Pottery Production: A Case Study from the Cycladic Islands," in *Prehistoric Production and Exchange: The Aegean and Eastern Mediterranean*, ed. A. B. Knapp and T. Stech, Los Angeles, pp. 79–92.
- Davis, J. L., and S. Stocker. 2016. "The Lord of the Gold Rings: The Griffin Warrior of Pylos," *Hesperia* 85, pp. 627–655.
- Day, L. P., and L. M. Snyder. 2004. "The 'Big House' at Vronta and the 'Great House' at Karphi: Evidence for Social Structure in LM IIIC Crete," in *Crete beyond the Palaces*, ed. M. S. Mook, J. D. Muhly, and L. P. Day, Philadelphia, pp. 63–80.
- deFrance, S. D. 2009. "Zooarchaeology in Complex Societies: Political Economy, Status, and Ideology," *Journal of Archaeological Research* 17, pp. 105–168.
- Delamotte, M., and E. Vardala-Theodorou. 1994. *Shells from the Greek Seas*, Athens.
- Demakopoulou, K. 1990. "The Burial Ritual in the Tholos Tomb at Kokla, Argolis," in *Celebrations of Death and Divinity in the Bronze Age Argolid* (*ActaAth* 4^o, 40), ed. R. Hägg and G. C. Nordquist, Stockholm, pp. 113–123.
- . 1993. "Argive Mycenaean Pottery: Evidence from the Necropolis at Kokla," in Zerner, Zerner, and Winder 1993, pp. 57–75.
- , ed. 1996. *The Aidonia Treasure*, Athens.
- Demakopoulou, K., and N. Valakou. 2009. "Mycenaean Figures and Figurines from Midea," in Schallin and Pakkanen 2009, pp. 37–53.
- Deniz, E., and S. Payne. 1982. "Eruption and Wear in the Mandibular Dentition as a Guide to Ageing Turkish Angora Goats," in Wilson, Grigson, and Payne 1982, pp. 155–205.
- Dickinson, O. T. P. K. 1972. "Late Helladic IIA and IIB: Some Evidence from Korakou," *BSA* 67, pp. 103–112.
- . 1974. "The Definition of Late Helladic I," *BSA* 69, pp. 109–120.
- . 1977. *The Origins of Mycenaean Civilization* (*SIMA* 49), Göteborg.
- . 1992. "Mycenaean Pottery from the Settlement Part I: The Late Helladic I and II Pottery," in McDonald and Wilkie 1992, pp. 469–488, 521–534.
- . 2014. "Late Helladic I Revisited: The Kytheran Connection," in Nakassis, Gulizio, and James 2014, pp. 3–15.
- Dickinson, O. T. P. K., L. Papazoglou-Manioudaki, A. Nafplioti, and A. J. N. W. Prag. 2012. "Mycenae Revisited Part 4: Assessing the New Data," *BSA* 107, pp. 1–28.
- Dietler, M. 2010. *Archaeologies of Colonialism: Consumption, Entanglement, and Violence in Ancient Mediterranean France*, Berkeley.
- Dietz, S. 1980. *Asine II.2: The Middle Helladic Cemetery, The Middle Helladic and Early Mycenaean Deposits*, Stockholm.
- . 1991. *The Argolid at the Transition to the Mycenaean Age: Studies in the Chronology and Cultural Development in the Shaft Grave Period*, Copenhagen.
- . 1998. "The Cyclades and the Mainland in the Shaft Grave Period—A Summary," *Proceedings of the Danish Institute at Athens* 2, pp. 9–35.
- Dietz, S., and N. Divari-Valakou. 1990. "A Middle Helladic III/Late Helladic I Grave Group from Myloi in the Argolid (Oikopedon Manti)," *OpAth* 18, pp. 45–62.
- Dietz, S., C. Zerner, and G. Nordquist. 1988. "Concerning the Classification of Late Middle Helladic Wares in the Argolid," *Hydra* 5, pp. 15–16.
- Döhl, H. 1975. "Tiryns-Stadt: Sondage 1968," in *Tiryns VIII*, pp. 137–154.
- Donnan, C. B. 1971. "Ancient Peruvian Potters' Marks and Their Interpretation through Ethnographic Analogy," *AmerAnt* 36, pp. 460–466.
- Dor, L., J. Jannoray, H. van Effenterre, and M. van Effenterre. 1960. *Kirra: Étude de préhistoire phocidienne*, Paris.
- Driessen, J. 2008. "Chronology of the Linear B Texts," in *A Companion to Linear B: Mycenaean Greek Texts and Their World I*, ed. Y. Duhoux and A. Morpurgo Davies, Louvain, pp. 69–79.
- Driessen, J., and C. F. Macdonald. 1997. *The Troubled Island: Minoan Crete before and after the Santorini Eruption* (*Aegeum* 17), Liège.
- Earle, T. 1987. "Chiefdoms in Archaeological and Ethnohistorical Perspective," *Annual Review of Anthropology* 16, pp. 279–308.
- Eder, B. 2017. "Rise and Fall of an Early Mycenaean Site: Kakovatos in Triphylia," *BICS Mycenaean Seminar* 2015–2016, no. 6, doi: 10.14296/1217.9781905670857.
- Engels, L., L. Bavay, and A. Tsingarida. 2009. "Calculating Vessel Capacities: A New Web-Based Solution," in *Shapes and Uses of Greek Vases (7th–4th Centuries B.C.)*, ed. A. Tsingarida, Brussels, pp. 129–133.
- Ervynck, A., W. van Neer, H. Hüster-Plogmann, and J. Schibler. 2003. "Beyond Affluence: The Zooarchaeology of Luxury," *WorldArch* 34, pp. 428–441.
- Evely, D., and C. Runnels. 1992. *Well Built Mycenae: The Helleno-British Excavations within the Citadel at Mycenae, 1959–1969* 27: *Ground Stone*, Oxford.
- Evely, R. D. G. 1993. *Minoan Crafts: Tools and Techniques* (*SIMA* 92), Göteborg.
- Evershed, R. P., S. J. Vaughan, S. N. Dudd, and J. S. Soles. 2000. "Organic Residue, Petrographic, and Typological Analyses of Late Minoan Lamps and Conical Cups from Excavations at Mochlos in East Crete, Greece," in *Paleodiet in the Aegean*, ed. S. Vaughan and W. Coulson, Oxford, pp. 37–54.
- Faraklas, N. 1972. *Φλειασία*, Athens.
- Felten, F., W. Gauss, and R. Smetana, eds. 2007. *Middle Helladic Pottery and Synchronisms. Proceedings of the International Workshop Held at Salzburg, October 31st–November 2nd, 2004* (Ägina-Kolonna Forschungen und Ergebnisse 1), Vienna.
- Fischer, W., M. L. Bauchot, and M. Schneider, eds. 1987. *Fiches FAO d'identification des espèces pour les besoins de la pêche: Méditerranée et mer Noire, zone de pêche 37*, 2 vols., Rome.
- Fitzsimons, R. 2011. "Monumental Architecture and the Construction of the Mycenaean State," in *State Formation and Greece: Questioning the Neoevolutionist Paradigm*, ed. R. Terrenato and D. C. Haggis, Oxford, pp. 75–118.

- Forste, K. M. 2012. "Agricultural Adaptations during the Late Bronze Age: Archaeobotanical Evidence from Sovjan, Albania, and Tsoungiza, Greece" (M.A. thesis, Univ. of Cincinnati).
- Forstenpointner, A., A. Galik, S. Zohmann, and G. Weissengruber. 2007. "Saitenspiel und Purpurschimmerarchäozoologische Ehrengaben aus dem späthelladischen Ägina Kolonna," in *Keimelion: Elitenbildung und Elitärer Konsum von der mykenischen Palastzeit bis zur homerischen Epoche/The Formation of Elites and Elitist Lifestyles from Mycenaean Palatial Times to the Homeric Period. Akten des internationalen Kongresses von 3. bis 5. Februar 2005 in Salzburg*, ed. E. Alram-Stern and G. Nightingale, Vienna, pp. 141–148.
- French, D., and E. French. 1971. "Prehistoric Pottery from the Area of the Agricultural Prison at Tiryns," in *Tiryns V*, pp. 21–40.
- French, E. 1964. "Late Helladic IIIA1 Pottery from Mycenae," *BSA* 59, pp. 241–261.
- . 1971. "The Development of Mycenaean Terracotta Figurines," *BSA* 66, pp. 101–187.
- . 2002. *Mycenae: Agamemnon's Capital*, Stroud.
- French, E. B., S. M. A. Hoffmann, V. J. Robinson, and J. E. Tomlinson. 2008. "The Perlman and Asaro Analyses of Late Helladic I–III Sherds from the 1963 Excavations: A Statistical Re-evaluation," in *Taylor and Janko 2008*, CD-ROM 118–123.
- French, E., and K. Shelton. 2005. "Early Palatial Mycenae," in *Autochthon: Papers Presented to O. T. P. K. Dickinson on the Occasion of His Retirement (BAR-IS 1432)*, ed. A. Dakouri-Hild and S. Sherratt, Oxford, pp. 175–184.
- French, E. B., and J. E. Tomlinson. 1999. "The Mainland 'Conical Cup,'" in *Betancourt et al. 1999*, pp. 259–265.
- Frizell, B. S. 1980. *An Early Mycenaean Settlement at Asine: The Late Helladic IIB–IIIA1 Pottery*, Göteborg.
- . 1986. *Asine II: The Late and Final Mycenaean Periods*, Stockholm.
- Furumark, A. 1941. *The Chronology of Mycenaean Pottery*, Stockholm.
- . 1972. *Mycenaean Pottery I: Analysis and Classification (ActaAth 4^a, 20:1)*, Stockholm.
- Galaty, M. L. 2016. "The Mycenaeanisation Process," in *Beyond Thalassocracies: Understanding Processes of Minoanisation and Mycenaeanisation in the Aegean*, ed. E. Gorogianni, P. Pavúk, and L. Girella, Oxford, pp. 207–218.
- Galaty, M., D. Nakassis, and W. Parkinson, eds. 2011. "Forum: Redistribution in Aegean Palatial Societies," *AJA* 115, pp. 175–244.
- Galik, A., G. Forstenpointner, G. E. Weissengruber, U. Thanheiser, M. Lindblom, R. Smetana, and W. Gaus. 2013. "Bioarchaeological Investigations at Kolonna, Aegina (Early Helladic III to Late Helladic III)," in *Diet, Economy, and Society in the Ancient Greek World: Towards a Better Integration of Archaeology and Science (Pharos Suppl. 1)*, ed. S. Voutsaki and S. M. Valamoti, Leuven, pp. 163–171.
- Gallagher, D. E. 2014. "Formation Processes of the Macrobotanical Record," in *Method and Theory in Paleoethnobotany*, ed. J. M. Marston, J. d'Alpoim Guedes, and C. Warinner, Boulder, pp. 19–34.
- Gamble, C. 1985. "Formation Processes and the Animal Bones from the Sanctuary," in *The Archaeology of Cult: The Sanctuary at Phylakopi*, ed. C. Renfrew, London, pp. 479–484.
- Gauss, W., and E. Kiriati. 2011. *Pottery Production and Supply at Bronze Age Kolonna, Aegina: An Integrated Archaeological and Scientific Study of a Ceramic Landscape (Ägina-Kolonna Forschungen und Ergebnisse 5)*, Vienna.
- Gauss, W., E. Kiriati, M. Lindblom, B. Lis, and J. E. Morrison. 2017. "Aeginetan Late Bronze and Early Iron Age Cooking Pottery," in *Hruby and Trusty 2017*, pp. 46–56.
- Gauss, W., G. Klebinder-Gauss, and C. von Rügen, eds. 2015. *The Transmission of Technical Knowledge in the Production of Ancient Mediterranean Pottery. Proceedings of the International Conference at the Austrian Archaeological Institute at Athens 23rd–25th November 2012 (Österreichisches Archäologisches Institut Sonderschriften 54)*, Vienna.
- Gauss, W., M. Lindblom, R. A. K. Smith, and J. C. Wright, eds. 2011. *Our Cups Are Full: Pottery and Society in the Aegean Bronze Age. Papers Presented to Jeremy B. Rutter on the Occasion of His 65th Birthday*, Oxford.
- Gejvall, N.-G. 1983. "Appendix VI: Animal Bones from the Acropolis," in *The Cuirass Tomb and Other Finds at Dendra 2: Excavations in the Cemeteries, the Lower Town, and the Cidatel (SIMA 4.2)*, ed. P. Åström, Göteborg, pp. 51–53.
- Gelbert, A. 1997. "De l'élaboration au tour au tournage sur motte: Difficultés motrices et conceptuelles," *Techniques & Culture* 30, pp. 1–23.
- Gercke, P., W. Gercke, and G. Hiesel. 1971. "Grabungen in der Unterstadt von Tiryns von 1884 bis 1929," in *Tiryns V*, pp. 1–19.
- . 1975. "Tiryns-Stadt 1971: Graben H," in *Tiryns VIII*, pp. 7–36.
- Gillis, C. 1990. *Minoan Conical Cups: Form, Function, and Significance (SIMA 89)*, Göteborg.
- . 1991. "Tin-Covered Vessels in the Aegean Bronze Age," *Hydra* 8, pp. 1–30.
- . 1997. "Tin-Covered Late Bronze Age Vessels: Analyses and Social Implications," in *Trade and Production in Premonetary Greece: Production and the Craftsman (SIMA-PB 143)*, ed. C. Gillis, C. Risberg, and B. Sjöberg, Jonsö, pp. 131–138.
- Gilstrap, W. D., P. M. Day, N. Müller, E. Kardamaki, K. Kazapageorgiou, C. Marabea, and Y. Lolos. Forthcoming. *Ceramics and Palatial Power: The Identification and Characterisation of a Ceramic Production Installation in Late Bronze Age Attica through Thin-Section Petrography. 39th International Symposium on Archaeometry, 28th May–1st June 2012*, Leuven.
- Girella, L. 2009. "Patterns of Exchange and Mobility: The Case of the Grey Ware in Middle and Late Minoan Crete," *SMEA* 51, pp. 279–314.
- Goldman, H. 1931. *Excavations at Eutresis in Boeotia*, Cambridge, Mass.
- Gorogianni, E., P. Pavúk, and L. Girella, eds. 2016. *Beyond Thalassocracies: Understanding Processes of Minoanisation and Mycenaeanisation in the Aegean*, Oxford.
- Grant, A. 1982. "The Use of Tooth Wear as a Guide to the Age of Domestic Ungulates," in *Wilson, Grigson, and Payne 1982*, pp. 91–108.
- Graziadio, G. 1988. "The Chronology of the Graves of Circle B at Mycenae: A New Hypothesis," *AJA* 92, pp. 343–372.
- . 1991. "The Process of Social Stratification at Mycenae in the Shaft Grave Period: A Comparative Examination of the Evidence," *AJA* 95, pp. 403–440.
- Green, F. J. 1979. "Phosphatic Mineralization of Seeds from Archaeological Sites," *JAS* 6, pp. 279–284.
- Greenfield, H. J. 1988. "Bone Consumption by Serbian Pigs in a Contemporary Serbian Village: Implications for the Interpretation of Prehistoric Faunal Assemblages," *JFA* 15, pp. 473–479.

- Grigson, C. 1982. "Sex and Age Determination of Some Bones and Teeth of Domestic Cattle: A Review of the Literature," in Wilson, Grigson, and Payne 1982, pp. 7–23.
- Gulizio, J., and C. W. Shelmerdine. 2017. "Mycenaean Cooking Vessels from Iklaina," in Hruby and Trusty 2017, pp. 27–38.
- Gustaffson, S. 2000. "Carbonized Cereal Grains and Weed Seeds in Houses: An Experimental Perspective," *JAS* 27, pp. 65–70.
- Hachtmann, V. 2013. "The Bronze Age Settlement at Aidonia," in Kissas and Niemeier 2013, pp. 405–416.
- Hale, C. 2014. "Middle Helladic Matt Painted and Dull Painted Pottery at Mitrou: An Important Distinction in Central Greece," *Melbourne Historical Journal* 42:2, pp. 31–57.
- Hallager, E., and B. P. Hallager, eds. 2000. *The Greek-Swedish Excavations at the Agia Aikaterini Square, Kastelli, Khania 1970–1987 II: The Late Minoan IIIC Settlement (ActaAth 4°, 47:2)*, Jonsö.
- . 2003. *The Greek-Swedish Excavations at the Agia Aikaterini Square, Kastelli, Khania 1970–1987 and 2001 III: The Late Minoan IIIB:2 Settlement (ActaAth 4°, 47:3)*, Jonsö.
- Hally, D. J. 1983. "Use Alteration of Pottery Vessel Surfaces: An Important Source of Evidence for the Identification of Vessel Function," *North American Archaeologist* 4, pp. 3–26.
- Halstead, P. 1985. "A Study of Mandibular Teeth from Romano-British Contexts at Maxey," in *Archaeology and Environment in the Lower Well and Valley 1* (East Anglian Archaeology 27), ed. F. Pryor and C. French, Cambridge, pp. 219–224.
- . 1987. "Traditional and Ancient Rural Economy in Mediterranean Europe: Plus ça change?" *JHS* 107, pp. 77–87.
- . 1992. "Agriculture in the Bronze Age Aegean: Towards a Model of Palatial Economy," in *Agriculture in Ancient Greece*, ed. B. Wells, Stockholm, pp. 105–117.
- . 1995. "Plough and Power: The Economic and Social Significance of Cultivation with the Ox-Drawn Ard in the Mediterranean," *Bulletin on Sumerian Agriculture* 8, pp. 11–22.
- . 1996. "Pastoralism or Household Herding? Problems of Scale and Specialization in Early Greek Animal Husbandry," *WorldArch* 28, pp. 20–42.
- . 1999. "Toward a Model of Mycenaean Palatial Mobilization," in *Rethinking Mycenaean Palaces: New Interpretations of an Old Idea*, ed. M. L. Galaty and W. A. Parkinson, Los Angeles, pp. 35–41.
- . 2001. "Mycenaean Wheat, Flax, and Sheep: Palatial Intervention in Farming and Its Implication for Rural Society, Economy, and Politics," in *The Mycenaean Palace States*, ed. S. Voutsaki and J. T. Killen, Cambridge, pp. 38–58.
- . 2002. "Texts, Bones, and Herders: Approaches to Animal Husbandry in LBA Greece," in *A-NA-QO-TA: Studies Presented to John T. Killen*, ed. J. Bennet and J. Driessen, pp. 149–189.
- . 2003. "Texts and Bones: Contrasting Linear B and Archaeological Evidence for Animal Exploitation in Mycenaean Southern Greece," in *Zoarchaeology in Greece: Recent Advances (BSA Studies 9)*, ed. E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble, and P. Elefanti, London, pp. 257–261.
- . 2011. "The Faunal Remains," in Pullen 2011, pp. 741–803.
- . 2014. *Two Oxen Ahead: Pre-mechanized Farming in the Mediterranean*, Chichester.
- Halstead, P., P. Collins, and V. Isaakidou. 2002. "Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult *Ovis* and *Capra*," *JAS* 29, pp. 545–553.
- Halstead, P., and V. Isaakidou. 2011a. "A Pig Fed by Hand Is Worth Two in the Bush: Ethnoarchaeology of Pig Husbandry in Greece and Its Archaeological Implications," in *Ethnozoarchaeology: The Present and Past of Human-Animal Relationships*, ed. U. Albarella and A. Trentacoste, Oxford, pp. 160–174.
- . 2011b. "Political Cuisine: Rituals of Commensality in the Neolithic and Bronze Age Aegean," in *Guess Who's Coming to Dinner: Feasting Rituals in the Prehistoric Societies of Europe and the Near East*, ed. G. Aranda Jiménez, S. Montón-Subías, and S. Romero, Oxford, pp. 91–108.
- Halstead, P., and G. Jones. 1980. "Appendix: Bioarchaeological Remains from Assiros Toumba," *BSA* 75, pp. 265–267.
- Hamilakis, Y. 2003. "The Sacred Geography of Hunting: Wild Animals, Social Power, and Gender in Early Farming Societies," in *Zoarchaeology in Greece: Recent Advances (BSA Studies 9)*, ed. E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble, and P. Elefanti, London, pp. 239–247.
- Hamilakis, Y., and E. Konsolaki. 2004. "Pigs for the Gods: Burnt Animal Sacrifices as Embodied Rituals at a Mycenaean Sanctuary" *OJA* 23:2, pp. 135–151.
- Hampe, R., and A. Winter, 1962. *Bei Töpfer und Töpferinnen in Kreta, Messenien und Zypern*, Bonn.
- Hansen, J. M. 1988. "Agriculture in the Prehistoric Aegean: Data versus Speculation," *AJA* 92, pp. 39–52.
- Hansen, J. M., and S. E. Allen. 2011. "Palaeoethnobotany," in Pullen 2011, pp. 805–891.
- Harland, J. P. 1925. *Prehistoric Aigina: A History of the Island in the Bronze Age*. Paris.
- . 1928. "The Excavations of Tsoungiza, the Prehistoric Site of Nemea," *AJA* 32, p. 63 (abstract).
- . n.d. "Tsoungiza: The Excavations at Tsoungiza, the 'Prehistoric' Site at Nemea" (unpublished manuscript, Nemea Valley Archaeological Project Archive, Bryn Mawr College).
- Hather, J. 2009. *The Identification of Northern European Woods: A Guide for Archaeologists and Conservators*, London.
- Hatzaki, E. 2007. "Neopalatial (MM IIIB–LM IB): KS 178, Gypsades Well (Upper Deposit), and SEX North House Groups," in *Knossos Pottery Handbook: Neolithic and Bronze Age (Minoan) (BSA Studies 14)*, ed. N. Momigliano, London, pp. 151–196.
- Helmer, D. 2000. "Discrimination des genres *Ovis* et *Capra* à l'aide des prémolaires inférieures 3 et 4 et interprétation des âges d'abattage: L'exemple de Dikili Tash (Grèce)," *Anthropozoologica* 31, pp. 29–38.
- Hershenson, C. R. 1998. "Late Helladic IIB at Ayia Irini, Keos," in *Kea–Kythnos: History and Archaeology*, ed. L. G. Mendoni and A. J. Mazarakis Ainian, Athens, pp. 161–168.
- Hiesel, G. 1982. "Ausgrabungen in Tiryns 1980: Bericht zur unbemalten mykenischen Keramik von Tiryns," *AA* 1982, pp. 431–439.
- . 1990. *Späthelladische Hausarchitektur: Studien zur Architekturgeschichte des griechischen Festlandes in der späten Bronzezeit*, Mainz.
- Higham, C. F. W. 1968. "Patterns of Prehistoric Economic Exploitation on the Alpine Foreland," *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich* 113, pp. 41–92.

- Hilditch, J. 2014. "Analyzing Technological Standardization: Revisiting the Minoan Conical Cup," in Kotsonas 2014a, pp. 25–37.
- Hill, B. H. 1966. *The Temple of Zeus at Nemea*, Princeton.
- Hirsch, E. S. 1977. *Painted Decoration on the Floors of Bronze Age Structures on Crete and the Greek Mainland (SIMA 53)*, Göteborg.
- Hoffmann, S. M. A., and V. J. Robinson. 1993. "Neutron Activation Groupings of Imported Material from Tell Abu Hawam," in Zerner, Zerner, and Winder 1993, pp. 7–10.
- Hoffmann, S. M. A., V. J. Robinson, and E. B. French. 1992. "Report on the Perlman/Asaro Analysis of Selected Nichoria Sherds," in McDonald and Wilkie 1992, pp. 779–782.
- Hoffmann, S. M. A., and V. J. Robinson, with R. E. Jones and E. B. French. 2013. "Part II. The Problem of the North East Peloponnese and Progress to Its Solution: Effects of Measurement Errors and Element-Element Correlations in Defining Ceramic Reference Groups," in E. B. French and J. E. Tomlinson, eds., *Well Built Mycenae: The Helleno-British Excavations within the Citadel at Mycenae, 1959–1969* 34.1: *Technical Reports. The Results of Neutron Activation Analysis of Mycenaean Pottery*, Oxford, pp. 5–22.
- Hope Simpson, R. 2017. *Mycenaean Messenia and the Kingdom of Pylos* (Prehistory Monographs 45), Philadelphia.
- Hope Simpson, R., and O. T. P. K. Dickinson. 1979. *A Gazetteer of Aegean Civilization in the Bronze Age 1: The Mainland and the Islands (SIMA 52)*, Göteborg.
- Hruby, J. 2013. "The Palace of Nestor, Craft Production, and Mechanisms for the Transfer of Goods," *AJA* 117, pp. 423–427.
- . 2014. "Moving from Ancient Typology to an Understanding of the Causes of Variability: A Mycenaean Case Study," in Kotsonas 2014a, pp. 49–58.
- . 2017. "Finding Haute Cuisine: Identifying Shifts in Food Styles from Cooking Vessels," in Hruby and Trusty 2017, pp. 15–26.
- Hruby, J., and D. A. Trusty, eds. 2017. *From Cooking Vessels to Cultural Practices in the Late Bronze Age Aegean*, Oxford.
- Hughes, M. 1992. "102 Aegina Samples Analysed by INAA" (unpublished manuscript, British Museum, London).
- Hughes-Brock, H. 1999. "Mycenaean Beads: Gender and Social Contexts," *OJA* 18, pp. 277–296.
- Hurcombe, L. M. 2014. *Perishable Material Culture in Prehistory: Investigating the Missing Majority*, London.
- Iakovidis, S. E. 1962. *Η μυκηναϊκή ακρόπολις των Αθηνών*, Athens.
- . 1969–1970. *Περατή, το νεκροταφείον: Οι τάφοι και τα ευρήματα* (Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 67), Athens.
- . 1990. "Mycenaean Roofs: Form and Construction," in *L'habitat égéen préhistorique (BCH Suppl. 19)*, ed. P. Darque and R. Treuil, Paris, pp. 147–160.
- , ed. 1998. *Γλας II: Η ανασκαφή 1981–1991* (Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 173), Athens.
- InsideWood. 2004–onward. <http://insidewood.lib.ncsu.edu/search> [accessed February 2012–January 2013].
- Isaakidou, V. 2006. "Ploughing with Cows: Knossos and the 'Secondary Products Revolution,'" in *Animals in the Neolithic of Britain and Europe*, ed. D. Serjeantson and D. Field, Oxford, pp. 95–112.
- . 2007a. "Cooking in the Labyrinth: Exploring 'Cuisine' at Bronze Age Knossos," in *Cooking Up the Past: Food and Culinary Practices in the Neolithic and Bronze Age Aegean*, ed. C. Mee and J. Renard, Oxford, pp. 5–24.
- . 2007b. "Faunal Remains and Evidence for Horn-Working," in *Knossos: Protopalatial Deposits in Early Magazine A and the South-West Houses*, ed. C. F. Macdonald and C. Knappett, London, pp. 139–142.
- . 2011. "Gardening with Cows: Hoe and Plough in Prehistoric Europe," in *The Dynamics of Neolithisation in Europe*, ed. A. Hadjikoimis, E. N. Robinson, and S. Viner, Oxford, pp. 90–112.
- Isaakidou, V., and P. Halstead. 2013. "Bones and the Body Politic? A Diachronic Analysis of Structured Deposition in the Neolithic-Early Iron Age Aegean," in *Bones, Behaviour, and Belief: The Zooarchaeological Evidence as a Source for Ritual Practice in Ancient Greece and Beyond (ActaAth 4°, 55)*, ed. G. Ekroth and J. Wallensten, Stockholm, pp. 87–99.
- Jones, G. 1995. "Charred Grain from Late Bronze Age Gla, Boiotia," *BSA* 90, pp. 235–238.
- Jones, G., M. Charles, A. Bogaard, J. G. Hodgson, and C. Palmer. 2005. "The Functional Ecology of Present-Day Arable Weed Floras and Its Applicability for the Identification of Past Crop Husbandry," *Vegetation History and Archaeobotany* 14, pp. 493–504.
- Jones, G., K. Wardle, P. Halstead, and D. Wardle. 1986. "Crop Storage at Assiros," *Scientific American* 254:3, pp. 96–103.
- Jones, G. G. 2006. "Tooth Eruption and Wear Observed in Live Sheep from Butser Hill, the Cotswold Farm Park, and Five Farms in the Pentland Hills, UK," in *Recent Advances in Ageing and Sexing Animal Bones*, ed. D. Ruscillo, Oxford, pp. 155–178.
- Jones, G. G., and P. Sadler. 2012. "Age at Death in Cattle: Methods, Older Cattle, and Known-Age Reference Material," *Environmental Archaeology* 17, pp. 11–28.
- Jones, R. E., and J. E. Tomlinson. 2009. "Chemical Analysis of Mycenaean Pottery from the Menelaion and Its Vicinity," in Catling 2009, CD-ROM pp. 147–169.
- Kalogeropoulos, K. 1998. *Die frühmykenischen Grabfunde von Analipsis (südöstliches Arkadien)*, Athens.
- Karabatsoli, A. 1997. "La production de l'industrie lithique taillée en Grèce centrale pendant le Bronze Ancien (Litharès, Manika, Nemée, Pefkakia)" (diss. Univ. de Paris X).
- . 2011. "The Chipped Stone Industry," in Pullen 2011, pp. 661–726.
- . 2016. "Early Bronze Chipped Stone Technology on the Greek Mainland: A Re-examination of the Material and Theoretical Parameters of Production," in *Lithics Past and Present: Perspectives on Chipped Stone Studies in Greece (SIMA 144)*, ed. P. Elefanti, N. Andreassen, P. N. Kardulias, and G. Marshall, Uppsala, pp. 111–120.
- Karali, L. 1990. "Sea Shells, Land Snails, and Other Marine Remains from Akrotiri," in *Thera and the Aegean World III: Proceedings of the Third International Congress, Santorini, Greece, 3–9 September 1989*, ed. D. A. Hardy, C. G. Doumas, J. A. Sakellarakis, and P. M. Warren, London, pp. 410–415.
- Kardamaki, E. 2015. "Conclusions from the New Deposit at the Western Staircase Terrace at Tiryns," in Schallin and Tournavitou 2015, pp. 79–97.
- Kardulias, P. N. 1992. "The Ecology of Bronze Age Flaked Stone Tool Production in Southern Greece: Evidence from Agios Stephanos and the Southern Argolid," *AJA* 96, pp. 421–442.
- Kardulias, P. N., and C. Runnels. 1995. "The Lithic Artifacts: Flaked Stone and Other Non-flaked Lithics," in *Artifact and Assemblage: The Finds from a Regional Survey of the Southern Argolid, Greece 1. The Prehistoric and Early*

- Iron Age Pottery and the Lithic Artifacts*, ed. C. N. Runnels, D. J. Pullen, and S. Langdon, Stanford, pp. 74–139.
- Karimali, L. 1994. “The Neolithic Mode of Production and Exchange Reconsidered: Lithic Production and Exchange Patterns in Thessaly, Greece, during the Transitional Late Neolithic–Bronze Age Period” (diss. Boston Univ.).
- . 2008. “Lithic and Metal Tools in the Bronze Age Aegean,” in *Aegean Metallurgy in the Bronze Age*, ed. I. Tzachili, Rethymno, pp. 315–325.
- Karo, G. 1930. *Die Schachtgräber von Mykenai*, Munich.
- Kasimi, P. 2015. “The Mycenaean Cemeteries of the North-Eastern Corinthia and the Early Tholos Tomb at Ancient Corinth,” in Schallin and Tournavitu 2015, pp. 503–514.
- Kaza-Papageorgiou, D. 1985. “An Early Mycenaean Cist Grave from Argos,” *AM* 100, pp. 1–21.
- . 2013. “Αγία Ειρήνη Φλιασίας,” in Kissas and Niemeier 2013, pp. 387–395.
- . 2015. “Agia Eirene Phliasias,” in Schallin and Tournavitu 2015, pp. 233–240.
- Kaza-Papageorgiou, K., and E. Kardamaki. 2012. “Κοντοπήγαδο Αλίμου: Ο οικισμός των ΥΕ χρόνων,” *ArchEph* 151, pp. 141–199.
- Keos* = *Keos: Results of the Excavations Conducted by the University of Cincinnati under the Auspices of the American School of Classical Studies at Athens*, Mainz
- III = W. W. Cummer and E. Schofield, *Ayia Irini: House A*, 1984.
- V = J. Davis, *Ayia Irini: Period V*, 1986.
- X = E. Schofield, *Ayia Irini: The Western Sector*, 2011.
- Killen, J. T. 1987. “Piety Begins at Home: Place-Names on Knossos Records of Religious Offerings,” in *Tractata Mycenaea. Proceedings of the Eighth International Colloquium on Mycenaean Studies, Ohrid*, ed. P. H. Ilievski and L. Crepajac, Skopje, pp. 163–177.
- . 1993. “The Oxen’s Names on the Knossos Ch Tablets,” *Minos* 27–28, pp. 101–107.
- . 1998. “The Role of the State in Wheat and Olive Production in Mycenaean Crete,” *Aevum: Rassegna di scienze storiche linguistiche e filologiche* 72, pp. 19–23.
- . 2001. “Some Thoughts on TA-RA-SI-JA,” in *Economy and Politics in the Mycenaean Palace States. Proceedings of a Conference Held on 1–3 July 1999 in the Faculty of Classics, Cambridge*, ed. S. Voutsaki and J. Killen, Cambridge, pp. 161–180.
- Kiriati, E. 2010. “Minoanizing’ Pottery Traditions in the Southwest Aegean during the Middle Bronze Age: Understanding the Social Context of Technological and Consumption Practice,” in *Mesohelladika: The Greek Mainland in the Middle Bronze Age (BCH Suppl. 52)*, ed. A. Philippa-Touchais, G. Touchais, S. Voutsaki, and J. C. Wright, Paris, pp. 683–699.
- Kissas, K., and W.-D. Niemeier, eds. 2013. *The Corinthia and the Northeast Peloponnese: Topography and History from Prehistoric Times until the End of Antiquity. Proceedings of the International Conference Organized by the Directorate of Prehistoric and Classical Antiquities, the LZ’ Ephorate of Prehistoric and Classical Antiquities, and the German Archaeological Institute, Athens, Held at Loutraki, March 26–29, 2009* (Athenaia 4), Munich.
- Klintberg, L. 2011. “The Late Helladic Period,” in *Mastos in the Berbati Valley: An Intensive Archaeological Survey*, ed. M. Lindblom and B. Wells, Stockholm, pp. 97–118.
- Knappett, C. J. 1999. “Can’t Live without Them: Producing and Consuming Minoan Conical Cups,” in Betancourt et al. 1999, pp. 415–421.
- Knappett, C. J., and J. Hilditch. 2015. “Colonial Cups? The Minoan Plain Handleless Cup as Icon and Index,” in *Plain Pottery Traditions of the Eastern Mediterranean and Near East: Production, Use, and Social Significance*, ed. C. Glatz, Walnut Creek, Calif., pp. 91–113.
- Konsolaki, E. 2003. “Η μυκηναϊκή εγκατάσταση στο νησάκι Μόδι της Τροιζηνίας,” in *Η Περιφέρεια του Μυκηναϊκού κόσμου / The Periphery of the Mycenaean World. Β’ Διεθνές Διεπιστημονικό Συμπόσιο, Λαμία, 26–30 Σεπτεμβρίου, Λαμία 1999*, ed. N. Kiparissi-Apostolika and M. Papa-konstantinou, Athens, pp. 417–432.
- Kotsonas, A., ed. 2014a. *Understanding Standardization and Variation in Mediterranean Ceramics: Mid 2nd to Late 1st Millennium B.C. (BABesch 25)*, Leuven.
- . 2014b. “Standardization, Variation, and the Study of Ceramics in the Mediterranean and Beyond,” in Kotsonas 2014a, pp. 7–23.
- Kotzamani, G., and A. Livarda. 2017. “Archaeobotanical Remains,” in *Ayia Sotira: A Mycenaean Chamber Tomb Cemetery in the Nemea Valley, Greece*, ed. R. A. K. Smith, M. K. Dabney, E. Pappi, S. Triantaphyllou, and J. C. Wright, Philadelphia, pp. 139–145.
- Kourakou-Drakona, S. 2012. *Νεμέα: Ιστορικό οινοπέδιο*, Athens.
- Kozłowski, J. K., M. Kaczanowska, and M. Pawlikowski. 1996. “Chipped-Stone Industries from Neolithic Levels at Lerna,” *Hesperia* 65, pp. 295–372.
- Kramer, J. L. 2004. “Analysis and Classification of the Late Helladic I Pottery in the Northeastern Peloponnese of Greece” (diss. Univ. of Cincinnati).
- Kratochwil, Z. 1969. “Species Criteria on the Distal Section of the Tibia in *Ovis ammon f. aries* L. and *Capra aegagrus f. hircus* L.,” *Acta Veterinaria (Brno)* 38, pp. 483–490.
- Krattenmaker, K. 2011. “The Ground-Stone Tools,” in Pullen 2011, pp. 727–740.
- Kreuz, A., E. Marinova, E. Schäfer, and J. Wiethold. 2005. “A Comparison of Early Neolithic Crop and Weed Assemblages from the Linearbandkeramik and the Bulgarian Neolithic Cultures: Differences and Similarities,” *Vegetation History and Archaeobotany* 14, pp. 237–258.
- Kroll, H. 1982. “Kulturpflanzen von Tiryns,” *AA* 1982, pp. 467–485.
- Krzyszowska, O. H. 1984. “Classification of the Bone Tools,” in *Keos* III, pp. 43–45.
- Lambropoulou, A. 1991. “The Middle Helladic Period in the Corinthia and the Argolid: An Archaeological Survey” (diss. Bryn Mawr College).
- Legge, A. J. 1981. “The Agricultural Economy,” in *Grimes Graves Excavations 1971–72*, ed. R. J. Mercer, London, pp. 79–103.
- Lennstrom, H. A., and C. A. Hastorf. 1995. “Interpretation in Context: Sampling and Analysis in Paleoethnobotany,” *AmerAnt* 60, pp. 701–721.
- Lenzusa, V. 2013. “Of Roofs and Roof Drainage: A Survey of the Evidence in Bronze Age Crete,” in *Philiki Sunavlia: Studies in Mediterranean Archaeology for Mario Benzi (BAR-IS 2460)*, ed. G. Graziadio, R. Guglielmino, V. Lenzusa, and S. Vitale, Oxford, pp. 79–98.
- Lerna* = *Lerna, a Preclassical Site in the Argolid: Results of Excavations Conducted by the American School of Classical Studies at Athens*, Princeton
- I = N.-G. Gejvall, *The Fauna*, 1969.
- III = J. B. Rutter, *The Pottery of Lerna IV*, 1995.
- IV = M. H. Wiencke, *The Architecture, Stratification, and Pottery of Lerna III*, 2000.
- Lewis, H. B. 1983. “The Manufacture of Early Mycenaean Pottery” (diss. Univ. of Minnesota).

- Lindblom, M. 2001. *Marks and Makers: Appearance, Distribution, and Function of Middle and Late Helladic Manufacturers' Marks on Aeginetan Pottery* (SIMA 128), Jonsered.
- . 2007. "Early Mycenaean Mortuary Meals at Lerna VI with Special Emphasis on Their Aeginetan Components," in Felten, Gauss, and Smetana 2007, pp. 115–135.
- . In prep. *The Shaft Graves and Other Remains of Lerna VI*.
- Lindblom, M., and G. Ekroth. 2016. "Heroes, Ancestors, or Just Any Old Bones? Contextualizing the Consecration of Human Remains from the Mycenaean Shaft Graves at Lerna in the Argolid," in *Metaphysis: Ritual, Myth, and Symbolism in the Aegean Bronze Age* (Aegaeum 39), ed. E. Alram-Stern, F. Blakolmer, S. Deger-Jalkotzy, R. Laffineur, and J. Weilhartner, Liège, pp. 235–245.
- Lindblom, M., W. Gauss, and E. Kiriatzi. 2015. "Some Reflections on Ceramic Technology Transfer at Bronze Age Kastri on Kythera, Kolonna on Aegina, and Lerna in the Argolid," in Gauss, Klebinder-Gauss, and von Rüdén 2015, pp. 225–237.
- Lindblom, M., and J. B. Rutter. Forthcoming. "An Explosion of Polychromy: Establishing Localized Ceramic Identities at the Dawn of the Mycenaean Era," in *(Social) Place and Space in Early Mycenaean Greece: International Discussions in Mycenaean Archaeology*, ed. B. Eder and M. Zavadil, Vienna.
- Lindblom, M., and B. Wells, eds. 2011. *Mastos in the Berbati Valley: An Intensive Archaeological Survey*, Stockholm.
- Lis, B. 2008a. "Cooked Food in the Mycenaean Feast—Evidence from the Cooking Pots," in *Dais: The Aegean Feast. Proceedings of the 12th International Aegean Conference, University of Melbourne, Centre for Classics and Archaeology, 25-29 March 2008* (Aegaeum 29), ed. L. A. Hitchcock, R. Laffineur, and J. L. Crowley, Liège, pp. 142–150.
- . 2008b. "The Role of Cooking Pottery and Cooked Food in the Palace of Nestor at Pylos," *Archeologia: Rocznik Instytutu Archeologii i Etnologii Polskiej Akademii Nauk* 57, pp. 7–24.
- . 2010. "Cooking Pottery in the Late Bronze Age Aegean—An Attempt at a Methodological Approach," in *Analysing Pottery: Processing, Classification, Publication*, ed. B. Horejs, R. Jung, and P. Pavúk, Bratislava, pp. 235–244.
- . 2012a. "Aeginetan Cooking Pottery in Central Greece and Its Wider Perspective," in *Αρχαιολογικό Έργο Θεσσαλίας και Στερεάς Ελλάδας. Πρακτικά επισημοποιημένης συνάντησης 3 / Proceedings of the 3rd Archaeological Meeting of Thessaly and Central Greece 2006–2008. From Prehistory to the Contemporary Period*, ed. A. Mazarakis Ainian and A. Doulgeri-Intzesiloglou, Volos, pp. 1203–1211.
- . 2012b. "Late Bronze Age Cooking Pots from Mitrou and Their Change in the Light of Socio-economic Transformations" (diss. Polish Academy of Sciences).
- . 2015. "From Cooking Pots to Cuisine: Limitations and Perspectives of a Ceramic-Based Approach," in *Ceramics, Cuisine, and Culture: The Archaeology and Science of Kitchen Pottery in the Ancient Mediterranean World*, ed. M. Spataro and A. Villing, Oxford, pp. 104–114.
- . 2017a. "Foodways in Early Mycenaean Greece: Innovative Cooking Sets and Social Hierarchy at Mitrou and Other Settlements on the Greek Mainland," *AJA* 121, pp. 183–217.
- . 2017b. "Mycenaean Cooking Pots: Attempt at an Interregional Comparison," in Hruby and Trusty 2017, pp. 39–45.
- Lis, B., and Š. Růckl. 2011. "Our Storerooms Are Full: Impressed Pithoi from Late Bronze/Early Iron Age East Lokris and Phokis and Their Socio-economic Significance," in Gauss, Lindblom, Smith, and Wright 2011, pp. 154–168.
- Lis, B., Š. Růckl, and M. Choleva. 2015. "Mobility in the Bronze Age Aegean—The Case of Aeginetan Potters," in Gauss, Klebinder-Gauss, and von Rüdén 2015, pp. 63–75.
- Lister, A. 1996. "The Morphological Distinction between Bones and Teeth of Fallow Deer (*Dama dama*) and Red Deer (*Cervus elaphus*)," *International Journal of Osteoarchaeology* 6, pp. 119–143.
- Lolos, Y. 1987. *The Late Helladic I Pottery of the Southwestern Peloponnesos and Its Local Characteristics* (SIMA-PB 50), Göteborg.
- Lord, L. E. 1947. *A History of the American School of Classical Studies at Athens, 1882–1942*, Cambridge, Mass.
- Lucas, A. 1948. *Ancient Egyptian Materials and Industries*, 3rd rev. ed., Timperley, Altrincham.
- Lyman, R. L. 1994. *Vertebrate Taphonomy*, Cambridge.
- MacGillivray, J. A. 1987. "Pottery Workshops and the Old Palaces in Crete," in *The Function of the Minoan Palaces* (*ActaAth* 4°, 35), ed. R. Hägg and N. Marinatos, Stockholm, pp. 273–279.
- Maier, A. M., and L. A. Hitchcock. 2011. "Absence Makes the Hearth Grow Fonder: Searching for the Origins of the Philistine Hearth," *ErIsr* 30, pp. 46–64.
- Mallaburn, A. C. 1991. "A Provenance Study of 57 Samples from Tsoungiza" (3rd year project for BSc degree, Univ. of Manchester).
- Mangafa, M., and K. Kotsakis. 1996. "A New Method for the Identification of Wild and Cultivated Charred Grape," *JAS* 23, pp. 409–418.
- Manning, S. W. 2010. "Chronology and Terminology," in *The Oxford Handbook of the Bronze Age Aegean (ca. 3000–1000 B.C.)*, ed. E. H. Cline, Oxford, pp. 11–28.
- Manning, S. W., F. Höflmayer, N. Moeller, M. W. Dee, C. Bronk Ramsey, D. Fleitmann, T. Higham, W. Kutschera, and E. M. Wild. 2014. "Dating the Thera (Santorini) Eruption: Archaeological and Scientific Evidence Supporting a High Chronology," *Antiquity* 88, pp. 1164–1179.
- Manning, S. W., C. B. Ramsey, W. Kutschera, T. Higham, B. Kromer, P. Steier, and E. M. Wild. 2006. "Supporting Online Material for Chronology for the Aegean Late Bronze Age 1700–1400 B.C.," *Science* 312, pp. 565–569, www.sciencemag.org/cgi/content/full/312/5773/565/DC1.
- Maran, J. 1988. "Zur Zeitstellung der Grabhügel von Marara," *ArchKorrBl* 18, pp. 341–355.
- . 1992a. *Die deutschen Ausgrabungen auf der Pevkakia-Magula in Thessalien III: Die mittlere Bronzezeit I–II* (Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer Kulturraumes 30–31), Bonn.
- . 1992b. *Kiapha Thiti: Ergebnisse der Ausgrabungen II.2: 2. Jt. v. Chr. Keramik und Kleinfunde* (MarbWPr 1990), Marburg.
- . 2001. "Zur Frage des Vorgängers des ersten Doppelpalastes von Tiryns," in *Ithake: Festschrift für Jörg Schäfer zum 75. Geburtstag am 25. April 2001*, ed. S. Böhm and K.-V. von Eickstedt, Würzburg, pp. 23–29.
- . 2009. "Mycenaean Citadels as Performative Space," in *Constructing Power: Architecture, Ideology, and Social Practice*, ed. J. Maran, C. Juwig, H. Schwengel, and U. Thaler, Berlin, pp. 75–88.
- . 2010. "Tiryns," in *The Oxford Handbook of the Bronze Age Aegean (ca. 3000–1000 B.C.)*, ed. E. H. Cline, Oxford, pp. 722–734.

- . 2011. “Lost in Translation: The Emergence of Mycenaean Culture as a Phenomenon of Glocalization,” in *Interweaving Worlds: Systemic Interactions in Eurasia, 7th to 1st Millennia B.C.*, ed. T. C. Wilkinson, S. Sherratt, and J. Bennet, Oxford, pp. 282–294.
- . 2015. “Tiryns and the Argolid in Mycenaean Times: New Clues and Interpretations,” in Schallin and Tournavitou 2015, pp. 277–293.
- Marthari, M. 1980. “Ακρωτήρι: κεραμική μεσοελλαδικής παράδοσης στο στρώμα της ηφαιστειακής καταστροφής,” *ArchEph* 1980, pp. 182–210.
- . 1993. “The Ceramic Evidence for Contacts between Thera and the Greek Mainland,” in Zerner, Zerner, and Winder 1993, pp. 249–256.
- Martin, S. L. 1992. “Mycenaean Pottery from the Settlement Part II: The Late Helladic IIIA1 Pottery,” in McDonald and Wilkie 1992, pp. 488–495, 534–537.
- Mathioudaki, I. 2011. “Η ‘ηπειρωτική πολύχρωμη’ κεραμική στην ηπειρωτική Ελλάδα και το Αιγαίο,” 2 vols. (diss. Univ. of Athens).
- Mattern, T. 2013. “Kleonai: Neue Forschungen in einer Stadt des ‘Dritten Griechenlands,’” in Kissas and Nie-meier 2013, pp. 323–332.
- Matthäus, H. 1980. *Die Bronzegefäße der kretisch-mykenischen Kultur* (Prähistorische Bronzefunde II.1), Munich.
- McDonald, W. A., and N. C. Wilkie, eds. 1992. *Excavations at Nichoria in Southwest Greece II: The Bronze Age Occupation*, Minneapolis.
- McNamee, C. 2016. “Starch Grain Analysis from Ground Stone Tools at Tsoungiza” (unpublished draft report, June 1, 2016).
- Megaloudi, F. 2006. *Plants and Diet in Greece from Neolithic to Classic Periods: The Archaeobotanical Remains (BAR-IS 1516)*, Oxford.
- Miksicek, C. H. 1986. “Formation Processes of the Archaeobotanical Record,” *Advances in Archaeological Method and Theory* 10, pp. 211–247.
- Miller, N. F. 1988. “Ratios in Paleoethnobotanical Analysis,” in *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, ed. C. A. Hastorf and V. S. Popper, Chicago, pp. 72–96.
- Miller, S. G. 1975. “Excavations at Nemea, 1973–1974,” *Hesperia* 44, pp. 143–172.
- . 1976. “Excavations at Nemea, 1975,” *Hesperia* 45, pp. 174–202.
- . 1980. “Excavations at Nemea, 1979,” *Hesperia* 49, pp. 178–205.
- . 1982a. “Excavations at Nemea, 1981,” *Hesperia* 51, pp. 19–40.
- . 1982b. “Kleonai, the Nemean Games, and the Lamian War,” in *Studies in Athenian Architecture, Sculpture, and Topography Presented to Homer A. Thompson (Hesperia Suppl. 20)*, Princeton, pp. 100–108.
- . 1988a. “Excavations at Nemea, 1984–1986,” *Hesperia* 57, pp. 1–20.
- . 1988b. “The Theorodokoi of the Nemean Games,” *Hesperia* 57, pp. 147–163.
- Minnis, P. E. 1981. “Seeds in Archaeological Sites: Sources and Some Interpretive Problems,” *AmerAnt* 46, pp. 143–152.
- Mommsen, H. 2014. “Provenance by Neutron Activation Analyses and Results of Euboean and Euboean-Related Pottery,” in *Archaeometric Analyses of Euboean and Euboean-Related Pottery: New Results and Their Interpretations* (Ergänzungshefte zu den Jahresheften des Österreichischen Archäologischen Instituts in Wien 15), ed. M. Kerschner and I. S. Lemos, pp. 13–36.
- Mommsen, H., M. Bentz, and A. Boix. 2016. “Provenance of Red-Figured Pottery of the Classical Period Excavated at Olympia,” *Archaeometry* 58, pp. 371–379.
- Mommsen, H., W. Gauss, S. Hiller, D. Ittameier, and J. Maran. 2001. “Charakterisierung bronzzeitlicher Keramik von Ägina durch Neutronaktivierungsanalyse,” in *Archäologisches Zellwerk: Beiträge zur Kulturgeschichte in Europa und Asien. Festschrift für Helmut Roth zum 60. Geburtstag*, ed. E. Pohl, U. Recker, and C. Theune, Rahden, pp. 79–96.
- Mommsen, H., A. Kreuser, and J. Weber. 1988. “A Method for Grouping Pottery by Chemical Composition,” *Archaeometry* 30, pp. 47–57.
- Mommsen, H., E. Lewandowski, J. Weber, and C. Podzweit. 1988. “Neutron Activation Analysis of Mycenaean Pottery from the Argolid: The Search for Reference Groups,” in *Proceedings of the 26th International Archaeometry Symposium*, ed. R. M. Farquhar, R. G. V. Hancock, and L. Pavlish, Toronto, pp. 165–171.
- Mommsen, H., and P. Pavúk. 2007. “Provenance of Grey and Tan Wares from Troy, Cyprus, and the Levant,” *Studia Troica* 17, pp. 25–41.
- Mommsen, H., and B. L. Sjöberg. 2007. “The Importance of the Best Relative Fit Factor When Evaluating Elemental Concentration of Pottery Demonstrated with Mycenaean Sherds from Sinda, Cyprus,” *Archaeometry* 49, pp. 357–369.
- Moody, J., H. L. Robinson, J. Francis, L. Nixon, and L. Wilson. 2003. “Ceramic Fabric Analysis and Survey Archaeology: The Sphakia Survey,” *BSA* 98, pp. 37–105.
- Moore, A. D., and W. D. Taylour. 1999. *Well Built Mycenae: The Helleno-British Excavations within the Citadel at Mycenae, 1959–1969 10: The Temple Complex*, Oxford.
- Morris, C., and R. Jones. 1998. “The Late Bronze Age III Town of Ayia Irini and Its Aegean Relations,” in *Kea-Kythnos: History and Archaeology*, ed. L. G. Mendoni and A. J. Mazarakis Ainian, Athens, pp. 189–199.
- Moundrea-Agrafioti, A. 1981. “La Thessalie du sud-est au néolithique: Outillage lithique et osseux” (thèse de 3^e cycle, Univ. de Paris X).
- . 1990. “Akrotiri, The Chipped-Stone Industry: Reduction Techniques and Tools of the LC I Phase,” in *Thera and the Aegean World III: Proceedings of the Third International Congress, Santorini, Greece, 3–9 September 1989*, ed. D. A. Hardy, C. G. Doumas, J. A. Sakellarakis, and P. M. Warren, London, pp. 390–406.
- . 2008. “Neolithic and Early Bronze Age Flaked Stone Industry of Ayios Dhimitrios (Lepreo),” in *Ayios Dhimitrios, a Prehistoric Settlement in the Southwestern Peloponnese: The Neolithic and Early Helladic Periods (BAR-IS 1770)*, by K. Zachos, Oxford, pp. 231–266.
- Mountjoy, P. A. 1981. *Four Early Mycenaean Wells from the South Slope of the Acropolis at Athens* (Miscellanea Graeca 4), Gent.
- . 1983. “The Ephyraean Goblet Reviewed,” *BSA* 78, pp. 265–271.
- . 1984. “The Marine Style Pottery of LM IB/LH IIA: Towards a Corpus,” *BSA* 79, pp. 161–219.
- . 1986. *Mycenaean Decorated Pottery: A Guide to Identification (SIMA 73)*, Göteborg.
- . 1999. *Regional Mycenaean Decorated Pottery*, Rahden.
- . 2003. *Knossos: The South House (BSA Suppl. 34)*, London.

- . 2008. “The Late Helladic Pottery,” in Tylour and Janko 2008, pp. 299–387.
- Mountjoy, P. A., R. E. Jones, and J. F. Cherry. 1978. “Provenance Studies of the LM IB/LH IIA Marine Style,” *BSA* 73, pp. 143–171.
- Mountjoy, P. A., and M. J. Ponting. 2000. “The Minoan Thalassocracy Reconsidered: Provenance Studies of LH IIA/LM IB Pottery from Phylakopi, Ay. Irini, and Athens,” *BSA* 95, pp. 141–184.
- Moutafi, I., and S. Voutsaki. 2016. “Commingle Burials and Shifting Notions of the Self at the Onset of the Mycenaean Era (1700–1500 B.C.E.): The Case of the Ayios Vasilios North Cemetery, Laconia,” *JAS Reports* 10, pp. 780–790.
- Müller, W. 1997. *Kretische Tongefässe mit Meeresdekor: Entwicklung und Stellung innerhalb der Feinen Keramik von Spätminosisch IB auf Kreta*, Berlin.
- Munsell Color Company. 1991. *Munsell Soil Color Charts*, Baltimore.
- Mylona, D. 2007. “The Fish Remains,” in *Palaikastro: Two Late Minoan Wells* (BSA Suppl. 43), ed. J. A. MacGillivray, L. H. Sackett, and J. M. Driessen, London, pp. 217–220.
- Mylonas, G. E. 1959. *Aghios Kosmas: An Early Bronze Age Settlement and Cemetery in Attica*, Princeton.
- . 1973. *Ο ταφικός κύκλος Β των Μυκηνών* (Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 73), Athens.
- . 1975. *Το δυτικόν νεκροταφείον της Ελευσίνος* (Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 81), 3 vols., Athens.
- Mylonas-Shear, I. 1987. *The Panagia Houses at Mycenae* (University Museum Monograph 68), Philadelphia.
- Nakassis, D. 2013. *Individuals and Society in Mycenaean Pylos* (Mnemosyne Suppl. 358), Leiden.
- . 2015. “Labor and Individuals in Late Bronze Age Pylos,” in *Labor in the Ancient World*, ed. P. Steinkeller and M. Hudson, Dresden, pp. 583–615.
- Nakassis, D., J. Gulizio, and S. A. James, eds. 2014. *KE-RA-ME-JA: Studies Presented to Cynthia W. Shelmerdine* (Prehistory Monographs 46), Philadelphia.
- Nelson, M. C. 2001. “The Architecture of Epano Englianos, Greece” (diss. Univ. of Toronto).
- . 2007. “Pylos, Block Masonry, and Monumental Architecture in the Late Bronze Age Peloponnese,” in *Power and Architecture: Monumental Public Architecture in the Bronze Age Near East and Aegean* (Orientalia Lovaniensia Analecta 156), ed. J. Bretschneider, J. Driessen, and K. van Lerberghe, Leuven, pp. 143–159.
- . 2017. “The Architecture of the Palace of Nestor,” in *The Minnesota Pylos Project, 1990–98* (BAR-IS 2856), ed. F. A. Cooper and D. Fortenberry, Oxford, pp. 283–418.
- Newhard, J. 2001. “The Chert Beds at Ayia Eleni: New Discoveries and Lithic Ecology in the Bronze Age Argolid,” *AJA* 105, p. 280 (abstract).
- Niekamp, A. N. 2016. “Crop Growing Conditions and Agricultural Practices in Bronze Age Greece: A Stable Isotope Analysis of Archaeobotanical Remains from Tsoungiza” (M.A. thesis, Univ. of Cincinnati).
- Niemeier, W.-D. 1985. *Die Palaststilkeramik von Knossos: Stil, Chronologie und historischer Kontext*, Berlin.
- Nikolakopoulou, I. 2007. “Aspects of Interaction between the Cyclades and the Mainland in the Middle Bronze Age,” in Felten, Gauss, and Smetana 2007, pp. 347–359.
- Noll, W. 1982. “Mineralogie und Technik der Keramiken Altkretas,” *Neues Jahrbuch für Mineralogie, Abhandlungen* 143, pp. 150–199.
- Noll, W., R. Holm, and L. Born. 1971. “Chemie und Techniken altkretischer Vasenmalerei vom Kamares-Typ,” *Die Naturwissenschaften* 58, pp. 615–618.
- Nordquist, G. 1985. “Floor Deposits on the Barbouna Slope at Asine,” *Hydra* 1, pp. 19–33.
- . 1987. *A Middle Helladic Village: Asine in the Argolid* (Uppsala Studies in Ancient Mediterranean and Near Eastern Civilizations 16), Uppsala.
- . 1999. “Pairing of Pots in the Middle Helladic Period,” in Betancourt et al. 1999, pp. 569–573.
- Orchomenos V* = P. A. Mountjoy, *Mycenaean Pottery from Orchomenos, Eutresis, and other Boeotian Sites* (Orchomenos V), Munich 1983.
- Orton, C., P. Tyers, and A. G. Vince. 1993. *Pottery in Archaeology*, Cambridge.
- Palaima, T. G. 1988. “The Development of the Mycenaean Writing System,” in *Texts, Tablets, and Scribes* (Minos Suppl. 10), ed. J.-P. Olivier and T. G. Palaima, Salamanca, pp. 269–342.
- Palmer, R. 1992. “Wheat and Barley in Mycenaean Society,” in *Mykenaiika. Actes du IX^e Colloque international sur les textes mycéniens et égéens* (BCH Suppl. 25), ed. J.-P. Olivier, Paris, pp. 475–497.
- . 2008. “Wheat and Barley in Mycenaean Society 15 Years Later,” in *Colloquium Romanum. Atti del XII colloquio internazionale di micenologia, Roma, 20–25 febbraio 2006* 2 (Pasiphae 2), ed. A. Sacconi, M. Del Freato, L. Godart, and M. Negri, Pisa, pp. 621–639.
- Palyou, C. 2005. *Akrotiri Thera: An Architecture of Affluence 3,500 Years Old* (Prehistory Monographs 15), Philadelphia.
- . 2016. *Akrotiri Thera: An Architecture of Affluence 3,500 Years Old* (Prehistory Monographs 15), repr. Philadelphia.
- Pantelidou-Gkophera, M. 1991. *Η νεολιθική Νέα Μάκρη: Οικοδομικά*, Athens.
- Papadimitriou, N. 2001. *Built Chamber Tombs of Middle and Late Bronze Age Date in Mainland Greece and the Islands* (BAR-IS 925), Oxford.
- Papadimitriou, N., A. Philippa-Touchais, and G. Touchais. 2015. “Argos in the MBA and LBA,” in Schallin and Tournavitou 2015, pp. 161–184.
- Papadopoulos, T. J. 1998. *The Late Bronze Age Daggers of the Aegean 1: The Greek Mainland* (Prähistorische Bronzefunde VI.11), Stuttgart.
- Papazoglou-Manioudaki, L. 2010. “The Middle Helladic and Late Helladic I Periods at Aigion in Achaia,” in *Mesohelladika: The Greek Mainland in the Middle Bronze Age* (BCH Suppl. 52), ed. A. Philippa-Touchais, G. Touchais, S. Voutsaki, and J. C. Wright, Paris, pp. 129–141.
- Papazoglou-Manioudaki, L., A. Nafplioti, J. H. Musgrave, R. A. H. Neave, D. Smith, and A. J. N. W. Prag. 2009. “Mycenae Revisited Part 1: The Human Remains from Grave Circle A. Stamatakis, Schliemann, and Two New Faces from Shaft Grave VI,” *BSA* 104, pp. 233–277.
- Papazoglou-Manioudaki, L., A. Nafplioti, J. H. Musgrave, and A. J. N. W. Prag. 2010. “Mycenae Revisited Part 3: The Human Remains from Grave Circle A. Behind the Masks: A Study of the Bones of Shaft Graves I–V,” *BSA* 105, pp. 157–224.
- Pappi, E., and V. Isaakidou. 2015. “On the Significance of Equids in the Late Bronze Age Aegean: New and Old Finds from the Cemetery of Dendra in Context,” in Schallin and Tournavitou 2015, pp. 469–481.

- Parkinson, W. A. 2007. "Chipping Away at a Mycenaean Economy: Obsidian Exchange, Linear B, and 'Palatial Control' in Late Bronze Age Messenia," in *Rethinking Mycenaean Palaces II* (Cotsen Institute Monograph 60), ed. M. L. Galaty and W. A. Parkinson, 2nd ed., Los Angeles, pp. 87–101.
- Parkinson, W. A., and J. F. Cherry. 2010. "Pylos Regional Archaeological Project, Part VIII: Lithics and Landscapes: A Messenian Perspective," *Hesperia* 79, pp. 1–51.
- Parkinson, W. A., D. Nakassis, and M. L. Galaty. 2013. "Crafts, Specialists, and Markets in Mycenaean Greece: Introduction," *AJA* 117, pp. 413–422.
- Parkinson, W. A., and D. J. Pullen. 2014. "The Emergence of Craft Specialization on the Greek Mainland," in Nakassis, Gulizio, and James 2014, pp. 73–81.
- Parlama, L., and N. C. Stampolidis, eds. 2000. *Athens: The City beneath the City*, Athens.
- Pavúk, P., and B. Horejs. 2012. *Sammlung Fritz Schachermeyr 3: Mittel- und spätbronzezeitliche Keramik Griechenlands*, Vienna.
- Payne, S. 1972. "Partial Recovery and Sample Bias: The Results of Some Sieving Experiments," in *Papers in Economic Prehistory*, ed. E. S. Higgs, London, pp. 49–64.
- . 1973. "Kill-Off Patterns in Sheep and Goats: The Mandibles from Aşvan Kalé," *AnatSt* 23, pp. 281–303.
- . 1985a. "Morphological Distinctions between the Mandibular Teeth of Young Sheep, *Ovis*, and Goats, *Capra*," *JAS* 12, 139–147.
- . 1985b. "Zoo-archaeology in Greece: A Reader's Guide," in *Contributions to Aegean Archaeology: Studies in Honor of William A. McDonald*, ed. N. C. Wilkie and W. D. E. Coulson, Minneapolis, pp. 211–244.
- . 1987. "Reference Codes for Wear States in the Mandibular Cheek Teeth of Sheep and Goats," *JAS* 14, pp. 609–614.
- Payne, S., and G. Bull. 1988. "Components of Variation in Measurements of Pig Bones and Teeth and the Use of Measurements to Distinguish Wild from Domestic Pig Remains," *Archaeozoologia* 2, pp. 27–66.
- Pearson, C. L., P. W. Brewer, D. Brown, T. J. Heaton, G. W. L. Hodgins, A. J. T. Jull, T. Lange, and M. W. Salzer. 2018. "Annual Radiocarbon Record Indicates 16th-Century B.C.E. Date for the Thera Eruption," *Science Advances* 4, doi: 10.1126/sciadv.aar8241.
- Pelegrin, J. 1995. *Technologie lithique: Le Châtelperronien de Roc-de-Combe (lot) et de la côte (Dordogne)* (Cahiers du Quaternaire 20), Paris.
- Perlès, C. 1990. "L'outillage de pierre taillée néolithique en Grèce: Approvisionnement et exploitation des matières premières," *BCH* 114, pp. 1–42.
- . 1992. "Systems of Exchange and Organization of Production in Neolithic Greece," *JMA* 5, pp. 115–164.
- . 1994. *Les industries lithiques taillées de Tharrounia (Eubée)* (Ateliers 15), Paris.
- Petrakis, V. P. 2011. "Politics of the Sea in the Late Bronze Age II–III Aegean: Iconographic Preferences and Textual Perspectives," in *The Seascape in Aegean Prehistory* (Monographs of the Danish Institute at Athens 14), ed. G. Vavouranakis, Athens, pp. 185–234.
- Philippa-Touchais, A. 2002. "Aperçu des céramiques mésohelladiques à décor peint de l'Aspis d'Argos," *BCH* 126, pp. 1–40.
- . 2007. "Aeginetan Matt Painted Pottery at Middle Helladic Aspis, Argos," in Felten, Gauss, and Smetana 2007, pp. 97–113.
- Philippa-Touchais, A., and G. Touchais. Forthcoming. "The Social Dynamics of Argos in a Constantly Changing Landscape (HM II–HR IIIA1)," in *(Social) Place and Space in Early Mycenaean Greece*, ed. B. Eder and M. Zavadil, Vienna.
- Piérart, M., and G. Touchais. 1996. *Argos: Une ville grecque de 6000 ans*, Paris.
- Podzuweit, C. 1977. "Ein mykenischer Kieselmosaikfußboden aus Tiryns: Die Fundsituation und Datierung des Mosaiks," *AA* 1977, pp. 123–134.
- Popham, M. R. 1984. *The Minoan Unexplored Mansion at Knossos* (BSA Suppl. 17), London.
- Poppe, G. T., and Y. Goto. 1991. *European Seashells 1: Polyplacochora, Caudofoveata, Solenogastrea, Gastropoda*, Wiesbaden.
- Popper, V. S. 1988. "Selecting Quantitative Measurements in Paleoethnobotany," in *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, ed. C. A. Hastorf and V. S. Popper, Chicago, pp. 53–71.
- Pritchett, W. K. 1969. *Studies in Ancient Greek Topography, Part II (Battlefields)*, Berkeley.
- Privitera, S. 2013. *Principi, Pelasgi e pescatori: L'Attica nella Tarda Età del Bronzo*, Athens.
- Protonotariou-Deilaki, E. 1980. *Οι τύμβοι του Άργους*, Athens.
- Pruckner, K. 2010. "Äginetische Keramik der Schachtgräberzeit: Bichrom und vollständig bemalte Keramik aus dem Brunnen SH B1/06 in Ägina Kolonna" (diss. Univ. of Salzburg).
- . 2011. "Vollständig und bichrom bemalte äginetische Keramik des späten MH bis frühen SH aus Ägina-Kolonna," in *Österreichische Forschungen zur Ägäischen Bronzezeit 2009*, ed. F. Blakolmer, C. Reinholdt, J. Weilharter, and G. Nightingale, Vienna, pp. 241–252.
- Prummel, W. 1987a. "Atlas for Identification of Foetal Skeletal Elements of Cattle, Horse, Sheep, and Pig: Part 1," *Archaeozoologia* 1:1, pp. 23–30.
- . 1987b. "Atlas for Identification of Foetal Skeletal Elements of Cattle, Horse, Sheep, and Pig: Part 2," *Archaeozoologia* 1:2, pp. 11–42.
- Prummel, W., and H.-J. Frisch. 1986. "A Guide for the Distinction of Species, Sex, and Body Side in Bones of Sheep and Goat," *JAS* 13, pp. 567–577.
- Pullen, D. 1992. "Ox and Plow in the Early Bronze Age Aegean," *AJA* 96, pp. 45–54.
- . 1994. "A Lead Seal from Tsoungiza, Ancient Nemea, and Early Bronze Age Sealing Systems," *AJA* 98, pp. 35–52.
- . 2008. "The Early Bronze Age in Greece," in Shelmerdine 2008b, pp. 19–46.
- . 2011. *Nemea Valley Archaeological Project I: The Early Bronze Age Village on Tsoungiza Hill*, Princeton.
- . 2013. "Exchanging the Mycenaean Economy," *AJA* 117, pp. 437–445.
- Radu, V. 2003. "Exploitation des ressources aquatiques dans les cultures néolithiques et chalcolithiques de la Roumanie méridionale" (diss. Univ. d'Aix-Marseille I).
- Rahmstorf, L. 2008. *Kleinfunde aus Tiryns: Terrakotta, Stein, Bein und Glas/Fayence vornehmlich aus der Spätbronzezeit* (Tiryns: Forschungen und Berichte 16), Wiesbaden.
- Rapoport, A. 1982. *The Meaning of the Built Environment: A Non-Verbal Communication Approach*, Beverly Hills.
- Reese, D. S. 1983. "The Use of Cone Shells in Neolithic and Bronze Age Greece," *BSA* 78, pp. 353–357.

- . 1992. “Appendix I: Recent and Fossil Invertebrates (with a Note on the Nature of the MHI Fauna),” in McDonald and Wilkie 1992, pp. 770–778.
- . 1995. “The Marine Invertebrates,” in *Kommos I: The Kommos Region and the Houses of the Minoan Town, Part 1: The Kommos Region, Ecology, and Minoan Industries*, ed. J. W. Shaw and M. C. Shaw, Princeton, pp. 240–273.
- . 2006. “The Shells: Appendix 2,” in *Lefkandi IV: The Bronze Age. The Late Helladic IIIC Settlement at Xeropolis* (BSA Suppl. 39), ed. D. Evely, London, CD-ROM pp. 20–29.
- . 2007. “Shells,” in *Palaikastro: Two Late Minoan Wells* (BSA Suppl. 43), ed. J. A. MacGillivray, L. H. Sackett, and J. M. Driessen, p. 221.
- . 2008a. “Faunal Remains from Late Helladic Lerna (Argolid, Greece),” *Mediterranean Archaeology and Archaeometry* 8, pp. 5–25.
- . 2008b. “The Marine and Fresh-Water Invertebrates, 1973–1977,” in Taylour and Janko 2008, pp. 519–524.
- Reese, D. S., D. Mylona, J. Bending, and M. Ntinou. 2011. “Fauna and Flora,” in *Mochlos IIC: Period IV, The Mycenaean Settlement and Cemetery. The Human Remains and Other Finds* (Prehistory Monographs 32), ed. J. S. Soles and C. Davaras, Philadelphia, pp. 125–148.
- Reimer, P. J., A. Bard, A. Bayliss, and W. Beck. 2013. “IntCal¹³ and Marine¹³ Radiocarbon Age Calibration Curves 0–50,000 Years Cal B.P.,” *Radiocarbon* 55, pp. 1869–1887.
- Reitz, E. J., and E. S. Wing, 1999. *Zooarchaeology* (Cambridge Manuals in Archaeology), Cambridge.
- Renfrew, A. C., and M. Wagstaff. 1982. *An Island Polity: The Archaeology of Exploitation in Melos*, Cambridge.
- Rice, P. M. 1987. *Pottery Analysis: A Sourcebook*, Chicago.
- Richards, M. P., and R. E. M. Hedges. 2008. “Stable Isotope Evidence of Past Human Diet at the Sites of the Neolithic Cave of Gerani, the Late Minoan III Cemetery of Armenoi, Grave Circles A and B at the Palace Site of Mycenae, and Late Helladic Chamber Tombs,” in *Archaeology Meets Science: Biomolecular and Site Investigations in Bronze Age Greece*, ed. H. Martlew and Y. Tzedakis, Oxford, pp. 220–230.
- Riley, J. A. 1981. “Late Bronze Age Aegean and the Roman Mediterranean: A Case for Comparison,” in *Production and Distribution: A Ceramic Viewpoint* (BAR-IS 120), ed. H. Howard and E. Morris, Oxford, pp. 133–143.
- Risch, R. 2002. *Recursos naturales, medios de producción y explotación social* (Iberia Archaeologica 3), Mainz.
- Rose, M. J. 1994. “With Line and Glittering Bronze Hook: Fishing in the Aegean Bronze Age” (diss. Indiana Univ.).
- . 1995. “The Fish Remains,” in *Kommos I: The Kommos Region and the Houses of the Minoan Town, Part 1: The Kommos Region, Ecology, and Minoan Industries*, ed. J. W. Shaw and M. C. Shaw, Princeton, pp. 204–239.
- . 2008. “The Fish Remains, 1973–1977,” in Taylour and Janko 2008, pp. 517–519.
- Roux, V., and M. A. Courty. 1998. “Identification of Wheel-Fashioning Methods: Technological Analysis of 4th–3rd Millennium B.C. Oriental Ceramics,” *JAS* 25, pp. 747–763.
- Runnels, C. N. 1981. “A Diachronic Study and Economic Analysis of Millstones from the Argolid, Greece” (diss. Indiana Univ., Bloomington).
- . 1985a. “The Bronze Age Flaked-Stone Industries from Lerna: A Preliminary Report,” *Hesperia* 54, pp. 357–391.
- . 1985b. “Trade and the Demand for Millstones in Southern Greece in the Neolithic and the Early Bronze Age,” in *Prehistoric Production and Exchange: The Aegean and Eastern Mediterranean* (UCLAMon 25), ed. A. B. Knapp and T. Stech, Los Angeles, pp. 30–43.
- Ruppenstein, F. 2012. “Gesellschaftliche Transformationen und politisch-soziale Krisen im frühen Griechenland: Überlegungen zur Entstehung mykenischer Palaststaaten,” in *Krise und Transformation: Beiträge des internationalen Symposiums vom 22. bis 23. November 2010 an der Österreichischen Akademie der Wissenschaften*, ed. S. Deger Jalkotzy and A. Suppan, Vienna, pp. 37–68.
- Rutter, J. B. 1983. “Some Thoughts on the Analysis of Ceramic Data Generated by Site Surveys,” in *Archaeological Survey in the Mediterranean Area* (BAR-IS 155), ed. D. R. Keller and D. W. Rupp, Oxford, pp. 137–143.
- . 1985. “Middle Helladic Pottery from Tsoungiza (Archaia Nemea): A Brief Report,” *Hydra* 1, pp. 34–36.
- . 1989. “A Ceramic Definition of Late Helladic I from Tsoungiza,” *Hydra* 6, pp. 1–19.
- . 1990. “Pottery Groups from Tsoungiza of the End of the Middle Bronze Age,” *Hesperia* 59, pp. 375–458.
- . 1993a. “Early Helladic Pottery: Inferences about Exchange and Production from Style and Clay Composition,” in Zerner, Zerner, and Winder 1993, pp. 19–37.
- . 1993b. “A Group of Late Helladic IIA Pottery from Tsoungiza,” *Hesperia* 62, pp. 53–93.
- . 1993c. “The Prepalatial Bronze Age of the Southern and Central Greek Mainland,” *AJA* 97, pp. 745–797.
- . 2001. “Review of Aegean Prehistory II: The Prepalatial Bronze Age of the Southern and Central Greek Mainland,” in *Aegean Prehistory: A Review*, ed. T. Cullen, Boston, pp. 95–155.
- . 2005. “Southern Triangles Revisited: Lakonia, Messenia, and Crete in the 14th–12th Centuries B.C.,” in *Ariadne’s Threads: Connections between Crete and the Greek Mainland in Late Minoan III (LM IIIA2 to LM IIIC)* (Tripodes 3), ed. A. L. D’Agata, J. Moody, and E. Williams, Athens, pp. 17–50.
- . 2007. “Reconceptualizing the Middle Helladic ‘Type Site’ from a Ceramic Perspective: Is ‘Bigger’ Really ‘Better?’” in Felton, Gauss, and Smetana 2007, pp. 35–44.
- . 2012a. “Migrant Drinking Assemblages in Aegean Bronze Age Settings,” in *Materiality and Social Practice*, ed. J. Maran and P. Stockhammer, Oxford, pp. 73–88.
- . 2012b. “Size Matters . . . So What Do Giant Semi-globular Cups Signify?” in *Kretes Minoidos: Tradizione e identità minoica tra produzione artigianale, pratiche cerimoniali e memoria del passato. Studi offerti a Vincenzo La Rosa per il Suo 70° compleanno*, ed. F. Carinci, N. Cucuzza, P. Militello, and O. Palio, Padua, pp. 139–149.
- . 2013. “What Happened to the Lights? Changes in the Usage of Ceramic Lamps at Neopalatial and Early Postpalatial Kommos,” in *Philike Sunavlia: Studies in Mediterranean Archaeology for Mario Benzi* (BAR-IS 2460), ed. G. Graziadio, R. Guglielmino, V. Lenuzza, and S. Vitale, Oxford, pp. 31–38.
- . 2014. “The Canaanite Transport Amphora within the Late Bronze Age Aegean: A 2013 Perspective on a Frequently Changing Picture,” in Nakassis, Gulizio, and James 2014, pp. 53–69.
- . 2015. “Ceramic Technology in Rapid Transition: The Evidence from Settlement Deposits of the Shaft Grave Era at Tsoungiza (Corinthia),” in Gauss, Klebinder-Gauss, and von Rügen 2015, pp. 207–223.

- . 2017. *House X at Kommos: A Minoan Mansion near the Sea 2. The Pottery* (Prehistory Monographs 57), Philadelphia.
- Rutter, J. B., and S. H. Rutter. 1976. *The Transition to Mycenaean: A Stratified Middle Helladic II to Late Helladic IIA Pottery Sequence from Ayios Stephanos in Lakonia* (Monumenta Archaeologica 4), Los Angeles.
- Säflund, G. 1965. *Excavations at Berbati 1936–1937*, Stockholm.
- Sahlins, M. 1972. *Stone Age Economics*, Chicago.
- Sarpaki, A. 1992. “The Palaeoethnobotanical Approach: The Mediterranean Triad or Is It a Quartet?” in *Agriculture in Ancient Greece. Proceedings of the Seventh International Symposium at the Swedish Institute at Athens, 16–17 May 1990*, ed. B. Wells, Stockholm, pp. 61–76.
- Schachermeyr, F. 1976. *Die ägäische Frühzeit 2: Die mykenische Zeit und die Gesittung von Thera* (SBWien 309), Vienna.
- Schallin, A.-L. 1997. “The Late Bronze Age Potter’s Workshop at Mastos in the Berbati Valley,” in *Trade and Production in Premonetary Greece: Production and the Craftsman* (SIMA-PB 143), ed. C. Gillis, C. Risberg, and B. Sjöberg, Jonsered, pp. 73–88.
- . 2002. “Pots for Sale: The Late Helladic IIIA and IIIB Ceramic Production at Berbati,” in *New Research on Old Material from Asine and Berbati in Celebration of the Fiftieth Anniversary of the Swedish Institute at Athens*, ed. B. Wells, Stockholm, pp. 141–155.
- Schallin, A.-L., and P. Pakkanen. 2009. *Encounters with Mycenaean Figures and Figurines. Papers Presented at a Seminar at the Swedish Institute at Athens, 27–29 April 2001* (ActaAth 8°, 20), Stockholm.
- Schallin, A.-L., and I. Tournavitou, eds. 2015. *Mycenaeans Up to Date: The Archaeology of the North-Eastern Peloponnese—Current Concepts and New Directions* (ActaAth 4°, 56), Stockholm.
- Scheffer, C. 1984. “Aegean Bronze-Age Spit Supports with Scalloped Tops,” *OpAth* 15, pp. 155–162.
- Schofield, E. 1984. “Destruction Deposits of the Earlier Late Bronze Age from Ayia Irini, Keos,” in *The Prehistoric Cyclades*, ed. J. A. MacGillivray and R. L. N. Barber, Edinburgh, pp. 179–183.
- Schweingruber, F. H. 1990. *Anatomy of European Woods*, Stuttgart.
- Schweingruber, F. H., A. Börner, and E. D. Schulze. 2008. *Atlas of Woody Plants: Evolution, Structure, and Environmental Modifications*, Berlin.
- Shaw, J. W. 1977. “New Evidence for Aegean Roof Construction from Bronze Age Thera,” *AJA* 81, pp. 229–233.
- Shay, J., and T. Shay. 1978. “Modern Vegetation and Fossil Plant Remains,” in *Excavations at Nichoria in Southwest Greece I: Site Environs and Techniques*, ed. G. Rapp and S. E. Aschenbrenner, Minneapolis, pp. 41–59.
- Shay, J., T. Shay, and M. R. M. Kapinga. 1998. “Appendix 4: The Bronze Age Plant and Insect Remains and Modern Vegetation,” in *Excavations on the Acropolis of Midea: Results of the Greek-Swedish Excavations 1.1: The Excavations on the Lower Terraces 1985–1991* (ActaAth 4°, 49), ed. G. Walberg, Stockholm, pp. 299–357.
- Shelmerdine, C. W. 2001. “Review of Aegean Prehistory VI: The Palatial Bronze Age of the Southern and Central Greek Mainland,” in *Aegean Prehistory: A Review*, ed. T. Cullen, Boston, pp. 329–381.
- . 2008a. “Background, Sources, and Methods,” in Shelmerdine 2008b, pp. 1–18.
- . ed. 2008b. *The Cambridge Companion to the Aegean Bronze Age*, Cambridge.
- Shelton, K. S. 1996. *The Late Helladic Pottery from Prosymna* (SIMA-PB 138), Jonsered.
- . 2009. “The Figurines from Petsas House,” in Schallin and Pakkanen 2009, pp. 55–60.
- . 2010. “Citadel and Settlement: A Developing Economy at Mycenae, The Case of Petsas House,” in *Political Economies in the Aegean Bronze Age*, ed. D. Pullen, Oxford, pp. 184–204.
- Shepard, A. O. 1965. *Ceramics for the Archaeologist*, Washington, D.C.
- Siennicka, M. 2010. “Spatial Organisation of Late Mycenaean Settlements,” in *Siedlung und Handwerk: Studien zu sozialen Kontexten in der Bronzezeit. Beiträge zu den Sitzungen der Arbeitsgemeinschaft Bronzezeit auf der Jahrestagung des Nordwestdeutschen Verbandes für Altertumsforschung in Schleswig 2007 und auf dem Deutschen Archäologenkongress in Mannheim 2008* (Universitätsforschungen zur prähistorischen Archäologie 194), ed. B. Horejs and T. L. Kienlin, Bonn, pp. 69–94.
- Silver, I. 1969. “The Ageing of Domestic Animals,” in *Science in Archaeology*, ed. D. Brothwell and E. Higgs, 2nd ed., London, pp. 283–302.
- Skibo, J. M. 1992. *Pottery Function: A Use-Alteration Perspective*, New York.
- Smith, R. A. K., M. K. Dabney, E. Pappi, S. Triantaphyllou, and J. C. Wright. 2017. *Ayia Sotira: A Mycenaean Chamber Tomb Cemetery in the Nemea Valley, Greece* (Prehistory Monographs 56), Philadelphia.
- SPSS. 2011. *SPSS Statistics Version 20*, Armonk, N.Y.
- Stanzel, M. 1991. “Die Tierreste aus dem Artemis-Apollo-Heiligtum bei Kalapodi in Bötien/Griechenland” (diss. Universität München).
- Sterba, J. H., H. Mommsen, G. Steinhauser, and M. Bichler. 2009. “The Influence of Different Tempers on the Composition of Pottery,” *JAS* 36, pp. 1582–1589.
- Stocker, S. R., and J. L. Davis. 2004. “Animal Sacrifice, Archives, and Feasting at the Palace of Nestor,” in *The Mycenaean Feast* (*Hesperia* 73), ed. J. C. Wright, Princeton, pp. 179–195.
- . 2017. “The Combat Agate from the Grave of the Griffin Warrior at Pylos,” *Hesperia* 86, pp. 583–605.
- Stockhammer, P. 2008. “Kontinuität und Wandel: Die Keramik der Nachpalastzeit aus der Unterstadt von Tiryns” (diss. Ruprecht-Karls-Universität Heidelberg).
- Strack, S. 2011. “‘Erfahrungsbericht’ of Application of Different Quantitative Methods at Kalapodi,” in *Early Iron Age Pottery: A Quantitative Approach. Proceedings of the International Round Table Organized by the Swiss School of Archaeology in Greece (Athens 2008)* (*BAR-IS* 2254), ed. S. Verdan, T. Theurillat, and A. Kenzelmann-Pfyyfer, Oxford, pp. 45–60.
- Stroulia, A. 2003. “Ground-Stone Celts from Franchthi Cave: A Close Look,” *Hesperia* 72, pp. 1–30.
- . 2010. *Flexible Stones: Ground-Stone Tools from Franchthi Cave* (Excavations at Franchthi Cave, Greece 14), Bloomington, Ind.
- Stummer, A. 1911. “Zur Urgeschichte der Rebe und des Weinbaues,” *MAGW* 41, pp. 283–296.
- Sutton, S. B. 1988. “What Is a Village in a Nation of Migrants?” *Journal of Modern Greek Studies* 6, pp. 187–215.
- Tachet, H., P. Richoux, M. Bournaud, and P. Usseglio-Polatera. 2000. *Invertébrés d’eau douce: Systématique, biologie, écologie*, Paris.
- Tartaron, T. F., D. J. Pullen, R. K. Dunn, L. Tzortzopoulou-Gregory, A. Dill, and J. I. Boyce. 2011. “The Saronic

- Harbors Archaeological Research Project (SHARP): Investigations at Mycenaean Kalamianos, 2007–2009,” *Hesperia* 80, pp. 559–634.
- Taylor, W. D., and R. Janko, eds. 2008. *Ayios Stephanos: Excavations at a Bronze Age and Medieval Settlement in Southern Laconia* (BSA Suppl. 44), London.
- Themelis, P. 1968. “Skillous,” *ArchDelt* 23, A’, pp. 284–292.
- Theodoropoulou, T. 2007. “L’exploitation des ressources aquatiques en Egée septentrionale aux périodes pré- et protohistoriques” (diss. Univ. de Paris I).
- . 2011a. “Fishing in Dark Waters: A Review of the Archaeological and Archaeozoological Evidence of the Exploitation of Aquatic Resources in the Greek Early Iron Age,” in *Dark Ages Revisited. Acts of an International Symposium in Memory of William D. E. Coulson*, ed. A. Mazarakis Ainian, Volos, pp. 995–1013.
- . 2011b. “*Spondylus gaederopus* in Aegean Prehistory: Deciphering Shapes from Northern Greece,” in *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies* (BAR-IS 2216), ed. F. Ifantidis and M. Nikolaidou, Oxford, pp. 37–47.
- . 2012. “Searching for the Sea: The Exploitation of Marine Resources in Late Bronze Age Aegean,” *Talanta* 44, pp. 295–314.
- . 2014. “Excavating the Sea: Recent Advances in Marine Zooarchaeology of Prehistoric Aegean,” in *Physis: L’environnement naturel et la relation homme-milieu dans le monde égéen protohistorique. Actes de la 14^e Rencontre égéenne internationale, Paris 11–14 décembre 2012* (Aegaeum 37), ed. G. Touchais, R. Laffineur, and F. Rougemont, Leuven, pp. 359–373.
- Thomas, P. M. 1992. “LH IIIB:1 Pottery from Tsoungiza and Zygouries” (diss. Univ. of North Carolina, Chapel Hill).
- . 1997. “Mycenaean Kylix Painters at Zygouries,” in *TEXNH: Craftsmen, Craftswomen, and Craftsmanship in the Aegean Bronze Age* (Aegaeum 16), ed. R. Laffineur and P. P. Betancourt, Liège, pp. 377–383.
- . 2004. “Some Observations on the ‘Zygouries’ Kylix and Late Helladic IIIB Chronology,” in *XAPIΣ: Essays in Honor of Sara A. Immerwahr* (Hesperia Suppl. 33), ed. A. Chapin, Princeton, pp. 207–224.
- . 2005. “A Deposit of Late Helladic IIIB:1 Pottery from Tsoungiza,” *Hesperia* 74, pp. 451–573.
- . 2011a. “A Deposit of Late Helladic IIIA2 Pottery from Tsoungiza,” *Hesperia* 80, pp. 171–228.
- . 2011b. “Mycenaean Tablewares and the Curious Careers of the Angular Kylix and Shallow Angular Basin,” in Gauss et al. 2011, pp. 297–305.
- Thompson, N. 2006. “Projectile Points from the MH–LH Site of Magoula, Galatas” (paper, Methana 2006).
- Tiryns = Tiryns: Die Ergebnisse der Ausgrabungen des Instituts, Mainz*
- V = P. Gercke, G. Hiesel, D. H. French, E. B. French, P. Grossman, J. Schäfer, H. B. Siedentopf, and W. Rudolph, *Grabungen in der Unterstadt von Tiryns von 1889 bis 1929*, 1971.
- VIII = K. Müller, P. Gercke, W. B. Gercke, G. Hiesel, L. Godart, J. P. Olivier, P. Grossmann et al., *Das Kupfelgrab von Tiryns*, 1975.
- XII = W. Güntner, *Figürlich bemalte mykenische Keramik aus Tiryns*, 2000.
- Tomlinson, J. E. 1991. “Provenance of Minoan Ceramics by Multivariate Analysis of Neutron Activation Data” (diss. Univ. of Manchester).
- . 1995a. “Chemical Analysis of Some Mycenaean Pottery from Perati, Attica,” *ArchEph* 1995, pp. 227–230.
- . 1995b. “Multivariate Analysis of Neutron Activation Data on Heavy Ware Stirrup Jars at Mycenae,” in *The ‘Ivory Houses’ at Mycenae* (BSA Suppl. 24), ed. I. Tournavitou, London, pp. 305–308.
- . 1996. “Chemical Evidence for a Cretan Origin of Heavy Ware Stirrup Jars Found at Mycenae,” in *Proceedings of the Second Symposium of the Hellenic Archaeometrical Society: Archaeometrical and Archaeological Research in Macedonia and Thrace*, ed. I. Stratis, M. Vavelidis, K. Kotsakis, G. Tsokas, and E. Tsoukala, Thessaloniki, pp. 371–378.
- . 1997. “Statistical Evaluation of the Asaro-Perlman Neutron Activation Data on Mycenaean Pottery from the Peloponnese,” *BSA* 92, pp. 139–164.
- . 1998. “A Provenance Investigation of Mycenaean Pottery from Gla by Neutron Activation Analysis,” in *Γλας II: Η ανασκαφή 1981–1991* (Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 173), ed. S. E. Iakovidis, Athens, pp. 205–209.
- . 2000. “Statistical Analysis of Neutron Activation Data on Mycenaean Pottery from Gla, Thebes, Eutresis, Kallithea, and Tanagra in Boeotia,” in *Πρακτικά του Γ’ Διεθνούς Συνεδρίου Βοιωτικών Μελετών, Θήβα, 4–8 Σεπτεμβρίου 1996* (Επετηρίς της Εταιρείας Βοιωτικών Μελετών 3.1), ed. V. Aravantinos, Athens, pp. 253–263.
- . 2004. “Statistical Evaluation of Neutron Activation Data on Mycenaean Pottery Found at Lachish,” in *The Renewed Archaeological Excavations at Lachish, 1973–1994* (Monograph Series of the Institute of Archaeology of Tel Aviv University 22), ed. D. Ussishkin, Tel Aviv, pp. 1437–1445.
- . 2013. “Statistical Analysis of Neutron Activation Data on Mycenaean Pottery from the Argolid and Corinthia,” in *Well Built Mycenae: The Helleno-British Excavations within the Citadel at Mycenae, 1959–1969* 34.1: *Technical Reports. The Results of Neutron Activation Analysis of Mycenaean Pottery*, Oxford, pp. 23–35.
- Tomlinson, J. E., and V. J. Robinson. In prep. “Neutron Activation Analysis of Minoan Pottery from Crete: The Search for Reference Groups.”
- Torrence, R. 1986a. “Chipped Stone,” in *Keos V*, pp. 90–96.
- . 1986b. *Production and Exchange of Stone Tools: Prehistoric Obsidian in the Aegean*, Cambridge.
- Touchais, G. 1997. “Aux marges du monde mycénien: Recherches sur les origines et la diffusion de la civilisation helladique” (diss. Univ. de Paris I).
- Tournavitou, I. 1999. “Hearths in Non-Palatial Settlement Contexts: The LBA Period in the Peloponnese,” in Betancourt et al. 1999, pp. 833–839.
- Tsartsidou, G. n.d. “Phytolith Analysis from the Sediments of Ayia Sotira: Report for Excavating Seasons 2006, 2007, 2008 (unpublished manuscript, Nemea Valley Archaeological Project Archive, Bryn Mawr College).
- Tzedakis, Y., and H. Martlew, eds. 1999. *Minoans and Mycenaeans: Flavours of Their Time*, Athens.
- Tzonou-Herbst, I. 2009. “Trashing the Sacred: The Use-Life of Mycenaean Figurines,” in Schallin and Pakkanen 2009, pp. 161–175.
- Uerpmann, M., and W. van Neer. 2000. “Fischreste aus den neuen Grabungen in Troia (1989–1999),” *Studia Troica* 10, pp. 145–177.
- Valamoti, S. M., M. Mangafa, C. Koukouli-Chrysanthaki, and D. Malamidou. 2007. “Grape-Pressings from Northern Greece: The Earliest Wine in the Aegean?” *Antiquity* 81, pp. 54–61.

- Van de Moortel, A. 2001. "The Area around the Kiln, and the Pottery from the Kiln and the Kiln Dump," in *A LM IA Ceramic Kiln in South-Central Crete: Function and Pottery Production* (Hesperia Suppl. 30), ed. J. W. Shaw, A. Van de Moortel, P. M. Day, and V. Kilikoglou, Princeton, pp. 25–110.
- . 2002. "Pottery as a Barometer of Economic Change: From the Protopalatial to the Neopalatial Society in Central Crete," in *Labyrinth Revisited: Rethinking "Minoan" Archaeology*, ed. Y. Hamilakis, Oxford, pp. 189–211.
- van der Veen, M., and N. Fieller. 1982. "Sampling Seeds," *JAS* 9, pp. 287–298.
- Van Horn, D. 1977. "A New Bronze Age Chipped Stone Type: The Denticulated Tranchet," *JFA* 4, pp. 386–392.
- Van Neer, W., and A. Ervynck, 2004. "Remains of Traded Fish in Archaeological Sites: Indicators of Status or Bulk Food?" in *Behaviour behind Bones: The Zooarchaeology of Ritual, Religion, Status, and Identity*, ed. S. J. O'Day, W. Van Neer, and A. Ervynck, Oxford, pp. 203–214.
- Vasilogamvrou, A. 2010. "Ανασκαφή στον Άγ. Βασίλειο Λακωνίας," *Prakt* 165, pp. 65–80.
- . 2013. "7. Άγ. Βασίλειος Λακωνίας," *Ergon* 2013, pp. 27–30.
- . 2014. "Tracing the Rulers of Mycenaean Laconia: New Insights from Excavations at Ayios Vasileios (Xerokampi) near Sparta," *BICS* 57, pp. 132–133.
- Verdan, S. 2011. "Pottery Quantification: Some Guidelines," in *Early Iron Age Pottery: A Quantitative Approach. Proceedings of the International Round Table Organized by the Swiss School of Archaeology in Greece (Athens 2008)* (BAR-IS 2254), ed. S. Verdan, T. Theurillat, and A. Kenzelmann-Pfytter, Oxford, pp. 165–171.
- Verdelis, N. 1962. "The West House," in *The Mycenae Tablets 3* (TAPS, n.s. 52.7), ed. J. Chadwick, Philadelphia, pp. 13–29.
- Vermeule, E., and V. Karageorghis. 1982. *Mycenaean Pictorial Vase Painting*, Cambridge, Mass.
- Veropoulidou, R. 2012. "Όστρεα από τους οικισμούς του Θερμαϊκού κόλπου: Ανασυνθέτοντας την κατανάλωση των μαλακίων στη Νεολιθική και την Εποχή του Χαλκού" (diss. Aristotle Univ. of Thessaloniki).
- Vicente, N. 1995. "Les mollusques, l'homme et l'imaginaire," in *Vingt ans de malacologie: Mémoires de l'Institut Océanographique Paul Ricard*, ed. J.-P. Peyret, pp. 99–108.
- Vika, E., and T. Theodoropoulou. 2012. "Re-investigating Fish Consumption in Greek Antiquity: Results from Fish Bone Collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ Analyses," *JAS* 39, pp. 1618–1627.
- Vitale, S. 2012. "Local Traditions and Mycenaeanization in Central Greece: A Preliminary Report on the Late Helladic IIA to Late Helladic IIIB Pottery from Mitrou, East Lokris, and Its Significance," in *Αρχαιολογικό Έργο Θεσσαλίας και Στερεάς Ελλάδας. Πρακτικά επιστημονικής συνάντησης 3 / Proceedings of the 3rd Archaeological Meeting of Thessaly and Central Greece 2006–2008. From Prehistory to the Contemporary Period*, ed. A. Mazarakis Ainian and A. Doulgeri-Intzesiloglou, Volos, pp. 1147–1158.
- Vollgraff, W. 1907. "Fouilles d'Argos: B. Les établissements préhistorique d'Aspis (suite)," *BCH* 31, pp. 139–144.
- Vonck, E. 1933. *Mollusques de Belgique*, Brussels.
- von den Driesch, A. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites* (Peabody Museum Bulletin 1), Cambridge, Mass.
- von den Driesch, A., and J. Boessneck. 1990. "Die Tierreste von der mykenischen Burg Tiryns bei Nafplion/Peloponnes," in *Tiryns Forschungen und Berichte* 11, ed. H.-J. Weisshaar, I. Weber-Hiden, A. von den Driesch, J. Boessneck, A. Rieger, and W. Böser, Mainz, pp. 87–164.
- Voyatzoglou, M. 1972. *Τα πιθάρια στο Θρασανό της Κρήτης: Η τεχνική και οι συντεχνίες των πιθαράδων*, Thessaloniki.
- . 1984. "Thrapsano, Village of Jar Makers," in *East Cretan White-on-Dark Ware: Studies on a Handmade Pottery of the Early to Middle Minoan Periods* (University Museum Monograph 51), ed. P. P. Betancourt, Philadelphia, pp. 130–142.
- Wace, A. J. B. 1932. *Chamber Tombs at Mycenae* (Archaeologia 82), Oxford.
- . 1956. "Ephyraean Ware," *BSA* 51, pp. 123–127.
- Walberg, G. 2007. *Midea: The Megaron Complex and Shrine Area. Excavations on the Lower Terraces 1994–1997* (Prehistory Monographs 20), Philadelphia.
- Waldstein, C. 1905. *The Argive Heraeum II*, Boston.
- Walsh, V. A., and W. A. McDonald. 1986. "Greek Late Bronze Age Domestic Architecture: Toward a Typology of Stone Masonry," *JFA* 13, pp. 493–499.
- . 1992. "House Construction and Town Layout," in McDonald and Wilkie 1992, pp. 455–466.
- Warren, P. M. 1969. *Minoan Stone Vases*, Cambridge.
- . 1972. *Myrtos: An Early Bronze Age Settlement in Crete* (BSA Suppl. 7), London.
- Warren, P., and V. Hankey. 1989. *Aegean Bronze Age Chronology*, Bristol.
- Washington, H. S. 1923. "Excavations at Phlius in 1892," *AJA* 27, pp. 428–446.
- Weiberg, E. 2009. "Production of Female Figurines at Mastos, Berbati," in Schallin and Pakkanen 2009, pp. 61–75.
- Wells, B., and C. Runnels. 1996. *The Berbati-Limnes Archaeological Survey 1988–1990* (ActaAth 4^o, 44), Stockholm.
- Whitbread, I. K. 2003. "Clays of Corinth: The Study of a Basic Resource for Ceramic Production," in *Corinth XX*, pp. 1–13.
- Whittaker, H. 2009. "The Cultic Function of Mycenaean Anthropomorphic Terracotta Figures," in Schallin and Pakkanen 2009, pp. 99–111.
- Wiener, M. H. 1984. "Crete and the Cyclades in LM I: The Tale of the Conical Cup," in *The Minoan Thalassocracy: Myth and Reality*, ed. R. Hägg and N. Marinatos, Stockholm, pp. 17–26.
- . 2011. "Conical Cups: From Mystery to History," in Gauss et al. 2011, pp. 355–368.
- . 2018. "The Absolute Chronology of Late Helladic III and the Recent Bronze Age in Italy in Light of Recent Developments in Egyptian Chronology," in *Mediterranea Itinera. Studies in Honour of Lucia Vagnetti* (Incunabula Graeca 106), ed. M. Bettelli, M. Del Freo, and G. J. van Wijngaarden, Rome, pp. 3–10.
- Wiersma, C. 2014. *Building the Bronze Age: Architecture and Social Change on the Greek Mainland during Early Helladic III, Middle Helladic, and Late Helladic I*, Oxford.
- Wilson, B., C. Grigson, and S. Payne. 1982. *Ageing and Sexing Animal Bones from Archaeological Sites* (BAR-BS 109), Oxford.
- Wiseman, J. R. 1978. *The Land of the Ancient Corinthians* (SIMA 50), Göteborg.
- Wishart, D. 1987. *CLUSTAN: User Manual. Cluster Analysis Software*, 4th ed., Edinburgh.
- Wohlmayr, W. 2007. "Aegina Kolonna MH III–LH I: Ceramic Phases of an Aegean Trade-Domain," in Felten, Gauss, and Smetana 2007, pp. 45–55.

- Wright, G. R. H. 1990. "Of Fishes and Men: Fish Symbols in Ancient Religion," *JPR* 3–4, pp. 30–43.
- Wright, H. 1984. "Prestate Political Formations," in *On the Evolution of Complex Societies. Essays in Honor of Harry Hoijer, 1982*, ed. W. T. Sanders, H. Wright, and R. M. Adams, Malibu, pp. 41–77.
- Wright, J. C. 1978. "Mycenaean Masonry Practices and Elements of Construction" (diss. Bryn Mawr College).
- . 1982. "Excavations at Tsoungiza (Archaia Nemea) 1981," *Hesperia* 51, pp. 375–397.
- . 1987. "Death and Power at Mycenae: Changing Symbols in Mortuary Practice," in *Thanatos: Les coutumes funéraires en Égée à l'âge du Bronze. Actes du colloque de Liège, 21–23 avril 1986 (Aegaeum 1)*, ed. R. Laffineur, Liège, pp. 171–184.
- . 1990. "An Early Mycenaean Hamlet on Tsoungiza at Ancient Nemea," in *L'habitat égéen préhistorique. Actes de la Table Ronde internationale organisée par le Centre National de la Recherche Scientifique, l'Université de Paris I et l'École française d'Athènes, 23–25 juin 1987 (BCH Suppl. 19)*, ed. P. Darcque and R. Treuil, Paris, pp. 347–357.
- . 1994. "The Spatial Configuration of Belief: The Archaeology of Mycenaean Religion," in *Placing the Gods: Sanctuaries and Sacred Space in Ancient Greece*, ed. S. E. Alcock and R. Osborne, Oxford, pp. 37–78.
- . 1999. "A Marble Figurine from Tsoungiza," in Betancourt et al. 1999, pp. 945–951.
- . 2004a. "Comparative Settlement Patterns during the Bronze Age in the Northeastern Peloponnesos, Greece," in *Side-by-Side Survey: Comparative Regional Studies in the Mediterranean World*, ed. S. E. Alcock and J. F. Cherry, Oxford, pp. 114–131.
- . 2004b. "Mycenaean Drinking Services and Standards of Etiquette," in *Food, Cuisine, and Society in Prehistoric Greece (Sheffield Studies in Aegean Archaeology 5)*, ed. P. Halstead and J. C. Barrett, Sheffield, pp. 90–104.
- . 2004c. "A Survey of Evidence for Feasting in Mycenaean Society," in *The Mycenaean Feast (Hesperia 73)*, ed. J. C. Wright, Princeton, pp. 13–58.
- . 2006. "The Social Production of Space and the Architectural Reproduction of Society in the Bronze Age Aegean during the 2nd Millennium B.C.E.," in *Constructing Power—Architecture, Ideology, and Social Practice*, ed. J. Maran, C. Juwig, H. Schwengel, and U. Thaler, Hamburg, pp. 49–74.
- . 2008. "Early Mycenaean Greece," in Shelmerdine 2008b, pp. 230–257.
- . 2015. "The Nature of Mycenaean Occupation of the Watersheds That Comprise the Longopotamos, Nemea, and Asopos Valleys," in Schallin and Tournavittou 2015, pp. 211–219.
- . 2020. "Mycenaean Ashlar Masonry: An Overview," in *ASHLAR: Exploring the Materiality of Cut Stone Masonry in the Eastern Mediterranean Bronze Age*, ed. M. Devolder, J. Driessen, and I. Kreigermann, Louvain-la-Neuve, pp. 187–214.
- Wright, J. C., J. F. Cherry, J. L. Davis, E. Mantzourani, S. B. Sutton, and R. F. Sutton Jr. 1990. "The Nemea Valley Archaeological Project: A Preliminary Report," *Hesperia* 59, pp. 579–659.
- Wright, J. C., and M. K. Dabney. 2011. "Interpreting Quantitative Analyses of Mycenaean Pottery," in Gauss et al. 2011, pp. 369–381.
- Wright, J. C., E. Pappi, S. Triantaphyllou, M. K. Dabney, P. Karkanias, G. Kotzamani, and A. Livarda. 2008. "Nemea Valley Archaeological Project, Excavations at Barnavos: Final Report," *Hesperia* 77, pp. 607–654.
- Yasur-Landau, A. 2006. "The Last Glendi in Halasmenos: Social Aspects of Cooking in a Dark Age Cretan Village," *Aegean Archaeology* 7, pp. 49–66.
- Yalouris, N. 1965. "Μυκηναϊκός τύμβος Σαμικού," *ArchDelt* 20, A', pp. 6–40.
- Zerner, C. W. 1986. "Middle Helladic and Late Helladic I Pottery from Lerna," *Hydra* 2, pp. 58–74.
- . 1988. "Middle Helladic and Late Helladic I Pottery from Lerna: Part II. Shapes," *Hydra* 4, pp. 1–10.
- . 1990. "Ceramics and Ceremony: Pottery and Burials from Lerna in the Middle and Early Late Bronze Ages," in *Celebrations of Death and Divinity in the Bronze Age Argolid*, ed. R. Hägg and G. C. Nordquist, Stockholm, pp. 23–34.
- . 1993. "New Perspectives on Trade in the Middle and Early Late Helladic Periods on the Mainland," in Zerner, Zerner, and Winder 1993, pp. 39–56.
- . 2008. "The Middle Helladic Pottery, with the Middle Helladic Wares from Late Helladic Deposits and the Potters' Marks," in Taylour and Janko 2008, pp. 177–298.
- Zerner, C., P. Zerner, and J. Winder, eds. 1993. *Wace and Blegen: Pottery as Evidence for Trade in the Aegean Bronze Age 1939–1989*, Amsterdam.
- Zohary, D., M. Hopf, and E. Weiss 2012. *Domestication of Plants in the Old World: The Origin and Spread of Domesticated Plants in Southwest Asia, Europe, and the Mediterranean Basin*, 3rd ed., Oxford.

ABBREVIATIONS OF PERIODICALS AND SERIES

- AA = *Archäologischer Anzeiger*
 ActaAth = *Skrifter utgivna av Svenska Institutet i Athen (Acta Instituti Atheniensis Regni Sueciae)*
 AJA = *American Journal of Archaeology*
 AM = *Mitteilungen des Deutschen Archäologischen Instituts, Athenische Abteilung*
 AmerAnt = *American Antiquity*
 AnatSt = *Anatolian Studies*
 AR = *Archaeological Reports* (supplement to *JHS*)
 ArchDelt = *Αρχαιολογικόν Δελτίον*
 ArchEph = *Αρχαιολογική Εφημερίς*
 ArchKorrBl = *Archäologisches Korrespondenzblatt*
 BAR-BS = *British Archaeological Reports, British Series*
 BAR-IS = *British Archaeological Reports, International Series*
 BCH = *Bulletin de correspondance hellénique*
 BÉFAR = *Bibliothèque des Écoles françaises d'Athènes et de Rome*
 BICS = *Bulletin of the Institute of Classical Studies of the University of London*
 BSA = *Annual of the British School at Athens*
 Ergon = *Το Έργον της εν Αθήναις Αρχαιολογικής Εταιρείας*
 ErIsr = *Eretz-Israel*
 ÉtCrét = *Études crétoises*
 JAS = *Journal of Archaeological Science*
 JFA = *Journal of Field Archaeology*
 JHS = *Journal of Hellenic Studies*
 JMA = *Journal of Mediterranean Archaeology*
 JPR = *Journal of Prehistoric Religion*
 MAGW = *Mitteilungen der anthropologischen Gesellschaft (Vienna)*
 MarbWPr = *Marburger Winckelmann-Programm*
 OJA = *Oxford Journal of Archaeology*
 OpAth = *Opuscula Atheniensia*
 Prakt = *Πρακτικά της εν Αθήναις Αρχαιολογικής Εταιρείας*
 RA = *Revue archéologique*
 RDAC = *Report of the Department of Antiquities, Cyprus*
 SBWien = *Sitzungsberichte, Österreichische Akademie der Wissenschaften (Wien), Philosophisch-historische Klasse*
 SIMA = *Studies in Mediterranean Archaeology and Literature*
 SIMA-PB = *Studies in Mediterranean Archaeology and Literature. Pocketbook*
 SMEA = *Studi micenei ed egeo-anatolici*
 TAPS = *Transactions of the American Philosophical Society*
 UCLAMon = *University of California at Los Angeles, Institute of Archaeology, Monograph*
 UCLAPap = *University of California at Los Angeles, Institute of Archaeology, Occasional Paper*
 WorldArch = *World Archaeology*

ABBREVIATIONS

- | | | | |
|----------|---|---------|---|
| CP | cooking pottery | masl | meters above sea level |
| D. | depth | max. | maximum |
| Diam. | diameter | MaxAU | maximum numbers of anatomical units |
| dim. | dimension | MBA | Middle Bronze Age |
| EBA | Early Bronze Age | MFF | macroscopic fabric family |
| EH | Early Helladic | MFG | macroscopic fabric group |
| EN | Early Neolithic | MH | Middle Helladic |
| est. | estimated | min. | minimum |
| ext. | exterior | MinAU | minimum numbers of anatomical units |
| EU | excavation unit | MNI | minimum numbers of individuals |
| EVE | estimated vessel equivalents | MURR | University of Missouri Research Reactor |
| FM | Furumark motif | NAA | neutron activation analysis |
| FN | Final Neolithic | NISP | numbers of identified specimens |
| fr., fr. | fragment, fragments | N/R | not recorded |
| FS | Furumark shape | NVAP | Nemea Valley Archaeological Project |
| GAS | Greek Archaeological Service | NVAP-AS | Nemea Valley Archaeological Project-Archaeological Survey |
| H. | height | p. | preserved |
| ICP-AES | inductively coupled plasma-atomic emission spectroscopy | perf. | perforation |
| INAA | instrumental neutron activation analysis | SMU | square meter unit |
| int. | interior | SU | stratigraphic unit |
| L. | length | Th. | thickness |
| LBA | Late Bronze Age | TS | Tsougiza |
| LH | Late Helladic | UCB | University of California at Berkeley |
| LM | Late Minoan | W. | width |
| LN | Late Neolithic | Wt. | weight |

FAUNAL REMAINS

by Paul Halstead

THE NVAP EXCAVATIONS on Tsoungiza yielded ca. 90 kg of animal bone from contexts sufficiently unmixed to warrant detailed study, including ca. 20 kg from MH III–LH II and ca. 29 kg from LH III deposits (Table 17.1).¹ The faunal material from both these broad periods is mainly derived from external surfaces, dumps, and pits, but the MH III–LH II settlement is better represented by preserved architectural remains and had evident access to prestige goods from a range of sources, whereas its LH III counterpart, in terms of portable material culture, seems poorer and more narrowly dependent on Mycenae.² Moreover, one LH III context (the LH IIIA2 early “feasting” dump) in EU 9 contained a wealth of ceramic tableware and a large anthropomorphic figurine, together suggestive of ritual feasting, while animal bones from the same context are dominated by the heads and feet of cattle, implying that meaty parts of the carcass had been removed for consumption elsewhere—whether on- or off-site. This deposit raises the possibility that at least parts of LH III Tsoungiza served as a rural shrine,³ conceivably linked to the major palatial center at nearby Mycenae.⁴ Either way, at least during LH III, Tsoungiza is likely to have been drawn within an expanding regional polity centered on Mycenae,⁵ with the attendant possibility that animal husbandry in the site’s vicinity shifted from relative local self-sufficiency toward production geared to nonlocal consumption.

The ultimate ambition of this chapter is to shed light on these potential diachronic changes by exploring osteological evidence for animal consumption and, more indirectly, management at Tsoungiza. The contrast between MH III–LH II and LH III in architectural preservation, however, raises the possibility of differences in depositional environment and faunal preservation that might be mistaken for changes over time in the types of activity represented. Accordingly, following a brief overview of the composition of the MH III–LH II and LH III faunal assemblages, this chapter sets out the methods used to recover and study the faunal material and examines its depositional history before attempting interpretation in terms of predepositional activity. To facilitate diachronic comparison, the organization of this report generally follows that of the published study of FN–EH faunal remains from Tsoungiza.⁶

METHODOLOGY

The faunal material examined is derived from excavations in 1984–1986 on Tsoungiza Hill. Most of this material was recovered in the trench, where collection by hand was normally

1. I am grateful to James C. Wright for the invitation to study the faunal material from Tsoungiza; to James, Mary K. Dabney, and Jeremy B. Rutter for contextual information on the later Bronze Age material; to Pat Collins, Valasia Isaakidou, Glynis Jones, and Helen Smith for help with faunal study in the Nemea Museum; to James, Mary, and Valasia for comments on a draft

text; and to Valasia for help producing figures.

2. Wright 2015.

3. Wright 1994.

4. Dabney, Halstead, and Thomas 2004; cf. Killen 1987.

5. E.g., Wright 2004a.

6. Halstead 2011.

TABLE 17.1. MH AND LH FAUNAL ASSEMBLAGE

<i>Phases and Contexts with 50+ MaxAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>Weight (g)</i>			
			<i>Trunk</i>	<i>Head</i>	<i>Limb</i>	<i>Total¹</i>
MH III	252	201	455	2,365	2,990	5,815
EU 2, exterior surface	160	125	190	1,440	1,705	3,335
MH III–LH II	13	8	10	35	300	345
LH I	277	226	655	3,850	3,890	8,430
EU 8, exterior surface	60	49	195	2,055	880	3,135
EU 8, fill	82	65	255	1,070	1,745	3,100
LH I–II	26	22	30	245	150	425
LH II	11	10	0	90	130	220
LH IIA	95	74	250	800	1,230	2,280
EU 10, dump	82	62	230	730	1,120	2,080
LH IIB	193	171	320	1,100	1,560	2,980
EU 2, spaces 8 and 9, dump	187	167	320	990	1,400	2,710
LH II–IIIA1–2	6	4	5	15	15	35
LH III	9	7	75	160	105	340
LH IIIA1–2	25	18	30	70	340	440
LH IIIA2	200	177	365	2,275	4,030	6,685
EU 9, “feasting,” lower dump	125	114	165	1,650	2,845	4,660
LH IIIA–B1	9	5	40	10	40	90
LH IIIA2–B1	21	15	25	170	245	440
LH IIIA2–B	7	7	10	65	65	140
LH IIIA2–B2	88	81	250	1,390	2,475	4,145
EU 8, pit 3	71	68	220	1,250	2,215	3,715
LH IIIB	94	78	135	645	1,225	2,005
LH IIIB1	336	285	280	4,770	6,965	12,015
EU 2, pit 1	123	103	130	1,620	2,650	4,400
EU 8, fill	90	79	55	1,040	1,575	2,670
LH IIIB2	97	79	170	770	1,280	2,220
EU 10, space 7 destruction	97	79	170	770	1,280	2,220
LH IIIC early	21	19	0	115	185	300
<i>Total MH III–LH II</i>	<i>867</i>	<i>712</i>	<i>1,720</i>	<i>8,485</i>	<i>10,250</i>	<i>20,495</i>
<i>Total LH II–IIIA1–2</i>	<i>6</i>	<i>4</i>	<i>5</i>	<i>15</i>	<i>15</i>	<i>35</i>
<i>Total LH III</i>	<i>907</i>	<i>771</i>	<i>1,380</i>	<i>10,440</i>	<i>16,955</i>	<i>28,820</i>

Note: This table displays overall anatomical composition (weight) and numbers of identified anatomical units (MaxAU and MinAU) by phase and for individual contexts with at least 50 MaxAU.

¹ Total bone weights include fragments of tortoise carapace excluded from anatomical subdivisions.

supplemented by dry-sieving through a 1 cm mesh of all excavated deposit except that destined for wet-sieving. Additional material was retrieved from partial or total wet-sieving through a 2 mm mesh of selected contexts (normally 25% of pits, 50% of ashy or burnt deposits, and 100% of pot contents and patches of burnt or heavily organic deposit).⁷ Bone was bagged separately for each SU, subdivided by SMU and also by trench/dry-sieve versus wet-

7. Wright et al. 1990, p. 623.

sieve recovery. In preparation for faunal study in the 1980s, these bags were sorted, using the stratigraphic and ceramic information then available, into the broad chronological groups MH III–LH II and LH III, while the EU 9 “feasting” dump was separated from the remainder of the LH III assemblage. This was done partly to facilitate quantification (see below) and partly to increase the likelihood of observing matches between articulating/paired specimens separated during excavation. Bags of unknown or widely mixed date were excluded from further study. Identification and recording of the retained bone bags were undertaken in two stages.

First, the contents of each bag, excluding any human bone and tortoise carapace, were sorted into three anatomical groups: “trunk” (vertebral column, ribs, sternum), “head” (including cranium, mandible, loose teeth, horn/antler), and “limb” (the appendicular skeleton, including pelvis and scapula). Each anatomical group was weighed to the nearest 5 g as a quantified record of head and trunk bones, many of which pose problems of taxonomic recognition and/or quantification, and so are largely excluded from the second stage of more detailed analysis. At this stage, note was also made of the presence of whole or partial skeletons, of groups of material skewed toward certain body parts, and of apparently “fresh,” and so perhaps intrusive, bones.

Second, bones and bone fragments potentially identifiable to anatomical part and taxon (e.g., sheep, sheep/goat) were selected for more detailed recording. The anatomical parts selected were horncore (base and tip)/antler, mandible (canine, premolar, and molar tooth row only), scapula (articular area and collum), proximal half of humerus, distal half of humerus, proximal half of radius, distal half of radius, proximal half of ulna, proximal half of metacarpal, distal half of metacarpal, pelvis (acetabular region), proximal half of femur, distal half of femur, proximal half of tibia, distal half of tibia, astragalus, calcaneum, proximal half of metatarsal, distal half of metatarsal, phalanx 1, phalanx 2, and phalanx 3. In the case of pig, only the larger, central metapodials (metacarpals 3–4, metatarsals 3–4) and phalanges were recorded. Phalanges from the forelimb and hind limb were not distinguished. For long bones (humerus, radius, metacarpal, femur, tibia, metatarsal), the proximal and distal units include their respective halves of the shaft. The carapace of tortoise was treated as a single unit. These anatomical parts were retained for detailed study because they are relatively durable, readily identifiable, informative on parameters such as age and biometry, and relatively easy to quantify.

Specimens removed from bags for detailed examination were individually marked with context information, and, where possible, fresh breaks were repaired. Any bone fragment attributed to one of the selected anatomical units was retained for potential taxonomic identification, to facilitate which specimens were first sorted by anatomical element and then by taxon rather than being studied bag by bag. Only material identified to both anatomical part and taxon was recorded in detail, and, for each such “identified” specimen, the following variables were documented where appropriate: presence/absence of proximal and distal units; side of body; state of epiphyseal fusion/dental development; sex; remodeling and pathological indications; metrical data; butchery marks; fragmentation; traces of gnawing and burning; and method of retrieval (trench/dry-sieve or wet-sieve).

The faunal assemblage was examined in the Nemea Museum, using a small collection of modern reference material. From later Bronze Age levels, bones of cattle (*Bos taurus*), pig (*Sus domesticus*), sheep (*Ovis aries*), and goat (*Capra hircus*) were identified in large numbers, and those of dog (*Canis familiaris*), horse (*Equus caballus*), donkey (*Equus asinus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), fox (*Vulpes vulpes*), hare (*Lepus europaeus*), hedgehog (*Erinaceus europaeus*), and tortoise (*Testudo* sp.) in smaller numbers. Distinction between sheep and goat was based on the published morphological and metrical criteria of

Boessneck, Müller, and Teichert, Kratochwil, and Prummel and Frisch for postcranial bones,⁸ of Payne for deciduous teeth,⁹ and of Helmer and Halstead, Collins, and Isaakidou for permanent teeth¹⁰ (reexamined in 2002). Much of the ovicaprid material, however, was identified only to the level “sheep/goat,” and so these two species are combined for most analyses.

All measurable specimens of cattle, pig, sheep, goat, and dog (Tables 17.2–17.6) fall within or occasionally below the ranges attributed to domesticates in more or less contemporary levels at nearby Tiryns¹¹ and Lerna¹² and thus offer no biometric evidence for exploitation of wild aurochs, boar, and wolf or of feral sheep and goat at Tsoungiza. Equid specimens were attributed to horse or donkey primarily on the basis of size, with measurable specimens (Table 17.7) matching similar attributions at Tiryns and Lerna. The larger deer specimens were identified as red rather than fallow deer, following the morphological criteria of Lister,¹³ and metrical data are again consistent with similar identifications at Tiryns and Lerna (Table 17.8); one indeterminate (and unmeasurable) specimen was assigned to red deer, because no firm identification of fallow deer was made. The few measurements of hare match those from Tiryns and Lerna (Table 17.9), while comparative data were lacking at these sites for the two measurable specimens of fox (Table 17.10).

Age at death of domestic mammals is estimated from the state of eruption and wear of mandibular cheek teeth and from the development of postcranial bones. Dental ageing follows Halstead and Jones and Sadler for cattle, Bull and Payne and Grant for pigs, and Payne and Jones for sheep and goats.¹⁴ The ageing of postcranial bones on the basis of epiphyseal fusion follows Silver.¹⁵ Postcranial bones classified as “neonatal” on grounds of size, morphology, and surface texture¹⁶ may represent late fetal or newborn animals (up to, say, one month after birth); mandibles with unworn deciduous premolars are roughly equivalent, in terms of age, to neonatal postcranial material and are grouped with the latter for certain purposes. Pelves were sexed on morphological grounds, following Grigson for cattle and Boessneck, Müller, and Teichert for sheep and goats.¹⁷ Metrical data¹⁸ also contribute to the determination of age and sex.

Bones were recorded as whole, “new break” (i.e., broken in or since excavation and not mendable), or “old break.” In addition, long bone specimens with old breaks were classified as articular “end,” “shaft,” or “end+shaft” and as “cylinder” or “splinter,” following Binford’s observations¹⁹ on the contrasting patterns of fragmentation associated with carnivore attrition and human extraction of marrow. Traces of carnivore-type gnawing,²⁰ digestion,²¹ and gnawing by rodents²² were recorded. Traces of burning were also recorded, but were often light and patchy so that dark mineral staining will have obscured some cases and was possibly misidentified as burning in others. Butchery marks were attributed, where possible, to skinning, dismembering, filleting, and marrow extraction following Binford²³ and on the basis of anatomical placement.

Because even small fragments of selected anatomical units were retained for detailed study, quantification in terms of maximum numbers of identified anatomical units (MaxAU) might lead to overrepresentation of body parts, taxa, and age/sex categories prone to fragmenta-

8. Boessneck, Müller, and Teichert 1964; Kratochwil 1969; Prummel and Frisch 1986.

9. Payne 1985a.

10. Helmer 2000; Halstead, Collins, and Isaakidou 2002.

11. Von den Driesch and Boessneck 1990.

12. *Lerna* I.

13. Lister 1996.

14. Cattle: Halstead 1985; Jones and Sadler 2012; pigs: Bull and Payne 1982; Grant 1982; sheep and goats: Payne 1973; Jones 2006.

15. Silver 1969.

16. Cf. Prummel 1987a, 1987b.

17. Cattle: Grigson 1982; sheep and goats: Boessneck, Müller, and Teichert 1964.

18. Recorded after von den Driesch (1976).

19. Binford 1981.

20. Cf. Lyman 1994, pp. 207–209, figs. 6.19–6.21.

21. Cf. Lyman 1994, p. 211, fig. 6.24.

22. Cf. Lyman 1994, pp. 196–197, fig. 6.15.

23. Binford 1981.

TABLE 17.2. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH CATTLE COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza																							LH Tiryns Cattle	MH-LH Early Lerna Cattle	Neol.- BA Lerna Aurochs		
		MH III	LH I	LH I-II	LH IIB	LH IIIA2			LH IIIA2-B			LH IIIA2-B2			LH IIIB	LH IIIB1								LH IIIB2				LH IIC Early	
Scapula	BG	-	-	-	34.8	-	-	-	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.2	-	35- 48(+)	-	64
	GLP	-	-	-	51.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61.1	-	54-69	-	82
Radius	Bp	-	73.0	-	76.0	-	-	-	-	-	-	-	-	-	-	63.0 ¹	70.5	-	-	-	-	-	-	-	-	-	66-78	-	107
	Bd	69.3	67.7 ¹	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54- 76(84)	-	-
Metacarpal	Bd ³	-	51.1 (f)	-	47.5 (f)	48.5 (f)	59.0 (m)	-	50.0 (f)	57.1 (?)	-	-	-	-	-	57.4 (?)	66.2 (m)	-	-	-	-	-	-	-	54.5 (f)	40-68	60-67	80	
	GL	-	-	-	-	169.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	166- 193	-	-
Tibia	Bd	-	-	-	-	54.6	-	-	-	-	-	-	-	-	54.0	49.2	52.9	59.4	-	-	-	-	-	-	-	-	46- 64(72)	-	-
Astragalus	Bd	-	-	37.8	-	-	42.7	-	32.2	33.3	41.1	-	-	-	-	30.6	37.5	-	-	-	-	-	-	-	-	-	32-50	-	-
	GL1	-	56.7	-	-	-	63.0	69.3	50.4	52.0	59.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48-75	-	77-80
	GLm	-	-	53.8	-	53.0	59.5	-	45.6	49.1	55.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73
Metatarsal	Bd ³	-	53.6 (m)	-	-	49.9 (f)	52.3 (m)	52.8 (m)	-	-	-	44.0 (f)	48.4 ² (f)	52.7 (m)	56.6 ² (m)	46.3 (f)	46.6 (f)	46.7 (f)	50.1 (f)	50.8 (f)	51.3 (?)	54.2 (m)	54.2 (m)	-	-	40-60	44-49	66	
	GL	-	-	-	-	-	-	-	-	-	-	-	-	-	209.0	-	-	-	-	-	-	-	-	-	-	-	187- 201+	-	-

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; BG = breadth of glenoid cavity; Bp = greatest breadth of proximal end; GL = greatest length; GL1 = greatest length of lateral half; GLm = greatest length of medial half; GLP = greatest length of glenoid process.

¹ Fusing (all other epiphyses fully fused).

² Possibly exaggerated by "traction pathologies."

³ m = male, f = female, ? = indeterminate, after attributions for LH Tiryns (von den Driesch and Boessneck 1990, pp. 133, 156, table 32:l, m, fig. 1).

TABLE 17.3. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH PIGS COMPARED WITH TIRYNS AND LERNA

Measurement		<i>Tsougiza</i>																<i>LH</i> <i>Tiryns</i> <i>Pig</i>	<i>LH</i> <i>Tiryns</i> <i>Boar</i>	<i>MH</i> <i>Lerna</i> <i>Pig</i>	<i>EH</i> <i>Lerna</i> <i>Boar</i>	
		<i>MH III</i>			<i>MH</i> <i>III-</i> <i>LH II</i>	<i>LH I</i>		<i>LH</i> <i>I-II</i>	<i>LH</i> <i>IIA</i>	<i>LH</i> <i>IIB</i>	<i>LH</i> <i>IIIA2</i>	<i>LH</i> <i>IIIA2-B</i>	<i>LH</i> <i>IIIB</i>	<i>LH IIIB1</i>			<i>LH</i> <i>IIIB2</i>					
Humerus	Bd	35.7	-	-	33.1	33.0	33.3 ¹	31.5	-	-	37.2	33.8	-	36.7 ¹	31.6	32.9	34.9	36.5	29-42	-	-	54
Radius	Bp	24.3	24.3	28.3	-	-	-	-	-	-	-	-	26.6	-	23.2 ¹	-	-	-	21-31	-	-	-
Tibia	Bd	28.1	-	-	26.5	28.0	-	-	-	-	27.0	-	-	-	26.7	-	-	-	24-31	37-39	31	-
Astragalus	GLl	38.3	-	-	-	36.4	40.3	-	-	-	-	-	-	-	33.4	-	-	-	28-42	54	-	-
	GLm	32.8	-	-	-	33.4	37.2	-	-	-	-	-	-	-	30.1	-	-	-	30-38	48	-	-
Phalanx 1	Bp	15.0	-	-	-	-	-	-	14.1	15.0 ¹	14.3	-	-	14.8 ¹	-	-	-	14.6	13-21	-	-	-

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; Bp = greatest breadth of proximal end; GLl = greatest length of lateral half; GLm = greatest length of medial half.

¹Fusing (all other epiphyses fully fused).

TABLE 17.4. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH SHEEP COMPARED WITH TIRYNS AND LERNA

Measurement		Tsonggiza																			LH Tiryns		MH-LH Early Lerna			
		MH III	MH III- LH II	LH I				LH IIA	LH IIB		LH IIIA2		LH IIIA2- B	LH IIIA2- B1	LH IIIA2- B2	LH IIIB	LH IIIB1				LH IIIB2	Range		Mean		
Humerus	Bd	26.4	29.5	-	26.4	27.5	29.3	30.2	-	27.1	31.2	-	-	-	28.3	29.5	-	27.2	-	-	-	-	-	-	-	27-30 ³
	BT	-	27.5	-	-	-	-	-	-	-	-	-	-	-	-	26.9	-	-	-	-	-	-	-	24-35 ²	28.4 ²	27-28 ³
Radius	Bp	27.7	-	-	-	29.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	26-42 ²	30.5 ²	30-34	
	Bd	-	-	-	26.2 ¹	27.0	-	-	-	-	-	-	-	26.5	-	27.0	-	-	-	-	-	25.2	24-37 ²	28.4 ²	27-32	
	GL	-	-	-	-	139.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128-151	-	144-148	
Metacarpal	Bd	-	-	-	-	-	-	-	-	22.6	-	-	-	-	-	-	-	-	-	-	-	24.0	22-29 ²	24.9 ²	24-27	
Tibia	Bd	-	-	26.2	24.9	25.4	25.9	-	-	24.6	24.8	24.0	26.7	-	-	-	24.2	24.3	24.5	26.2	28.1	-	22-30 ²	25.6 ²	25 ³	
Astragalus	Bd	17.2	-	-	-	-	-	-	16.9	-	18.2	-	-	-	-	-	-	17.9	-	-	-	-	16-22 ²	18.1 ²	-	
	GLl	28.1	-	-	26.7	-	-	-	-	-	28.5	-	-	-	-	-	-	27.8	-	-	-	-	25-32 ²	28.4 ²	26-27 ³	
	GLm	27.1	-	-	25.5	-	-	-	25.2	26.1	26.8	27.9	-	-	-	-	-	25.7	-	-	-	-	23-33 ²	26.8 ²	24-25 ³	
Metatarsal	Bp	-	-	-	19.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Bd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.7	-	-	-	-	-	20-28 ²	23.8 ²	23-24	
	GL	-	-	-	122.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	121-157	-	-	
Phalanx 1	Bp	10.5	-	-	10.8	12.1	12.8	-	-	10.9	11.2	-	-	-	-	-	12.0	-	-	-	-	-	-	-	-	

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of digital end; Bp = greatest breadth of proximal end; BT = greatest breadth of trochlea; GL = greatest length; GLl = greatest length of lateral half; GLm = greatest length of medial half.

¹ Fusing (all other epiphyses fully fused).

² Including a few EH specimens.

³ MH specimens only.

TABLE 17.5. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH GOATS COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza									LH Tiryns ¹		MH-LH Early Lerna	
		MH III	MH III- LH II	LH I	LH IIA	LH IIB	LH IIIB	LH IIIB1	LH IIIB2	Range	Mean			
Humerus	Bd	28.0	—	29.3	28.0	—	29.0	—	—	—	—	—	—	—
Radius	Bp	30.0	30.5	—	—	—	—	—	30.0	30.0	29.4	26–38	29.7	—
Metacarpal	Bd	—	—	—	—	—	—	—	24.6	—	25.7	23–34	26.8	26–32
Tibia	Bd	22.6	—	27.0	—	—	—	—	—	—	—	22–29	24.6	23 ²
Astragalus	Bd	—	—	—	—	—	19.5	—	17.1	—	—	16–22	18.1	—
	GLl	—	—	—	—	—	30.0	—	—	—	—	25–33	28.4	—
	GLm	—	—	—	—	—	28.1	—	25.6	—	—	23–31	26.4	—
Metatarsal	Bd	—	—	—	—	23.3	—	—	—	—	—	22–32	24.9	29–30 ²
Phalanx 1	Bp	12.0	—	12.2	—	—	11.9	13.1	—	—	—	—	—	—

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; Bp = greatest breadth of proximal end; GLl = greatest length of lateral half; GLm = greatest length of medial half.

¹ Including a few EH specimens.

² MH specimens only.

TABLE 17.6. METRICAL DATA (MM) FOR TSOUNGIZA LH DOGS COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza			LH Tiryns	MH Lerna
		LH IIB	LH IIIA2			
Pelvis	LAR	—	18.0	18.1	22–23	—
Tibia	Bd	17.6	—	—	17–23	22
Calcaneum	GL	38.4	—	—	32–47	40

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; GL = greatest length; LAR = length of acetabulum on rim.

TABLE 17.7. METRICAL DATA (MM) FOR TSOUNGIZA LH DONKEYS AND HORSES COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza								LH Tiryns		MH-LH Lerna	
		Donkey				Horse				Donkey	Horse		
		LH IIA	LH IIIA2	LH IIIA2-B	LH IIIB1	LH I	LH IIIA2	LH IIIB1					
Radius	Bd	—	—	53.0	—	—	—	—	—	—	52–56	74	—
	BFd	—	—	42.6	—	—	—	—	—	—	45–47	62	—
Metacarpal	Bp	—	—	—	—	—	46.0	—	—	—	—	—	—
	Bd	—	—	—	—	—	47.1	—	—	—	—	—	—
	GL	—	—	—	—	—	212.0	—	—	—	—	—	—
Tibia	Bp	—	—	63.1	—	—	—	—	—	—	—	—	—
	Bd	—	—	—	49.7	53.2	—	—	—	—	48–54	63–66	59
Metatarsal	Bd	—	34.2	—	—	—	—	—	—	—	31–36	44–49	—
Phalanx 1	Bp	37.4	36.4	—	—	—	—	53.7	ca. 50	—	32–37	51–58	—
	Bd	31.5	32.4	—	—	—	—	45.5	39.3	—	29–32	41–48	—
Phalanx 2	Bp	—	—	—	—	—	50.0	—	—	—	30–36	48–54	—
	Bd	—	—	—	—	—	46.4	—	—	—	27–33	42–50	—

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; BFd = breadth of distal articular surface; Bp = greatest breadth of proximal end; GL = greatest length.

TABLE 17.8. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH RED DEER COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza					LH Tiryns	MH-LH Early Lerna
		MH III	LH I	LH IIA	LH IIIA2-B	LH IIIB		
Scapula	BG	-	46.6	-	-	-	36-46	40 ¹
	LG	-	47.4	-	-	-	41-44	42 ¹
	GLP	-	64.3	-	-	-	52-59	53 ¹
Radius	Bd	-	-	-	-	53.9	48-53	-
Tibia	Bd	-	50.5	-	-	-	45-52	43-46
Calcaneum	GL	-	-	106.6	-	-	111-116	-
Phalanx 1	Bp	-	20.4	-	21.4	-	19-23	21-22
	Bd	19.2	19.2	-	21.6	-	18-28	20
	GLpe	-	51.1	-	53.8	-	47-58	51-56
Phalanx 2	Bp	-	19.4	-	-	-	19-25	-
	Bd	20.0	16.0	-	-	-	16-20	-

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; BG = breadth of glenoid cavity; Bp = greatest breadth of proximal end; GL = greatest length; GLP = greatest length of glenoid process; GLpe = greatest length of peripheral half; LG = length of glenoid cavity.

¹ MH specimens only.

TABLE 17.9. METRICAL DATA (MM) FOR TSOUNGIZA LH HARES COMPARED WITH TIRYNS AND LERNA

Measurement		Tsoungiza			LH Tiryns	MH-LH Early Lerna
		LH IIB	LH IIIB1			
Humerus	Bd	12.9	-	-	11-12	12-13 ¹
Radius	Bp	-	9.0	9.2	9-10	9

Note: Measurements after von den Driesch (1976). Bd = greatest breadth of distal end; Bp = greatest breadth of proximal end.

¹ MH specimens only.

TABLE 17.10. METRICAL DATA (MM) FOR TSOUNGIZA MH AND LH FOXES

Measurement		Tsoungiza	
		MH III-LH II	LH IIIA-BI
Phalanx 1	Bp	6.1	4.5
	Bd	4.9	4.3
	GL	23.5	24.2

Note: Measurements after von den Driesch (1976).

Bd = greatest breadth of distal end; Bp = greatest breadth of proximal end; GL = greatest length.

tion into several durable and identifiable pieces. To minimize this effect, minimum numbers of anatomical units (MinAU) have also been estimated and are used in analysis of the relative abundance of different body parts or taxa. MaxAU is used in the analysis of breakage, gnawing, burning, and butchery, however, because MinAU tends to discount poorly preserved or heavily fragmented (and hence imprecisely identified) specimens, and so is likely to underestimate the frequency of such modifications of bone.

Where two or more fragments might be derived from the same anatomical unit (e.g., a single left proximal tibia) of the same individual animal, only the most complete example contributes to MinAU. Similarly, to simplify comparison between species with different

numbers of foot bones, quantification of fragments of metapodials and phalanges has been standardized in terms of minimum numbers of feet; for example, if two specimens of phalanx 2 or metacarpal could be derived from the same foot of the same individual animal, only one contributes to MinAU. Assessment of MinAU was based on visual comparison of specimens after stewing each anatomical/taxonomic group (e.g., pig humerus) into subgroups (left/right, proximal/distal, medial/lateral, fused/unfused, etc.). Estimation of MinAU, as of minimum numbers of individuals, requires an archaeological (rather than osteological) judgment of which bone groups are sufficiently close in date of deposition to justify searching for notional “joins” between fragments. On the basis of contextual information available during recording, notional “joins” were sought within the following three groups of material: MH III–LH II, LH III “feasting” dump, and other LH III deposits. With further stratigraphic and ceramic analysis, a few EUs have been redated (including a few reassignments between MH III–LH II and LH III or between LH III “feasting” dump and LH III other), introducing minor inaccuracy to MinAU figures.

SIZE AND OVERALL COMPOSITION OF THE MH AND LH ASSEMBLAGES

The MH III–LH II and LH III faunal assemblages each comprise less than 1,000 identified anatomical units (712 MinAU/867 MaxAU and 771 MinAU/907 MaxAU, respectively). Given that a sample of about 400 is needed for an accurate (within 5%) and reliable ($p \leq 0.05$) estimate of taxonomic or anatomical composition²⁴ and that only a minority of fragments offers information on age, sex, butchery, or metrical properties, the limitations of both assemblages are plain. The material is distributed evenly between MH III–LH II and LH III, but very unevenly between shorter chronological subphases and especially between individual contexts (Table 17.1). The MH III, LH I, LH IIB, LH IIIA2, and LH IIIB1 subassemblages include enough identified specimens (201, 226, 171, 177, and 285 MinAU, respectively) for fairly meaningful estimates of taxonomic composition. Conversely, the biggest samples from individual contexts are those from the MH III exterior surface in EU 2 (125 MinAU), the LH IIB dump in spaces 8 and 9 in EU 2 (167 MinAU), the LH IIIA2 early “feasting” dump in EU 9 (114 MinAU), and LH IIIB1 pit 1 in EU 2 (103 MinAU). Accordingly, most of the following analysis is not attempted for chronological groupings finer than MH III–LH II and LH III. In comparing groups of bones, whether defined on chronological/contextual or archaeozoological criteria, the statistical significance of any differences observed is assessed by the chi-square (χ^2) test,²⁵ with significance values of $p < 0.01$ described as “very significant” and those of $p < 0.05$ (and ≥ 0.01) as “significant.” Because of the large number of tests performed, “significant” results may be fortuitous in a few cases, and so should also be evaluated in terms of their consistency with other significant patterns in the data set.

For the MH III–LH II and LH III assemblages, MinAU excludes 18% and 15% of MaxAU, respectively (Table 17.11). These figures, which are substantially higher than the 7% discounted for the FN–EH assemblage,²⁶ raise the possibility of diachronic change in bone fragmentation or preservation, and thus in butchery or taphonomy, which will be considered below. On either method of quantification, however, overall taxonomic composition is

24. Van der Veen and Fieller 1982.

25. SPSS 2011.

26. Halstead 2011.

TABLE 17.11. TAXONOMIC COMPOSITION OF IDENTIFIED MH AND LH FAUNAL MATERIAL

	<i>Cattle</i>		<i>Pig</i>		<i>Sheep</i>		<i>Sheep/ Goat</i>		<i>Goat</i>		<i>Dog</i>		<i>Horse</i>		<i>Donkey</i>		<i>Red Deer</i>		<i>Roe Deer</i>		<i>Hare</i>		<i>Fox</i>		<i>Hedgehog</i>		<i>Tortoise</i>		<i>All Taxa</i>	
	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>
MH III-LH II																														
Total	99	126	228	259	90	104	190	243	58	71	9	9	5	5	2	2	17	24	1	1	6	6	2	2	1	1	4	14	712	867
% ¹	13.9	14.5	32.0	29.9	28.9	28.7	-	-	18.6	19.6	1.3	1.0	0.7	0.6	0.3	0.2	2.4	2.8	0.1	0.1	0.8	0.7	0.3	0.2	0.1	0.1	0.6	1.6	100.0	100.0
MinAU as % of MaxAU	78.6		88.0		80.9				100.0		100.0		100.0		70.8		100.0		100.0		100.0		100.0		28.6		82.1			
LH III																														
Total	251	292	168	198	78	84	163	211	58	60	15	18	4	4	17	17	9	12	-	-	6	6	1	1	-	-	1	4	771	907
% ¹	32.6	32.2	21.8	21.8	22.2	22.8	-	-	16.5	16.3	1.9	2.0	0.5	0.4	2.2	1.9	1.2	1.3	-	-	0.8	0.7	0.1	0.1	-	-	0.1	0.4	100.0	100.0
MinAU as % of MaxAU	86.0		84.8		84.2				83.3		100.0		100.0		75.0		-		100.0		100.0		-		25.0		85.0			

¹ Percentages of sheep and goat include sheep/goat assigned proportionately.

TABLE 17.12. POSTCRANIAL EVIDENCE FOR NEONATAL MORTALITY IN MH AND LH PRINCIPAL DOMESTICATES

Taxon	MH III–LH II					LH III				
	Neonatal		Postneonatal		Total	Neonatal		Postneonatal		Total
	MinAU	%	MinAU	%	MinAU	MinAU	%	MinAU	%	MinAU
Cattle	–	–	81	100.0	81	5	2.2	221	97.8	226
Pig	55	28.6	137	71.4	192	23	16.0	121	84.0	144
Sheep + goat	35 ¹	12.7	240	87.3	275	9 ²	4.0	218	96.0	227

¹ Including 4 tentatively assigned to goat.

² Including 2 tentatively assigned to sheep.

TABLE 17.13. EPIPHYSEAL FUSION EVIDENCE FOR POSTNEONATAL MORTALITY IN MH AND LH CATTLE

Fusion Stage (mos.) ¹	MH III–LH II				LH III			
	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)
7–10	–	4	100.0	1	–	5	100.0	7
18	2	27	93.1	2	–	38	100.0	5
24–36	3	6	66.7	–	6	41	87.2	13
36–48	6	3	33.3	10	8	8	50.0	17

¹ Following Silver 1969 (for anatomical abbreviations, see Table 17.19):

7–10 months: fusion of SC, PE;

18 months: fusion of Hd, Rp, PH1p, PH2p;

24–36 months: fusion of MCd, Td, MTd;

36–48 months: fusion of Hp, Rd, Up, Fp, Fd, Tp, C.

² Including unfused diaphyses, unfused epiphyses, fusing specimens, and those of unambiguously immature size and/or texture.

broadly similar. Wild animals, of which red deer is most common, make up approximately 4% of MH III–LH II and 2% of LH III MinAU, while the minor domesticates—dog, horse, and donkey—together make up 2% and 5% of MinAU, respectively. The overwhelming bulk of the assemblages is made up, in descending order of frequency, by pig (32%), sheep (29%), goat (19%), and cattle (14%) in MH III–LH II; and by cattle (33%), sheep (22%), pig (22%), and goat (17%) in LH III. Both assemblages differ from their FN–EH predecessor in the addition of horse and donkey and in a shift of predominance from goat over sheep to sheep over goat, while the LH III assemblage differs from both its EH and MH III–LH II counterparts in the increased frequency of cattle at the expense of pigs.

The three common taxa display different age profiles: postcranial evidence of neonatal deaths is most common in pig, intermediate in sheep/goat, and least common in cattle (Table 17.12), while after infancy both postcranial epiphyseal fusion (Tables 17.13–17.15) and mandibular tooth eruption and wear (Tables 17.16–17.18) indicate a much higher proportion of young deaths in pigs than in sheep/goats and cattle. Body part representation differs between postneonatal (Tables 17.19, 17.20) and neonatal remains (Tables 17.21, 17.22) and, at least among the former, between cattle, pigs, and sheep/goats. There are also differences between the three common taxa in fragmentation and incidence of gnawing, burning, and butchery marks. These variables are used to explore the depositional history of the assemblage, before attempting interpretation in terms of human consumption and management of animals.

TABLE 17.14. EPIPHYSEAL FUSION EVIDENCE FOR POSTNEONATAL MORTALITY IN MH AND LH PIGS

Fusion Stage (mos.) ¹	MH III-LH II				LH III			
	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)
12	13	18	58.1	23	11	17	60.7	18
24-30	17	7	29.2	6	9	7	43.8	9
36-42	22	1	4.3	16	16	2	11.1	22

¹ Following Silver 1969 (for anatomical abbreviations, see Table 17.19):

12 months: fusion of SC, Hd, Rp, PE, PH2p;

24-30 months: fusion of MCd, Td, MTd, C, PH1p;

36-42 months: fusion of Hp, Rd, Up, Fp, Fd, Tp.

² Including unfused diaphyses, unfused epiphyses, fusing specimens, and those of unambiguously immature size and/or texture.

TABLE 17.15. EPIPHYSEAL FUSION EVIDENCE FOR POSTNEONATAL MORTALITY IN MH AND LH SHEEP AND GOATS

Fusion Stage (mos.) ¹	MH III-LH II				LH III			
	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)	Unfused (MinAU) ²	Fused (MinAU)	Fused (%)	Indeterminate (MinAU)
SHEEP								
6-10	1	15	-	4	-	6	-	3
13-16	-	7		-	-	2		-
18-28	1	8		4	1	9		2
30-42	1	6		1	1	4		4
GOAT								
6-10	1	7	-	1	2	6	-	1
13-16	-	3		-	-	4		-
18-28	-	4		3	-	4		-
30-42	2	2		2	1	-		4
SHEEP/GOAT INDET.								
6-10	7	7	-	26	5	11	-	31
13-16	3	7		1	1	7		2
18-28	4	1		28	4	2		16
30-42	22	2		30	10	3		32
ALL (SHEEP + GOAT + SHEEP/GOAT)								
6-10	9	29	76.3	31	7	23	76.7	35
13-16	3	17	85.0	1	1	13	92.9	2
18-28	5	13	72.2	35	5	15	75.0	18
30-42	25	10	28.6	33	12	7	36.8	40

¹ Following Silver 1969 (for anatomical abbreviations, see Table 17.19):

6-10 months: fusion of SC, Hd, Rp, PE;

13-16 months: fusion of PH1p, PH2p;

18-28 months: fusion of MCd, Td, MTd;

30-42 months: fusion of Hp, Rd, Up, Fp, Fd, Tp, C.

² Including unfused diaphyses, unfused epiphyses, fusing specimens, and those of unambiguously immature size and/or texture.

TABLE 17.16. MANDIBULAR EVIDENCE FOR MORTALITY IN MH AND LH CATTLE (MINAU)

Stage (Definition) ¹	Age ²	MH III-LH II				LH III					
		No. of Stages		Total		No. of Stages				Total	
		1	3	MinAU	%	1	2	3	4	MinAU	%
A (d4U)	few days	-	-	-	-	-	-	-	-	-	-
B (d4W, M1U)	0-6 mos.	-	-	-	-	1	-	-	-	2.0	9.0
C (M1W, M2U)	5-18 mos.	-	1	-	-	1	1	2	-	2.0	9.0
D (M2W, M3U)	16-28 mos.	1	-	2.0	22.2	4	-	-	-	6.1	27.6
E (M3W, M3.3U)	26-36 mos.	-	-	-	-	-	-	1	-	-	-
F (M3.3W, M3 < g)	34-43 mos.	3	-	3.0	33.3	1	1	-	1	2.8	12.7
G (M3 = g)	40 mos.-6.5 yrs	1	-	1.0	11.1	5	1	-	-	6.2	28.1
H (M3 = h/j)	6-11 yrs.	3	-	3.0	33.3	3	-	-	-	3.0	13.6
I (M3 > j)	7-20+ yrs.	-	-	-	-	-	-	-	-	-	-
Total		8	1	9	100	15	3	3	1	22	100

Note: d4 = fourth deciduous premolar; M1/M2/M3 = first/second/third molar; U = unworn, W = worn.

¹ M3 wear stages after Grant 1982.

² After Jones and Sadler 2012, p. 22, table 7.

TABLE 17.17. MANDIBULAR EVIDENCE FOR MORTALITY IN MH AND LH PIGS (MINAU)

Stage (Definition)	Age (mos.) ¹	MH III-LH II				LH III			
		No. of Stages		Total		No. of Stages		Total	
		1	2	MinAU	%	1	3	MinAU	%
A (d4U)	0-2	5	-	5.0	15.2	2.0	-	2.0	9.5
B (d4W, M1U)	2-6	6	-	6.0	18.2	-	-	-	-
C (M1W, M2U)	6-12	6	-	6.5	19.7	6.0	-	6.0	28.4
D (M2W, M3U)	12-24	7	1	7.5	22.7	7.0	-	7.6	36.0
E (M3W, M3.3U)	24-30	2	-	2.0	6.1	3.0	1	3.3	15.6
F (M3.3W)	>30	6	-	6.0	18.2	2.0	-	2.2	10.4
Total		32	1	33	100	20	1	21	100

Note: Dental stage abbreviations as in Table 17.16.

¹ After Bull and Payne 1982.

TABLE 17.18. MANDIBULAR EVIDENCE FOR MORTALITY IN MH AND LH SHEEP AND GOATS (MINAU)

Stage (Definition) ¹	Age (mos.) ²	MH III-LH II										LH III								
		No. of Stages						Total				No. of Stages				Total				
		1	2	3	3	4	4	S	G	S+G	S+G%	1	2	3	3	4	S	G	S+G	S+G%
A (d4U)	0-2	1s	-	-	-	-	-	1.0	-	1.0	1.8	1s	-	-	-	-	1.0	-	1.0	1.7
B (d4W, M1U)	2-6	-	-	-	-	-	-	-	-	-	-	1s	-	-	-	-	1.0	-	1.1	1.8
C (M1W, M2U)	6-12	3s, 1g	-	2sg, 1g	-	-	-	3.0	1.3	4.9	8.8	4s, 1sg, 1g	1sg, 2g	-	-	-	5.0	3.3	10.2	17.0
D (M2W, M3U)	12-24	7s, 5g	1sg	-	1g	-	-	7.9	7.9	18.6	33.2	1sg, 3g	1g	-	-	-	-	4.2	6.0	10.0
E (M3W, M3.3U)	24-36	4s, 1g	1s	2g	-	1s, 1sg, 1g	-	4.6	1.8	7.2	12.8	2s	1sg	1g	-	-	2.1	-	2.8	4.7
F (M3.3W, M3 < 11G)	36-48	3s, 4g	1g	-	3sg	-	-	3.5	6.8	11.6	20.7	4s, 1g	3g	-	4sg, 2g	1sg	4.8	5.7	12.1	20.2
G (M3 = 11G, M2 = 9A)	48-72	4s, 1g	1s	-	-	-	-	9.0	1.2	12.7	22.7	3s, 2g	1s	-	-	-	14.0	4.5	22.2	37.1
H (M3 = 11G, M2 > 9A)	72-96	-	1sg	1s	-	-	-	-	-	-	-	1g	9s, 1g	1s, 1sg, 2g	-	-	0.5	3.3	4.0	6.7
I (M3 > 11G)	96-120	-	-	-	-	-	-	-	-	-	-	-	1g	-	-	-	0.5	-	0.5	0.8
Total		34	8	10	4	29	19	56	100	25	22	11	2	29	21	60	100			

Note: s = sheep; g = goat; sg = indeterminate sheep/goat.

¹ M2 and M3 wear stages after Payne 1987; dental stage abbreviations as in Table 17.16.

² After Payne 1973.

TABLE 17.19. ANATOMICAL AND TAXONOMIC COMPOSITION OF MH III–LH II POSTNEONATAL REMAINS

Anatomical Unit	Cattle		Pig		Sheep + Goat		Dog		Horse		Donkey		Red Deer		Roe Deer		Hare		Fox		Hedgehog		Tortoise		All Taxa		
	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	MinAU	MaxAU	
H/A	8	8			6	9							2	9	1	1										17	27
MD	10	18	31	50	56	87	3	3	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	101	159	
SC	4	5	12	12	5	5	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	22	23	
Hp	2	3	13	14	11	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	29	
Hd	9	11	19	21	32	37	1	1	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	63	72	
Rp	6	7	10	10	22	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	44	
Up	2	2	6	6	5	5	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	16	16	
Rd	3	4	5	5	19	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	30	
MCp ¹	4	4	7	8	8	10	1	1	1	1	1	1	1	1	-	-	1	1	-	-	-	-	-	-	24	27	
MCd ¹	5	6.5	6.5	6.5	16	18	-	-	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	29.5	33	
PE	1	1	12	12	10	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	30	
Fp	3	4	2	2	4	6	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	11	14	
Fd	2	2	4	4	8	12	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	15	19	
Tp	4	6	9	10	11	15	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	26	33	
Td	1	1	11	11	30	30	1	1	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	45	45	
A	5	5	3	3	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	18	
C	3	3	1	1	10	10	1	1	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	17	17	
MTp ¹	7	9	1	2	6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	23	
MTd ¹	3	6.5	2.5	2.5	7	10	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	13.5	20	
PH1 ²	14	17	9	11	16	19	-	-	1	1	1	1	2	2	-	-	-	-	2	2	-	-	-	-	45	53	
PH2 ²	2	2	1	1	5	5	-	-	1	1	-	-	2	2	-	-	-	-	-	-	-	-	-	-	11	11	
PH3 ²	1	1	3	3	5	5	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	
Carapace																								4	14	4	14
Total	99	126	168	195	302	382	9	9	5	5	2	2	17	24	1	1	6	6	2	2	1	1	4	14	616	767	
%	16.1	16.4	27.3	25.4	49.0	49.8	1.5	1.2	0.8	0.7	0.3	0.3	2.8	3.1	0.2	0.1	1.0	0.8	0.3	0.3	0.2	0.1	0.6	1.8			
MinAU as % of MaxAU	78.6		86.2		79.1		100.0		100.0		100.0		70.8		100.0		100.0		100.0		100.0		28.6		80.3		

Note: H/A = horn/antler; MD = mandible; SC = scapula; H = humerus; R = radius; U = ulna; MC = metacarpal; PE = pelvis; F = femur; T = tibia; A = astragalus; C = calcaneum; MT = metatarsal; PH1 = phalanx 1; PH2 = phalanx 2; PH3 = phalanx 3; p = proximal; d = distal.

¹ A few specimens identified only to “metapodial” have been assigned equally to MC and MT.

² PH1–3 include phalanges of both forelimb and hind limb.

TABLE 17.20. ANATOMICAL AND TAXONOMIC COMPOSITION OF LH III POSTNEONATAL REMAINS

<i>Anatomical Unit</i>	<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>		<i>Dog</i>		<i>Horse</i>		<i>Donkey</i>		<i>Red Deer</i>		<i>Hare</i>		<i>Fox</i>		<i>Tortoise</i>		<i>All Taxa</i>			
	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>		
H/A	4	4			10	12							1	4								15	20	
MD	21	28	22	42	61	82	3	3	-	-	2	2	-	-	-	-	-	-	-	-	-	109	157	
SC	8	9	10	10	7	7	1	1	-	-	3	3	-	-	-	-	-	-	-	-	-	29	30	
Hp	4	7	7	7	7	7	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	19	22	
Hd	8	10	24	26	32	37	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	65	74	
Rp	6	12	4	4	12	17	-	-	-	-	1	1	-	-	3	3	-	-	-	-	-	26	37	
Up	3	4	6	6	6	6	2	2	-	-	-	-	2	2	-	-	-	-	-	-	-	19	20	
Rd	4	4	5	5	17	17	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	28	28	
MCp	27	27	4	5	7	10	1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	39	43.5	
MCd	15	16	1	1	9	9.5	0.5	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	25.5	28	
PE	4	5	6	7	14	15	2	2	-	-	-	-	1	1	-	-	-	-	-	-	-	27	30	
Fp	4	5	2	2	5	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	15	
Fd	4	6	9	10	6	8	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	20	25	
Tp	10	12	11	11	13	13	-	-	1	1	2	2	1	1	1	1	-	-	-	-	-	39	41	
Td	7	8	11	11	22	24	-	-	-	-	2	2	1	1	1	1	-	-	-	-	-	44	47	
A	11	11	1	1	10	10	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	23	23	
C	4	5	4	4	5	5	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	14	15	
MTp	27	28	4	6	17	22	2	2.5	-	-	-	-	1	1	-	-	-	-	-	-	-	51	59.5	
MTd	38	40	2	3	7	12.5	0.5	1.5	-	-	1	1	-	-	-	-	-	-	-	-	-	48.5	58	
PH1	23	29	7	8	10	11	3	3	1	1	2	2	1	1	1	1	1	1	-	-	-	49	57	
PH2	6	8	2	3	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	17	
PH3	8	9	1	1	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	16	
Carapace																					1	4	1	4
Total	246	287	143	173	289	345	15	18	4	4	17	17	9	12	6	6	1	1	1	4	731	867		
%	33.7	33.1	19.6	20.0	39.5	39.8	2.1	2.1	0.5	0.5	2.3	2.0	1.2	1.4	0.8	0.7	0.1	0.1	0.1	0.5				
MinAU as % of MaxAU	85.7		82.7		83.8		83.3		100.0		100.0		75.0		100.0		100.0		25.0		84.3			

Note: For anatomical abbreviations, see Table 17.19; a few specimens identified only to “metapodial” have been assigned equally to MC and MT; PH1–3 include phalanges of both forelimb and hind limb.

TABLE 17.21. ANATOMICAL AND TAXONOMIC COMPOSITION OF MH III-LH II NEONATAL REMAINS

<i>Anatomical Unit</i>	<i>Pig</i>		<i>Sheep + Goat</i>		<i>All Taxa</i>	
	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>
MD	5	5	1	1	6	6
SC	3	3	–	–	3	3
Hp	5	5	1	1	6	6
Hd	5	5	2	2	7	7
Rp	3	3	5	5	8	8
Up	2	2	–	–	2	2
Rd	3	3	5	5	8	8
MCp	5	6	4	4	9	10
MCd	5	6	4	4	9	10
PE	4	4	1	1	5	5
Fp	3	3	2	2	5	5
Fd	4	4	2	2	6	6
Tp	4	4	1	1	5	5
Td	4	4	2	2	6	6
A	–	–	–	–	–	–
C	–	–	1	1	1	1
MTp	2	3	2	2	4	5
MTd	3	4	2	2	5	6
PH1	–	–	1	1	1	1
PH2	–	–	–	–	–	–
PH3	–	–	–	–	–	–
Total	60	64	36	36	96	100
%	62.5	64.0	37.5	36.0		
MinAU as % of MaxAU	93.8		100.0		96.0	

Note: For anatomical abbreviations, see Table 17.19; a few specimens identified only to “metapodial” have been assigned equally to MC and MT; PH1–3 include phalanges of both forelimb and hind limb.

FORMATION OF THE ASSEMBLAGE: ARCHAEOLOGICAL EXCAVATION AND RETRIEVAL

Retrieval standards at Tsoungiza were far more intensive and rigorous than those normally applied in Greece,²⁷ with two major benefits: the almost universal use of coarse dry-sieving will have ensured that recovery was both less incomplete and less variable than usual; and extensive fine wet-sieving offers some insight into remaining retrieval biases. Material recovered in the wet sieve included no identified specimens of the larger cattle (or donkey, horse, and red deer), but approximately 1%–3% of the smaller sheep/goat and pig MinAU (Table 17.23), with the latter potentially underestimating what was missed in the trench given that wet-sieving was selective. Likewise, among postneonatal postcranial material recovered in the trench, the smaller limb bones (ulna, astragalus, calcaneum, and phalanx 1–3) are under-represented relative to their frequency in a complete carcass and, consistent with this being

27. Payne 1985b.

TABLE 17.22. ANATOMICAL AND TAXONOMIC COMPOSITION OF LH III NEONATAL REMAINS

<i>Anatomical Unit</i>	<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>		<i>All Taxa</i>	
	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>	<i>MinAU</i>	<i>MaxAU</i>
MD	–	–	2	2	1	1	3	3
SC	–	–	–	–	2	2	2	2
Hp	–	–	5	5	–	–	5	5
Hd	–	–	5	5	–	–	5	5
Rp	–	–	1	1	–	–	1	1
Up	–	–	–	–	–	–	–	–
Rd	–	–	1	1	–	–	1	1
MCp	1	1	–	–	1	1	2	2
MCd	1	1	–	–	1	1	2	2
PE	–	–	1	1	1	1	2	2
Fp	–	–	2	2	–	–	2	2
Fd	–	–	2	2	–	–	2	2
Tp	–	–	3	3	1	1	4	4
Td	–	–	3	3	1	1	4	4
A	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
MTp	1	1	–	–	1	1	2	2
MTd	2	2	–	–	1	1	3	3
PH1	–	–	–	–	–	–	–	–
PH2	–	–	–	–	–	–	–	–
PH3	–	–	–	–	–	–	–	–
Total	5	5	25	25	10	10	40	40
%	12.5	12.5	62.5	62.5	25.0	25.0		
MinAU as % of MaxAU	100.0		100.0		100.0		100.0	

Note: For anatomical abbreviations, see Table 17.19; a few specimens identified only to “metapodial” have been assigned equally to MC and MT.

a result of retrieval bias,²⁸ the discrepancy is relatively modest for cattle but more marked for pigs and sheep/goats (Table 17.24). This pattern is quite stable over time: of FN–EH,²⁹ MH III–LH II, and LH III postcranial MinAU recovered in the trench, small limb bones make up 30%, 33%, and 25%, respectively, for cattle; 13%, 16%, and 17% for pigs; and 18%, 20%, and 20% for sheep/goats. Partial recovery has doubtless particularly affected neonatal specimens, as previously documented for the FN–EH assemblage, although too little identifiable material was found in the wet sieve to demonstrate a consistent bias in the later Bronze Age assemblages (Table 17.25).

Overall, approximately 1% of both MH III–LH II and LH III MinAU were recovered in the wet sieve, compared with 8% for the FN–EH assemblage (Table 17.23). To a large extent, deposits of each of these three periods were investigated in different EUs and thus by different personnel, but the same retrieval protocols were applied across the site. The sparser returns from wet-sieving for the later Bronze Age should be attributable, therefore, not to

28. Payne 1972.

29. Halstead 2011, p. 761, table 13.23.

TABLE 17.23. ANATOMICAL AND TAXONOMIC COMPOSITION OF MH AND LH FAUNAL REMAINS (MINAU)
BY RECOVERY METHOD

Anatomical Unit	MH III-LH II										LH III									
	Cattle		Pig		Sheep/Goat		Other		Total		Cattle		Pig		Sheep/Goat		Other		Total	
	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws
H/A	8	-			6	-	3	-	17	-	4	-			10	-	1	-	15	-
MD	10	-	36	-	57	-	3	1 ¹	106	1	21	-	23	1	61	1	5	-	110	2
SC	4	-	15	-	5	-	1	-	25	-	8	-	10	-	9	-	4	-	31	-
Hp	2	-	17	1	12	-	-	-	31	1	4	-	12	-	7	-	1	-	24	-
Hd	9	-	23	1	34	-	3	-	69	1	8	-	29	-	31	1	1	-	69	1
Rp	6	-	13	-	27	-	-	-	46	-	6	-	5	-	12	-	4	-	27	-
Up	2	-	7	1	5	-	3	-	17	1	3	-	6	-	6	-	4	-	19	-
Rd	3	-	8	-	24	-	-	-	35	-	4	-	6	-	16	1	2	-	28	1
MCp	4	-	10	2	12	-	5	-	31	2	28	-	4	-	8	-	1	-	41	-
MCd	5	-	9.5	2	20	-	2	-	36.5	2	16	-	1	-	10	-	0.5	-	27.5	-
PE	1	-	16	-	11	-	-	-	28	-	4	-	7	-	15	-	3	-	29	-
Fp	3	-	5	-	6	-	2	-	16	-	4	-	4	-	5	-	-	-	13	-
Fd	2	-	8	-	10	-	1	-	21	-	4	-	11	-	5	1	1	-	21	1
Tp	4	-	13	-	12	-	2	-	31	-	10	-	14	-	14	-	5	-	43	-
Td	1	-	15	-	32	-	3	-	51	-	7	-	14	-	23	-	4	-	48	-
A	5	-	3	-	10	-	-	-	18	-	11	-	1	-	10	-	1	-	23	-
C	3	-	1	-	11	-	3	-	18	-	4	-	4	-	5	-	1	-	14	-
MTp	7	-	3	-	8	-	-	-	18	-	28	-	4	-	18	-	3	-	53	-
MTd	3	-	5.5	-	9	-	1	-	18.5	-	40	-	2	-	8	-	1.5	-	51.5	-
PH1	14	-	9	-	15	2	6	-	44	2	23	-	7	-	10	-	9	-	49	-
PH2	2	-	1	-	4	1	3	-	10	1	6	-	1	1	6	-	-	-	13	1
PH3	1	-	3	-	5	-	1	-	10	-	8	-	1	-	6	-	-	-	15	-
Carapace							3	1	3	1							1	-	1	-
Total	99	-	221	7	335	3	45	2	700	12	251	-	166	2	295	4	53	-	765	6
% ws	0.0		3.2		0.9		4.4		1.7		0.0		1.2		1.4		0.0		0.8	

Note: t/ds = trench/dry sieve; ws = wet sieve; for anatomical abbreviations, see Table 17.19.

¹ One hedgehog mandible.

TABLE 17.24. ABUNDANCE OF LARGE AND SMALL LIMB BONES (MINAU) OF MH AND LH PRINCIPAL DOMESTICATES BY RECOVERY METHOD

<i>Age</i>	<i>Cattle</i>			<i>Pig</i>			<i>Sheep + Goat</i>			
	<i>Large</i> ¹	<i>Small</i> ²	<i>% Small</i>	<i>Large</i> ¹	<i>Small</i> ²	<i>% Small</i>	<i>Large</i> ¹	<i>Small</i> ²	<i>% Small</i>	
MH III–LH II										
Expected (whole)	28	18	39.1	28	18	39.1	28	18	39.1	
Postneonatal	t/ds	54	27	33.3	112	22	16.4	189	48	20.3
	ws	–	–	–	2	1	33.3	–	3	100.0
Neonatal	t/ds	–	–	–	49	2	3.9	33	2	5.7
	ws	–	–	–	4	–	0.0	–	–	–
All	t/ds	54	27	33.3	161	24	13.0	222	50	18.4
	ws	–	–	–	6	1	14.3	–	3	100.0
LH III										
Expected (whole)	28	18	39.1	28	18	39.1	28	18	39.1	
Postneonatal	t/ds	166	55	24.9	100	20	16.7	172	43	20.0
	ws	–	–	–	–	1	100.0	3	–	0.0
Neonatal	t/ds	5	–	0.0	23	–	0.0	9	–	0.0
	ws	–	–	–	–	–	–	–	–	–
All	t/ds	171	55	24.3	123	20	14.0	181	43	19.2
	ws	–	–	–	–	1	100.0	3	–	0.0

Note: Comparing trench/dry-sieve and wet-sieve recovery for postneonatal and neonatal specimens; t/ds = trench/dry sieve; ws = wet sieve.

¹ Scapula, humerus, radius, metacarpal, pelvis, femur, tibia, metatarsal.

² Ulna, astragalus, calcaneum, phalanx 1–3.

TABLE 17.25. ABUNDANCE OF POSTNEONATAL AND NEONATAL SPECIMENS (MINAU) OF MH AND LH PRINCIPAL DOMESTICATES BY RECOVERY METHOD

<i>Taxon</i>	<i>t/ds</i>			<i>ws</i>			χ^2 Test
	<i>Postneonatal</i>	<i>Neonatal</i>	<i>% Neonatal</i>	<i>Postneonatal</i>	<i>Neonatal</i>	<i>% Neonatal</i>	
MH III–LH II							
Cattle	99	–	0.0	–	–	–	–
Pig	165	56	25.3	3	4	57.1	$\chi^2 = 3.539$, p = 0.060
Sheep + goat	299	36	10.7	3	–	0.0	$\chi^2 = 0.361$, p = 0.548
Total	563	92	14.0	6	4	40.0	$\chi^2 = 5.371$, p = 0.020
LH III							
Cattle	246	5	2.0	–	–	–	–
Pig	141	25	15.1	2	–	0.0	$\chi^2 = 0.354$, p = 0.552
Sheep + goat	285	10	3.4	4	–	0.0	$\chi^2 = 0.140$, p = 0.708
Total	672	40	5.6	6	–	0.0	$\chi^2 = 0.357$, p = 0.550

Note: t/ds = trench/dry sieve; ws = wet sieve.

TABLE 17.26. ABUNDANCE OF ADJACENT SMALL AND LARGE LIMB BONE UNITS (MINAU, NEONATAL EXCLUDED) OF MH AND LH PRINCIPAL DOMESTICATES BY RECOVERY METHOD

Anatomical Unit ¹	MH III–LH II						LH III					
	Cattle		Pig		Sheep + Goat		Cattle		Pig		Sheep + Goat	
	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws	t/ds	ws
Rp	6	–	10	–	22	–	6	–	4	–	12	–
Up	2	–	5	1	5	–	3	–	6	–	6	–
Td	1	–	11	–	30	–	7	–	11	–	22	–
A	5	–	3	–	10	–	11	–	1	–	10	–
C	3	–	1	–	10	–	4	–	4	–	5	–
MCd + MTd	8	–	9	–	23	–	53	–	3	–	16	–
PH1	14	–	9	–	14	2	23	–	7	–	10	–
PH2	2	–	1	–	4	1	6	–	1	1	6	–
PH3	1	–	3	–	5	–	8	–	1	–	6	–

Note: t/ds = trench/dry sieve; ws = wet sieve; for anatomical abbreviations, see Table 17.19; PH1–3 include both forelimb and hind limb phalanges.

¹ For each group (e.g., Rp and Up), the expected ratio (with complete recovery) of anatomical units compared is 1:1.

better in-trench recovery or less frequent wet-sieving, but to diachronic differences in the deposition or survival of small identifiable specimens. Thus, although the LH III assemblage differs from its FN–EH and MH III–LH II counterparts in two respects that *could* be due to poorer recovery—a scarcity of pig and sheep/goat neonatal (Table 17.12) and abundance of cattle bones (Table 17.11)—the fairly even representation of small limb bones in all three phases and the contrast in wet-sieve returns between the FN–EH and *both* later Bronze Age assemblages suggest that these differences primarily reflect diachronic variability in the faunal material available for recovery.

Because particular body parts may be underrepresented for reasons other than poor retrieval (e.g., phalanges might be discarded during off-site butchery), Table 17.26 compares the representation of small limb bones with that of adjacent large limb units:³⁰ proximal ulna with proximal radius; astragalus and calcaneum with distal tibia; phalanx 1–3 with distal metacarpal and distal metatarsal, again for the three common domestic taxa and excluding neonatal specimens (given apparent differences between species in the frequency of such young animals). In the trench/dry-sieve material, the representation of adjacent large and small body parts is inconsistent for cattle (and the sample generally small), but small body parts are usually less abundant than adjacent long bone units in the case of pig and invariably so in the case of sheep/goat. This suggests that underrepresentation of the smaller bones is at least partly due to retrieval losses, whether the “missing” material passed through the dry sieve or was retained but overlooked during sorting. Material recovered in the wet sieve cannot be used to “correct” for partial retrieval, because sediment for wet-sieving was not dry-sieved beforehand, because wet-sieving was targeted (for sound reasons) on selected deposits, and because the amount of identifiable material from the wet sieve is too limited for extrapolation.

Damage during and after excavation was modest (Table 17.27), with only 5% and 8% of identified MH III–LH II and LH III material (MaxAU—excluding loose teeth, which might

30. Cf. Payne 1985b, p. 222, table 2.

TABLE 17.27. INCIDENCE OF NEW AND OLD BREAKS BY TAXON (MAXAU, EXCLUDING LOOSE TEETH) IN MH AND LH FAUNAL REMAINS

<i>Fragmentation</i>	<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>		<i>Dog</i>	<i>Horse</i>	<i>Donkey</i>	<i>Red Deer</i>	<i>Roe Deer</i>	<i>Hare</i>	<i>Fox</i>	<i>Hedgehog</i>	<i>Tortoise</i>	<i>All Taxa</i>	
	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>MaxAU</i>	<i>%</i>
MH III-LH II																	
Whole	33	29.2	86	38.6	68	19.3	3	5	–	9	1	3	2	1	14	225	30.0
Old break	80	70.8	137	61.4	284	80.7	5	–	1	15	–	3	–	–	–	525	70.0
New break	3	2.6	17	7.1	22	5.9	–	–	1	–	–	–	–	–	–	43	5.4
Total	116	–	240	–	374	–	8	5	2	24	1	6	2	1	14	793	–
LH III																	
Whole	46	18.0	38	22.6	48	16.9	5	3	3	5	–	–	1	–	4	153	20.1
Old break	209	82.0	130	77.4	236	83.1	8	1	11	7	–	5	–	–	–	607	79.9
New break	20	7.3	16	8.7	19	6.3	4	–	3	–	–	1	–	–	–	63	7.7
Total	275	–	184	–	303	–	17	4	17	12	–	6	1	–	4	823	–

Note: Whole and old break percentages are calculated out of total whole + old break; new break percentage is calculated out of total whole + old break + new break.

result from either ancient or recent breakage of mandibles) exhibiting new breaks (cf. 8% for FN–EH). The following section reviews the evidence for modification of the assemblage in antiquity, during and after discard, focusing especially on the effects of gnawing and burning and the contribution of gnawing and trampling to pre-excavation fragmentation.

FORMATION OF THE ASSEMBLAGE: DISTURBANCE, DISCARD, AND ATTRITION

Repeated use of Tsoungiza from the Final Neolithic period to the end of the Bronze Age and beyond has resulted in a high proportion of chronologically mixed deposits, evident mainly in residual ceramic material from earlier periods. Although not intrinsically datable, the animal bones from Tsoungiza do shed a little light on postdepositional disturbance of deposits. First, a handful of bones, identified as probable recent intrusions on the basis of weight and texture, have been excluded from analysis, but no indication of burrows (whole or partial skeletons of rodents, foxes, badgers, etc.) was observed in the material reported here. Thus, although animals other than humans evidently modified the later Bronze Age faunal material, there is no evidence that the assemblage is not ultimately derived from human activity. Second, a few deposits in EU 2 yielded the odd human phalanx or metapodial as well as a few more or less intact human infants, presumably resulting from the burial of both infants and adults and the subsequent disinterment of the latter (see pp. 163, 166, 170–171). Third, groups of articulating bones found together, and so implying limited postdepositional disturbance, were observed in the following contexts: a right-sided horse forefoot (carpals, metacarpal, and first, second, and third phalanx) in the LH I fill in EU 8 (Table 17.1); a right-sided cattle hindfoot (male metatarsal with two first, two second, and one third phalanges) in a LH IIIB deposit in EU 2; and a burnt newborn piglet in the LH IIB dump in EU 2, spaces 8 and 9 (Table 17.1). Both the horse foot and the cattle foot bore cut marks indicating their dismembering from the rest of the leg, and so do not represent disturbed burials.³¹ The piglet, almost complete and with no observed traces of butchery, was lacking astragali, calcanea, and phalanges (very likely to have been missed in excavation) as well as scapulae. A pair of unburnt scapulae in the same context might indicate that this animal was partly butchered before burning, but a handful of other specimens, some burnt and some unburnt, are derived from at least two additional newborn piglets that could have been deposited intact and disturbed subsequently (or butchered and deposited piecemeal).

The condition of most of the later Bronze Age material was fairly robust, suggesting limited degradation of bone while buried, but traces of preburial gnawing (and digestion) were very frequent, occurring on 37% of MH III–LH II and 39% of LH III identified postneonatal specimens (MaxAU, excluding loose teeth—Table 17.28). Most of these traces were compatible with gnawing by domestic dogs, which are represented in both later Bronze Age assemblages, but modification by pigs³² or even humans³³ cannot be excluded, and one sheep first phalanx from the LH IIB dump in spaces 8 and 9 in EU 2 (Table 17.1) had been gnawed by rodents. In addition, one sheep or goat astragalus from LH IIIA2–B2 pit 3 (Table 17.1) had evidently been digested, presumably by a dog. Overall, gnawing of postneonatal bones was more frequent than for the FN–EH assemblage (28%). In common with the latter, however, such traces were more frequent (very significantly so for MH III–LH II) on bones of pig (49%

31. Cf. Pappi and Isaakidou 2015.

32. Greenfield 1988.

33. Cf. Brain 1981.

and 46%) than of cattle (37% and 38%) or sheep/goat (34% and 39%). As previously noted for the FN–EH assemblage, the proportion of unfused bones, which are most vulnerable to complete destruction by gnawing, is also far higher in pig than in cattle or sheep/goat, suggesting that surviving bones may underestimate the extent to which pig bones were particularly accessible or attractive to scavengers. The incidence of gnawing in the three common taxa also varies between age categories: very significantly lower in neonatal (13% and 5%) than postneonatal material (37% and 39%) (Table 17.28); and, within postcranial material of postneonatal age, lower (very significantly so for the LH III assemblage) in skeletally immature (29% and 27%) than mature (36% and 48%) specimens (Table 17.29). The incidence of attrition may have been underestimated for neonatal and unfused material, however, because gnawing is more likely to destroy such fragile specimens and also more likely to obscure the state of fusion in unfused than fused epiphyses. The anatomical distribution of gnawing in postneonatal material of each of the three commonest taxa also exhibits some (very) significant differences between head, forelimb, hind limb, ankle, and foot (not tabulated), but these are patchy and inconsistent between species and periods, and so difficult to interpret in isolation (but see below).

To explore the possibility that gnawing has selectively *destroyed* vulnerable body parts, Figures 17.2–17.4 present relative abundance of body parts for sheep/goat, pig, and cattle (in MinAU), excluding neonatal material as particularly affected by retrieval loss; body parts are ranked from top to bottom in order of increasing vulnerability to attrition, on the basis of Brain's observations of goat bones gnawed by dogs and, to a lesser extent, humans in a modern village in southern Africa (Fig. 17.1).³⁴ The small body parts of postneonatal sheep/goat and pig potentially underrepresented for reasons of partial retrieval (calcaneum, astragalus, phalanx 1–3) are highlighted. Anatomical representation in sheep/goat (the taxon most directly comparable with Brain's observations) declines from top to bottom of the diagrams (Fig. 17.2), suggesting that attrition by gnawing (and perhaps also trampling) has contributed to selective destruction of the less robust body parts. To some extent these diagrams understate the correspondence with Brain's modern data, because long bone units with destroyed articulations but surviving shafts, treated as absent by Brain, are here recorded as present. On the other hand, the anomalously low numbers of sheep/goat metacarpals and metatarsals in both later Bronze Age assemblages suggests that factors other than partial retrieval and survival have also shaped anatomical representation. Pig anatomical representation (Fig. 17.3) also basically declines from top to bottom, with irregularities at least partly due to differences in skeletal structure (e.g., scapula is more robust, ulna larger, and metapodials probably less robust and certainly less identifiable than in sheep/goat). The poor correspondence with Brain's model in the case of cattle (Fig. 17.4) may partly reflect the greater size and robustness of cattle bones and, for the MH III–LH II assemblage, partly small sample size, but the anomalously high frequencies of LH III metacarpals and metatarsals must be due to selective carcass processing and/or discard, as discussed below. Bones of sheep/goat and probably pig were thus apparently subjected to more *severe* (as distinct from more *frequent*) attrition by scavengers than were those of cattle, but this was not the only factor causing variation in anatomical representation or the differences in this respect between taxa.

Conversely, human involvement in assemblage formation is indicated by traces of burning on 17% of MH III–LH II and 15% of LH III identified postneonatal material (Table 17.30), figures dramatically higher than the 3% for FN–EH;³⁵ the corresponding figures for neonatal

34. Brain 1981. Figures throughout this chapter use the anatomical abbreviations presented in Table 17.19. They count only the minimum numbers of anatomical units (MinAU) of

postneonatal animals.

35. Halstead 2011, p. 766, table 13.27.

TABLE 17.28. INCIDENCE OF GNAWING(/DIGESTION) BY TAXON (MAXAU, EXCLUDING LOOSE TEETH) IN MH AND LH POSTNEONATAL AND NEONATAL REMAINS

Age	Gnawing	Cattle		Pig		Sheep + Goat		Dog	Horse	Donkey	Red Deer	Roe Deer	Hare	Fox	Hedgehog	Tortoise	All Taxa	
		MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU
MH III-LH II																		
Postneonatal	Ungnawed	73	62.9	93	51.4	224	66.3	5	5	2	18	1	5	2	1	14	443	63.5
	Gnawed ¹	43	37.1	88	48.6	114	33.7	3	-	-	6	-	1	-	-	-	255	36.5
	χ^2 test	$\chi^2 = 11.168, p = 0.004$																
Neonatal	Ungnawed	-	-	56	94.9	27	75.0	-	-	-	-	-	-	-	-	-	83	87.4
	Gnawed ¹	-	-	3	5.1	9	25.0	-	-	-	-	-	-	-	-	-	12	12.6
	χ^2 test	$\chi^2 = 8.035, p = 0.005$																
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 24.397, p = 0.000$																
LH III																		
Postneonatal	Ungnawed	168	62.2	87	54.0	179	61.1	14	1	14	9		6	1		4	483	61.5
	Gnawed ¹	102	37.8	74	46.0	114	38.9	3	3	3	3		-	-		-	302	38.5
	χ^2 test	$\chi^2 = 3.084, p = 0.214$																
Neonatal	Ungnawed	3	60.0	23	100.0	10	100.0	-	-	-	-	-	-	-	-	-	36	94.7
	Gnawed ¹	2	40.0	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5.3
	χ^2 test	$\chi^2 = 13.933, p = 0.001$																
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 18.491, p = 0.000$																

¹ Including specimens both gnawed and burnt.

TABLE 17.29. INCIDENCE OF GNAWING AMONG UNFUSED AND FUSED POSTNEONATAL SPECIMENS OF MH AND LH PRINCIPAL DOMESTICATES

	<i>MH III–LH II</i>				<i>LH III</i>			
	<i>Unfused</i> ¹		<i>Fused</i>		<i>Unfused</i> ¹		<i>Fused</i>	
	<i>MinAU</i>	%	<i>MinAU</i>	%	<i>MinAU</i>	%	<i>MinAU</i>	%
Ungnawed	79	71.2	87	64.4	59	72.8	92	52.3
Gnawed	32	28.8	48	35.6	22	27.2	84	47.7
χ^2 test	$\chi^2 = 1.256, p = 0.262$				$\chi^2 = 9.682, p = 0.002$			

Note: Postcranial only, excluding proximal metapodials.

¹ Including unfused diaphyses, unfused epiphyses, fusing specimens, and specimens of unambiguously immature size and/or texture.

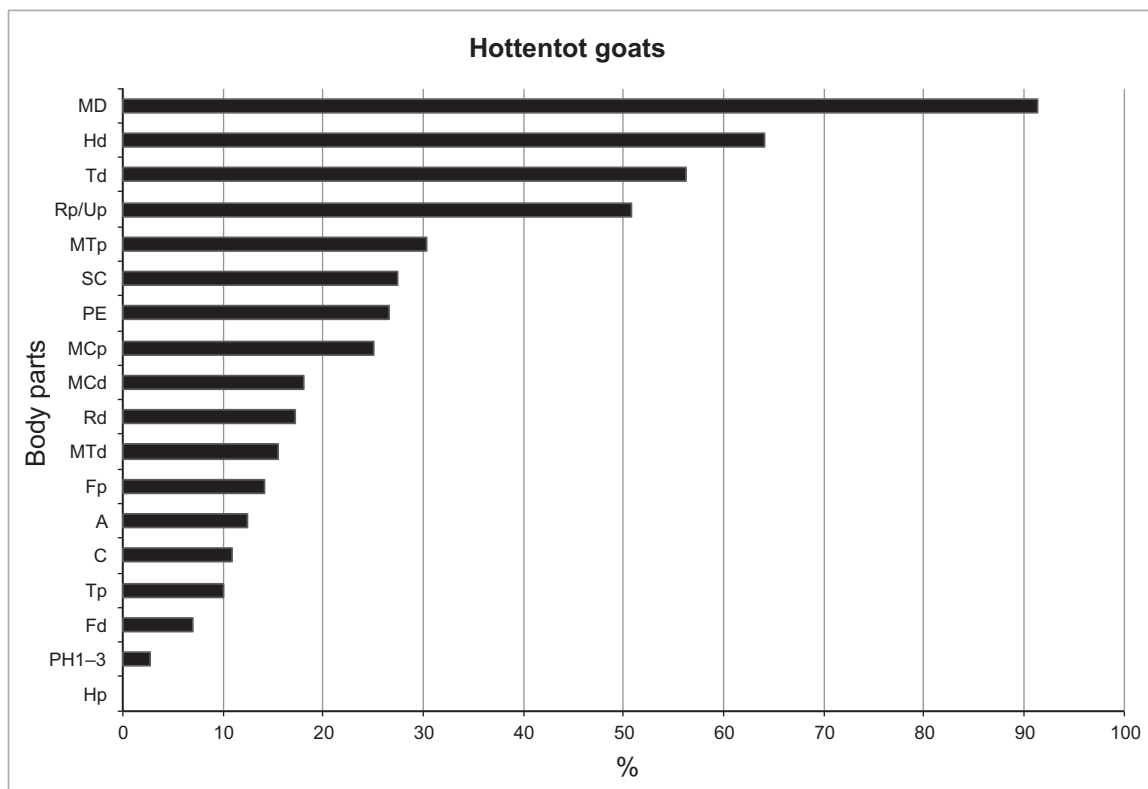


FIGURE 17.1. Anatomical representation (in descending order of frequency) of modern Hottentot goats subject to attrition by dogs. P. Halstead, after Brain 1981

material are 40% for MH III–LH II (largely due to the single burnt piglet in the LH IIB dump in spaces 8 and 9 in EU 2) and 11% for LH III, again higher than the 4% for FN–EH. If burning took place after discard, it is probably of interest here primarily as a source of assemblage degradation, like gnawing. Burning before or during discard, however, may shed more direct light on human treatment of animal carcasses. A young pig radius from LH I floor deposits was evidently exposed to fire after breakage and perhaps after discard, since it comprised two joining fragments burnt blue and white, respectively. The LH IIB newborn piglet was burnt more or less entirely, and so probably before or during discard—whether as a ritual act or waste-disposal measure—rather than in food preparation. Other specimens were apparently burnt during food preparation, as in the case of a cattle distal metatarsal from a

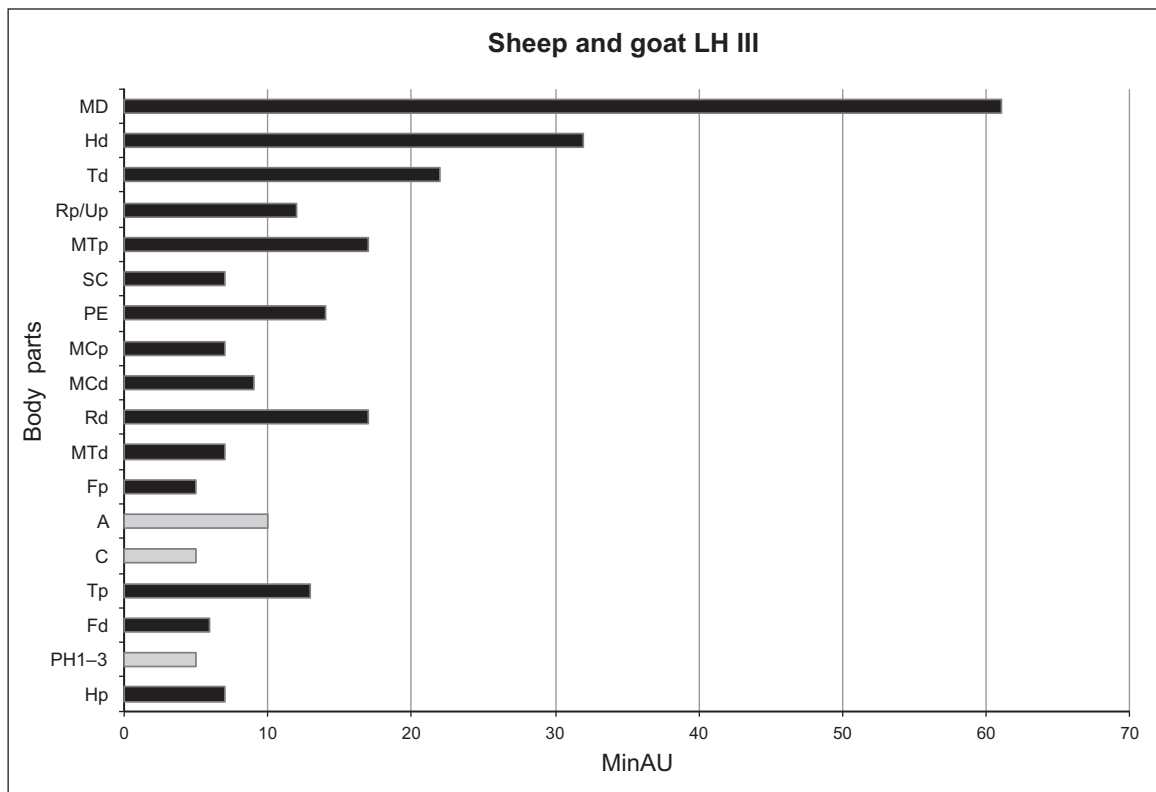
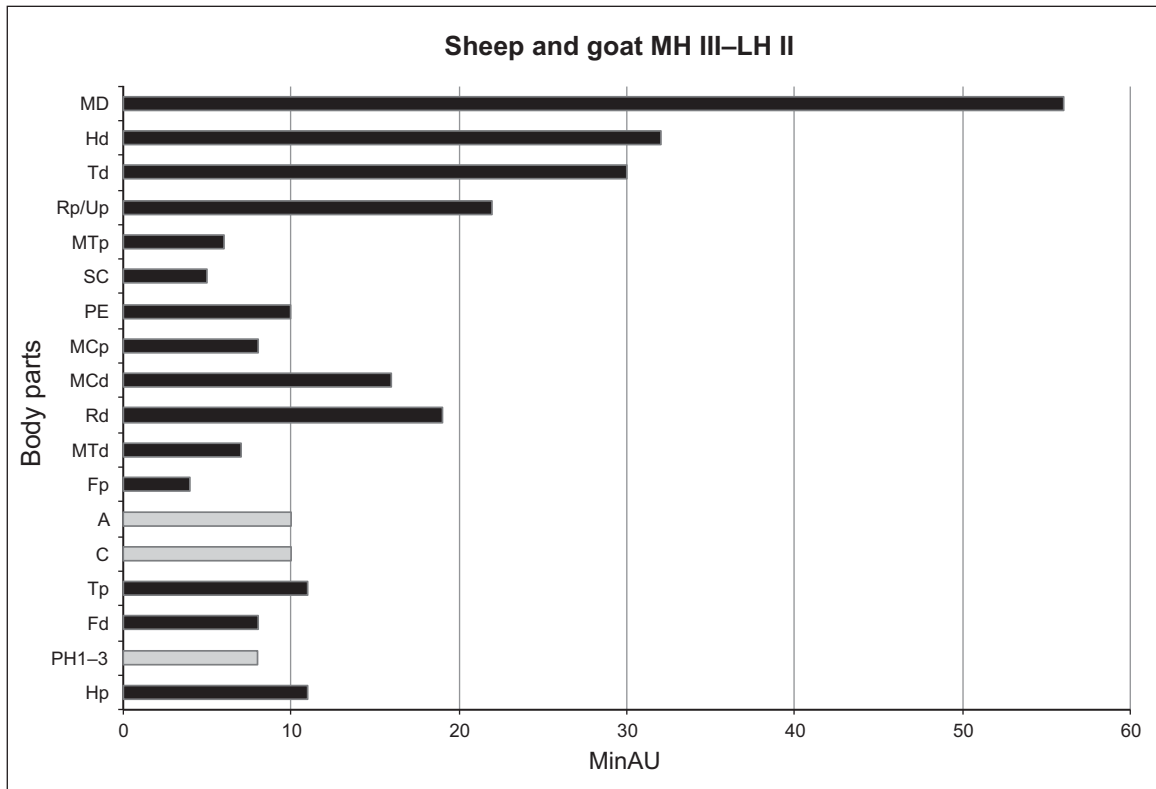


FIGURE 17.2. Anatomical representation of MH III-LH II and LH III sheep and goat, ordered for comparison with Brain's modern Hottentot goats (Fig. 17.1). Light gray shading indicates the small body parts that are particularly susceptible to partial retrieval. *P. Halstead*

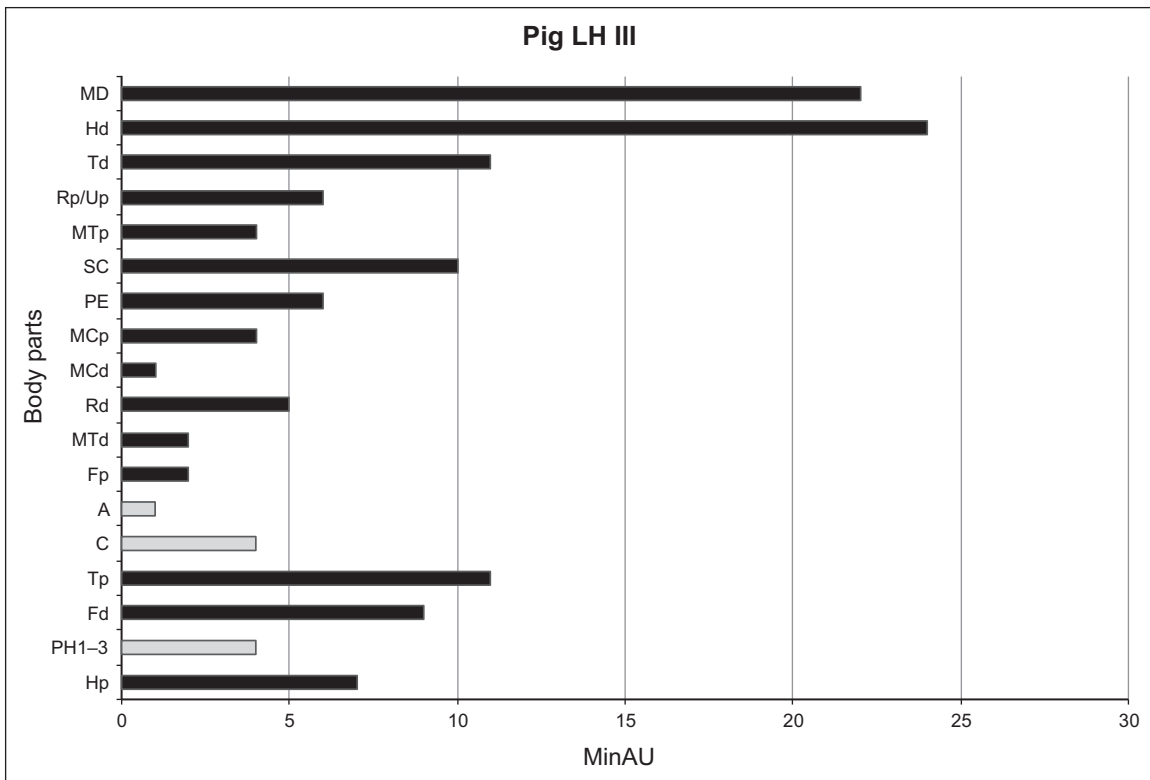
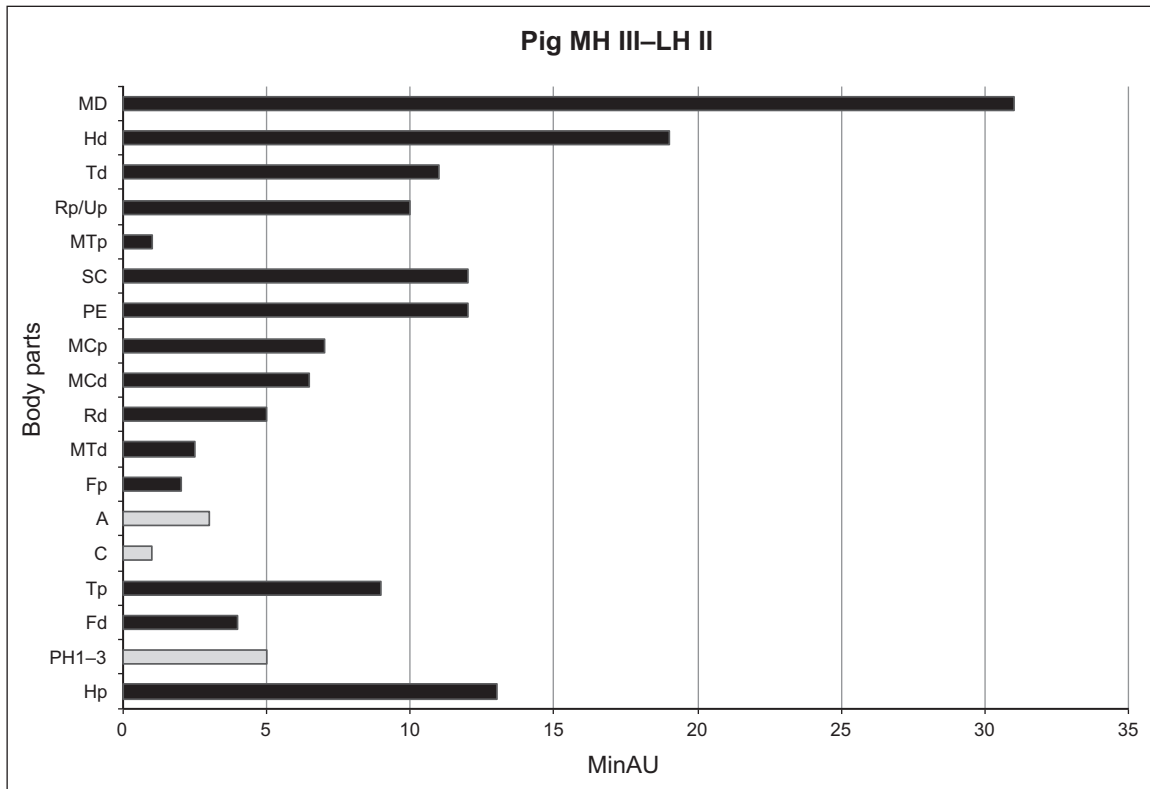


FIGURE 17.3. Anatomical representation of MH III-LH II and LH III pig, ordered for comparison with Brain's modern Hottentot goats (Fig. 17.1). Light gray shading indicates the small body parts that are particularly susceptible to partial retrieval. *P. Halstead*

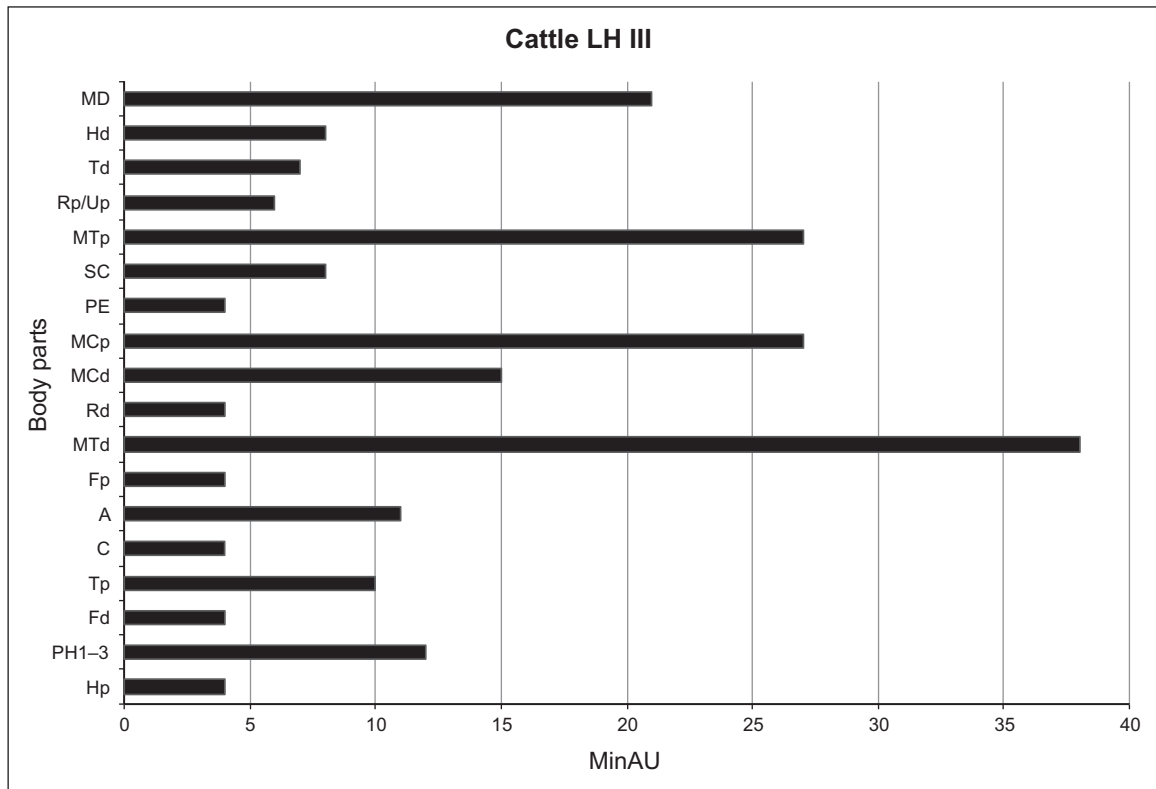
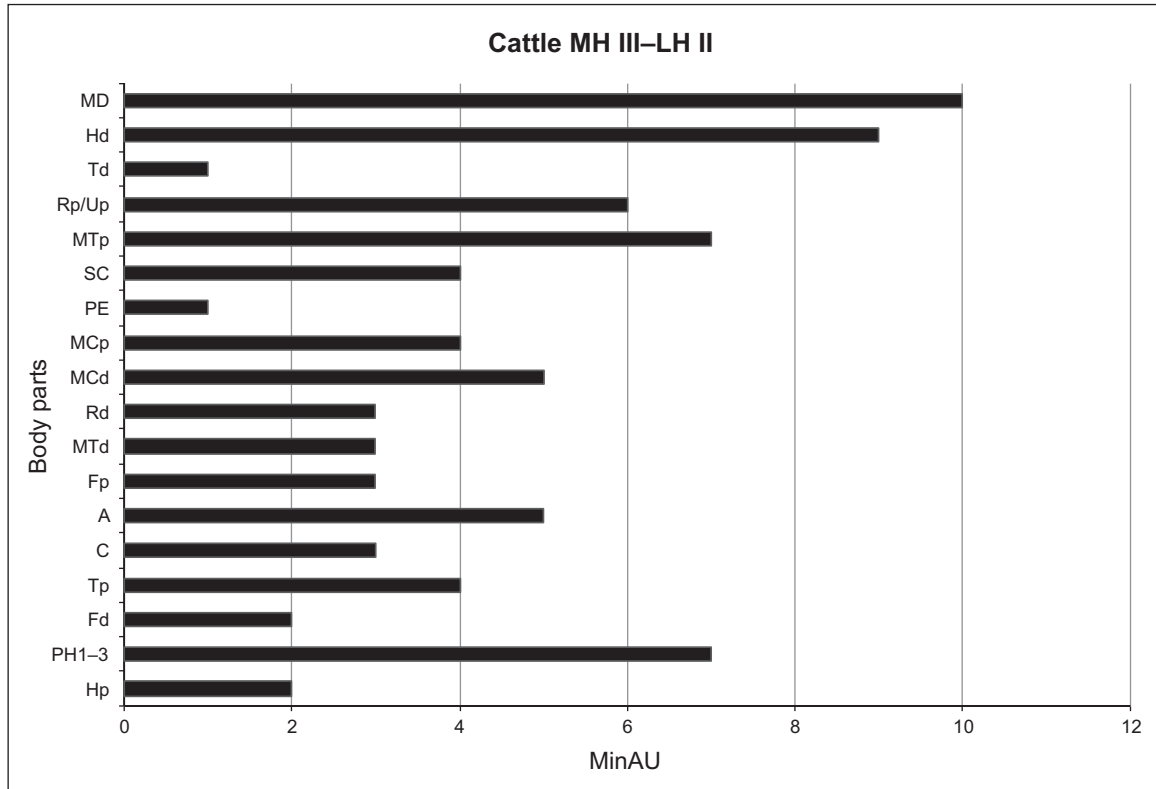


FIGURE 17.4. Anatomical representation of MH III-LH II and LH III cattle, ordered for comparison with Brain's modern Hottentot goats (Fig. 17.1). *P. Halstead*

TABLE 17.30. INCIDENCE OF BURNING BY TAXON AMONG MH AND LH POSTNEONATAL AND NEONATAL SPECIMENS

Age	Burning	Cattle		Pig		Sheep + Goat		Dog	Horse	Donkey	Red Deer	Roe Deer	Hare	Fox	Hedgehog	Tortoise	All Taxa		
		MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	%
MH III-LH II																			
Postneonatal	Unburnt	103	88.8	134	74.0	289	85.5	8	5	2	19	-	5	2	1	14	582	83.4	
	Burnt ¹	13	11.2	47	26.0	49	14.5	-	-	-	5	1	1	-	-	-	116	16.6	
	χ^2 test	$\chi^2 = 14.450, p = 0.001$																	
Neonatal	Unburnt	-	-	28	47.5	29	80.6	-	-	-	-	-	-	-	-	-	57	60.0	
	Burnt ¹	-	-	31	52.5	7	19.4	-	-	-	-	-	-	-	-	-	38	40.0	
	χ^2 test	$\chi^2 = 10.205, p = 0.001$																	
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 26.793, p = 0.000$																	
LH III																			
Postneonatal	Unburnt	215	79.6	135	83.9	263	89.8	12	4	16	10	-	6	1	-	4	666	84.8	
	Burnt ¹	55	20.4	26	16.1	30	10.2	5	-	1	2	-	-	-	-	-	119	15.2	
	χ^2 test	$\chi^2 = 11.218, p = 0.004$																	
Neonatal	Unburnt	3	60.0	21	91.3	10	100.0	-	-	-	-	-	-	-	-	-	34	89.5	
	Burnt ¹	2	40.0	2	8.7	-	-	-	-	-	-	-	-	-	-	-	4	10.5	
	χ^2 test	$\chi^2 = 5.870, p = 0.053$																	
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 0.651, p = 0.420$																	

Note: Excluding loose teeth.

¹ Including specimens both gnawed and burnt.

LH IIIA2 fill with traces of burning at the midshaft break, probably where the bone had been heated to facilitate fracturing and marrow extraction as observed among the Nunamiut by Binford.³⁶

In contrast to the perhaps deliberate burning of the pig radius and newborn piglet, heating as a prelude to marrow extraction is likely to leave light and patchy traces that are susceptible to non- or misidentification when combined with postdepositional mineral staining, and so is difficult to quantify reliably. Nonetheless, recorded traces of burning exhibit very significant variability in anatomical and taxonomic distribution (discussed in the following section), suggesting that exposure to fire mainly occurred before discard, during selective carcass processing, rather than after discard, when bone refuse is likely to have been more or less mixed. If so, prior heating for marrow extraction or burning is likely to have affected the attractiveness of discarded bone to scavengers and may thus help account for the observed anatomical and taxonomic variability in the incidence of gnawing. Both the uneven distribution of burning and its possible contribution to selective gnawing are further discussed below in relation to carcass processing.

The majority of the identified material had been fragmented in antiquity: excluding freshly broken specimens and loose teeth (for the latter, new and old breaks may be difficult to distinguish), 70% of MH III–LH II and 80% of LH III identified specimens (MaxAU) displayed old breaks, and only 30% and 20%, respectively, were unbroken (Table 17.27), compared with 68% broken and 32% unbroken FN–EH specimens.³⁷ Apparently marked differences between body parts and taxa in the incidence of old breaks are again the outcome of various pre- and postdepositional processes that are likely to be of greater and lesser intrinsic interest, respectively. Important to the latter are the shape and density of different bones: for example, even if discarded whole, the broad and thin-walled scapula and pelvis are relatively unlikely to survive burial and excavation intact, while the small, compact astragalus, calcaneum, and phalanges have good survival prospects but are subject to severe retrieval bias (and especially so if fragmented). The following discussion thus focuses on the long bones (humerus, radius, metacarpal, femur, tibia, metatarsal; excluding loose epiphyses), which are generally less fragile than the former and less vulnerable to partial retrieval than the latter.

Given its high incidence in both of the later Bronze Age assemblages, there can be little doubt that gnawing has contributed to bone fragmentation, and this seems to be confirmed by the significantly higher incidence of breakage among gnawed than ungnawed postneonatal long bones of the principal domesticates (Table 17.31): 96% versus 89% for MH III–LH II and 99% versus 95% for LH III. On the other hand, it has already been suggested that the anatomical and taxonomic distribution of gnawing traces was shaped by prior human processing of bones. To explore the likely causes of old breaks, focus on the long bones is appropriate also because these have the largest marrow cavities, and so are particularly likely targets of deliberate human fracturing to extract within-bone nutrients; several long bones also carry significant amounts of meat, and so may be broken for pot-sizing. Other things being equal, fragmentation by dogs or trampling should be most severe in the more fragile remains of small taxa and young individuals, whereas deliberate human breakage for pot-sizing or marrow extraction should be more intensive in bones of greater length or with bigger marrow cavities and thus in larger taxa and older individuals.

Accordingly, Table 17.32 presents the incidence of old breaks separately for postneonatal and neonatal long bones, while Table 17.33 further compares fragmentation between un-

36. Binford 1978, pp. 145–148, 152–155.

37. Halstead 2011, p. 768, table 13.28.

TABLE 17.31. RELATIONSHIP BETWEEN BONE FRAGMENTATION AND GNAWING IN MH AND LH FAUNAL REMAINS

Taxon	Fragmentation	MH III–LH II				LH III			
		Ungnawed		Gnawed		Ungnawed		Gnawed	
		MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%
Cattle	Whole	–	–	3	14.3	5	5.4	2	2.7
	Old break	39	100.0	18	85.7	88	94.6	71	97.3
	χ^2 test	$\chi^2 = 5.865, p = 0.015$				$\chi^2 = 0.704, p = 0.401$			
Pig	Whole	14	31.1	2	4.4	6	15.8	–	–
	Old break	31	68.9	43	95.6	32	84.2	41	100.0
	χ^2 test	$\chi^2 = 10.946, p = 0.001$				$\chi^2 = 7.006, p = 0.008$			
Sheep + goat	Whole	8	6.9	–	–	–	–	–	–
	Old break	108	93.1	74	100.0	101	100.0	67	100.0
	χ^2 test	$\chi^2 = 5.328, p = 0.021$							
Total	Whole	22	11.0	5	3.6	11	4.7	2	1.1
	Old break	178	89.0	135	96.4	221	95.3	179	98.9
	χ^2 test	$\chi^2 = 6.216, p = 0.013$				$\chi^2 = 4.410, p = 0.036$			

Note: Postneonatal long bones only, excluding loose epiphyses and new breaks.

fused (immature) and fused (skeletally mature) postneonatal long bones (excluding the proximal metacarpal and proximal metatarsal, which fuse before birth). Old breaks are very significantly more frequent among postneonatal than neonatal long bones for both MH III–LH II (91% vs. 45%) and LH III (97% vs. 52%), as also for the FN–EH assemblage (90% vs. 28%³⁸). Old breaks are likewise more frequent among fused/mature than unfused/immature postneonatal specimens, significantly so for MH III–LH II (92% vs. 80%) but not for LH III (97% vs. 92%). The incidence of old breaks also differs very significantly between the three common taxa, being lower in postneonatal pigs (82% MH III–LH II and 92% LH III) than sheep/goats (96% and 100%) or cattle (95% and 96%) and dramatically lower in neonatal pigs (14% and 22%) than sheep/goats (88% and 100%) or cattle (100% LH III). Even excluding the LH IIB burnt piglet, neonatal long bones of pig from MH III–LH II comprise only 30% old breaks. The relationship of bone fragmentation with age (lowest in neonatal and lower in immature than mature) thus matches the expectations of deliberate human breakage rather than gnawing or trampling. The majority of neonatal remains are from pigs, which produce large litters of very undeveloped young, and so are likely to have suffered much higher natural infant mortality than sheep/goats or cattle. The low level of neonatal bone fragmentation *might*, therefore, reflect the discard on-site of unbutchered natural deaths. Only one fairly complete neonatal pig skeleton was recovered, however, while a few MH III–LH II neonatal specimens bear cut marks (see below) and others of both MH III–LH II and LH III date have traces of gnawing that imply a delay between death and burial. Moreover, natural deaths are unlikely to account for the low proportion of broken *postneonatal* long bones of pig.

The incidence of old breaks also differs between taxa, but this is perhaps related not to carcass size (fragmentation is marginally lower in cattle than sheep/goats), but to the high proportion of young deaths in pigs. Analysis of the morphology of old breaks in postneonatal long bones, however, reveals very significant differences between taxa in the incidence of shaft cylinders, typical of carnivore attrition, and bone ends plus end splinters, more suggestive

38. Halstead 2011, p. 768, table 13.29.

TABLE 17.32. INCIDENCE OF OLD BREAKS BY TAXON AMONG MH AND LH POSTNEONATAL AND NEONATAL LONG BONES

Age	Fragmentation	Cattle		Pig		Sheep + Goat		Dog	Horse	Donkey	Red Deer	Hare	All Taxa	
		MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU
MH III-LH II														
Postneonatal	Whole	3	5.0	16	17.8	8	4.2	-	2	-	-	2	31	8.6
	Old break	57	95.0	74	82.2	182	95.8	3	-	1	8	3	328	91.4
	χ^2 test	$\chi^2 = 16.239, p = 0.000$												
Neonatal	Whole	-	-	37	86.0	4	12.5	-	-	-	-	-	41	54.7
	Old break	-	-	6	14.0	28	87.5	-	-	-	-	-	34	45.3
	χ^2 test	$\chi^2 = 40.044, p = 0.000$												
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 97.917, p = 0.000$												
LH III														
Postneonatal	Whole	7	4.2	6	7.6	-	-	-	2	-	-	-	15	3.4
	Old break	159	95.8	73	92.4	168	100.0	7	1	8	4	4	424	96.6
	χ^2 test	$\chi^2 = 11.208, p = 0.004$												
Neonatal	Whole	-	-	14	77.8	-	-	-	-	-	-	-	14	48.3
	Old break	5	100.0	4	22.2	6	100.0	-	-	-	-	-	15	51.7
	χ^2 test	$\chi^2 = 16.541, p = 0.000$												
χ^2 test, postneonatal vs. neonatal		$\chi^2 = 96.217, p = 0.000$												

Note: Long bones = humerus, radius, metacarpal, femur, tibia, metatarsal; loose epiphyses are excluded.

TABLE 17.33. INCIDENCE OF OLD BREAKS AMONG UNFUSED AND FUSED POSTNEONATAL SPECIMENS OF MH AND LH PRINCIPAL DOMESTICATES

Fragmentation	MH III–LH II				LH III			
	Unfused ¹		Fused		Unfused ¹		Fused	
	MinAU	%	MinAU	%	MinAU	%	MinAU	%
Whole	12	20.0	6	7.6	4	8.0	3	2.8
Old break	48	80.0	73	92.4	46	92.0	106	97.2
χ^2 test	$\chi^2 = 4.655, p = 0.031$				$\chi^2 = 2.243, p = 0.134$			

Note: Long bones only, excluding proximal metapodials and loose epiphyses.

¹ Including unfused diaphyses, fusing specimens, and specimens of unambiguously immature size and/or texture.

TABLE 17.34. INCIDENCE OF OLD BREAK MORPHOLOGICAL TYPES BY TAXON IN POSTNEONATAL LONG BONES OF MH AND LH PRINCIPAL DOMESTICATES

Type of Old Break	MH III–LH II						LH III					
	Cattle		Pig		Sheep + Goat		Cattle		Pig		Sheep + Goat	
	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%
End	12	21.1	37	50.0	41	22.5	62	39.0	33	45.2	45	26.8
End splinter	20	35.1	2	2.7	17	9.3	44	27.7	6	8.2	26	15.5
Shaft cylinder	1	1.8	14	18.9	55	30.2	12	7.5	23	31.5	49	29.2
Shaft splinter	24	42.1	21	28.4	69	37.9	41	25.8	11	15.1	48	28.6
χ^2 test: end/end splinter vs. cylinder	$\chi^2 = 25.766, p = 0.000$						$\chi^2 = 30.957, p = 0.000$					
χ^2 test: end vs. end splinter	$\chi^2 = 27.472, p = 0.000$						$\chi^2 = 8.628, p = 0.013$					
χ^2 test: shaft splinter vs. cylinder	$\chi^2 = 14.445, p = 0.001$						$\chi^2 = 18.865, p = 0.000$					

Note: Excluding loose epiphyses.

of fracturing for marrow extraction; the remaining category, shaft splinters, may result from either carnivore attrition or human extraction of marrow.³⁹ Long bone shaft cylinders make up only 2% (MH III–LH II) and 8% (LH III) of cattle specimens with old breaks, whereas the corresponding figures are 19% and 32% for pigs and 30% and 29% for sheep/goats (Table 17.34). Similarly, while articular ends and end splinters are both well represented for cattle (21% vs. 35% in MH III–LH II; 39% vs. 28% in LH III), ends greatly outnumber end splinters for pigs (50% vs. 3%; 45% vs. 8%) and sheep/goats (23% vs. 9%; 27% vs. 16%). In terms of fragment morphology, therefore, it is clear that long bones of cattle are far more intensively fragmented than those of sheep/goats and especially pigs. Given that cattle long bones are more robust than those of sheep/goats or pigs and that the proportion of immature deaths (with fragile bones) was far higher in pigs than in cattle or sheep/goats, the predominant role of deliberate human agency in bone fragmentation is thus confirmed. While some bone cylinders were created by canid attrition, their varying frequency between taxa again primarily reflects the extent to which prior human pot-sizing or processing for marrow left more or less intact long bones that dogs could reduce to cylinders.

39. Binford 1981.

In sum, gnawing and especially burning are substantially more frequent in the later Bronze Age assemblages than their FN–EH predecessor, and both will have impaired the preservation and the precision of identification of bones, and so contributed to the raised proportion of identified specimens discounted by MinAU. In addition, unbroken specimens are considerably scarcer among LH III (3%) than MH III–LH II (9%) or FN–EH (10%) postneonatal long bones, but intensity of breakage as reflected in frequencies of splinters (cattle—LH III 54%, MH III–LH II 77%, FN–EH 73%; pig—23%, 31%, 25%; sheep/goat—44%, 47%, 44%) does not differ consistently between periods (Tables 17.32, 17.34).⁴⁰ The contribution of mandibles to discounted specimens, however, is much higher for the later Bronze Age (around 40%) than FN–EH (20%), perhaps reflecting older mortality at least in LH III (see below); adult mandibles have longer tooth rows and are less accurately ageable than immature ones, and so are more likely to yield fragments that cannot be shown to be from unique specimens.

The impact of scavenger attrition and perhaps trampling on later Bronze Age (as also FN–EH) assemblage composition is partly shaped by variation in bone density, as is evident in the broad overall similarity in sheep/goat anatomical representation between Tsoungiza and Brain's actualistic study. The uneven distribution of gnawing traces, however, suggests variation between taxa and body parts in accessibility or attractiveness to scavengers that was ultimately perhaps shaped by prior human strategies of carcass processing. Traces of burning were variously inflicted after, perhaps during, and before discard (the last at least partly in the heating of bones to facilitate breakage and extraction of marrow), while uneven distribution of burning between taxa and body parts is again likely to reflect variation in human carcass-processing. Finally, although gnawing certainly contributed to bone fragmentation, and burning probably likewise (if only in rendering bones more fragile), breakage is more intensive in the robust bones of cattle and mature animals than in the more vulnerable bones of pigs, sheep/goats, and immature animals, and so must be primarily due to anthropogenic carcass-processing.

CARCASS PROCESSING

Having established that the MH III–LH II and LH III assemblages for the most part represent material discarded by humans after some form of carcass processing, the sequence of carcass processing can now be explored in more detail using the following complementary data sets: the relative abundance by weight of head, trunk, and limb fragments for all taxa combined; the relative abundance in MinAU of identified postneonatal body parts for each of the three common taxa; the stages of butchery represented by cut marks for each taxon; and the bone fragmentation patterns argued above to be of primarily anthropogenic origin.

In a sample of complete modern reference skeletons of cattle, sheep, goats, and farmed wild boar,⁴¹ limbs make up 40%–56%, trunk 24%–35%, and head 14%–32% of overall bone weight. By contrast (and contrary to Halstead⁴²), the Tsoungiza FN–EH, MH III–LH II, and LH III assemblages (Table 17.1) all include substantially less trunk (11%, 8%, and 5%, respectively) and more head material (33%, 42%, and 36%), as might be expected in assemblages subject to carnivore attrition, to which trunk bones are particularly susceptible and the head (and especially teeth) least so.⁴³ That trunk is better represented in the FN–EH assemblage, for which 28% of identified MaxAU exhibited gnawing, than in the later Bronze

40. Halstead 2011, pp. 768, 770, tables 13.29, 13.32.

41. Halstead 2011, p. 772, fig. 13.3:a.

42. Halstead 2011, p. 772, fig. 13.3:b.

43. E.g., Brain 1981.

Age assemblages, with 37% and 39% of identified MaxAU gnawed, also matches the expectations of differential attrition. Despite almost identical frequencies of gnawing, however, the representation of trunk in the MH III–LH II assemblage is nearly double that in the LH III assemblage, suggesting that trunk material was preferentially discarded in the excavated parts of MH III–LH II (and probably also FN–EH) Tsoungiza or, more parsimoniously (given its marked underrepresentation), was preferentially *not* discarded in the excavated parts of the LH III site. One obvious interpretation of the latter scenario is that the LH III assemblage is biased toward waste from primary carcass-dressing, in which heads and/or feet were discarded, while the earlier assemblages are biased toward refuse from the processing and consumption of complete or dressed carcasses. This suggestion can be tested by considering the anatomical distribution of identified specimens.

Figures 17.5–17.7 (based on Tables 17.19 and 17.20) display the relative abundance in MinAU of identified postneonatal body parts of the principal domesticates, arranged in three anatomical groups relevant to butchery: head, shown in black in the figures (represented by mandible; omitting horns, as these are absent in pigs, young ruminants, and perhaps adult female sheep); more or less meat-rich upper limbs, shown in gray in the figures (scapula, humerus, radius, ulna, pelvis, femur, tibia); and meat-poor feet, shown in white in the figures (metacarpal, astragalus, calcaneum, metatarsal, phalanx 1–3). For MH III–LH II cattle, pigs, and sheep/goats alike, the best represented anatomical unit is the mandible, in part at least reflecting the high durability and identifiability (to age as well as taxon) of teeth. Among limb bones of the same period, an apparent bias toward meat-rich anatomical elements for pigs (humerus, scapula, pelvis, tibia, radius) and sheep/goats (humerus, tibia, radius) may partly be due to the loss of most pig and sheep/goat phalanges during excavation and perhaps also to the vulnerability of pig metacarpals and metatarsals to attrition. On the other hand, sheep/goat metacarpals and metatarsals seem underrepresented to a degree not easily attributable just to partial survival or retrieval, implying that many sheep and goats (and possibly also pigs) were slaughtered and dressed (including removal of the feet) elsewhere before introduction of their carcasses to the excavated part of the settlement. For cattle, both meat-rich (especially humerus, radius) and meat-poor (metatarsal, first phalanx) bones are well represented, suggesting more limited off-site carcass dressing or the introduction to the settlement of whole (live?) animals. For the LH III assemblage, anatomical representation of sheep/goats and pigs does not differ significantly from that for MH III–LH II (sheep/goats: $\chi^2 = 18.284$, $p = 0.631$; pigs: $\chi^2 = 19.618$, $p = 0.482$; sheep/goats and pigs combined: $\chi^2 = 24.036$, $p = 0.291$), with a predominance of mandibles and meat-rich upper limb bones and scarcity of sheep/goat metacarpals and metatarsals suggesting the remains from consumption of carcasses dressed (at least in the case of many sheep and goats) elsewhere. Conversely, for cattle, anatomical representation differs significantly between the two periods ($\chi^2 = 39.023$, $p = 0.010$): LH III foot bones (especially metacarpals and metatarsals) are heavily *over*represented and outnumber mandibles, while meaty upper limb bones are scarce, indicating a predominance of carcass dressing waste. The suggested contrast in discard, inferred from weight data, between MH III–LH II and LH III is thus confirmed by identified bones, at least in the case of cattle, which, being larger and heavier than the other domesticates, have contributed disproportionately to bone weights.

Cut marks inflicted during butchery were noted on 6% of MH III–LH II and 7% of LH III postneonatal specimens and 4% of MH III–LH II neonatal material (Table 17.35); no cuts were recorded on the small sample of LH III neonatal specimens. These figures, which are lower than those for FN–EH (11% postneonatal, 2% neonatal⁴⁴), certainly underestimate the

44. Halstead 2011, p. 773, table 13.34.

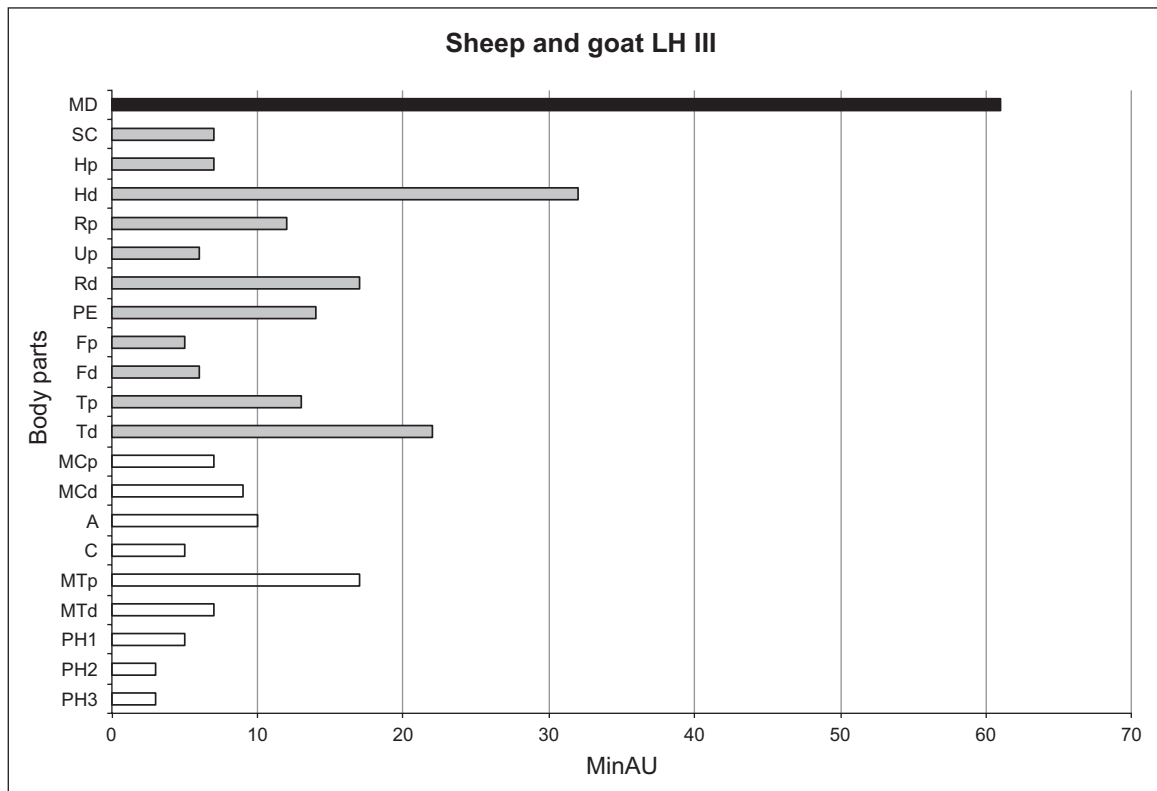
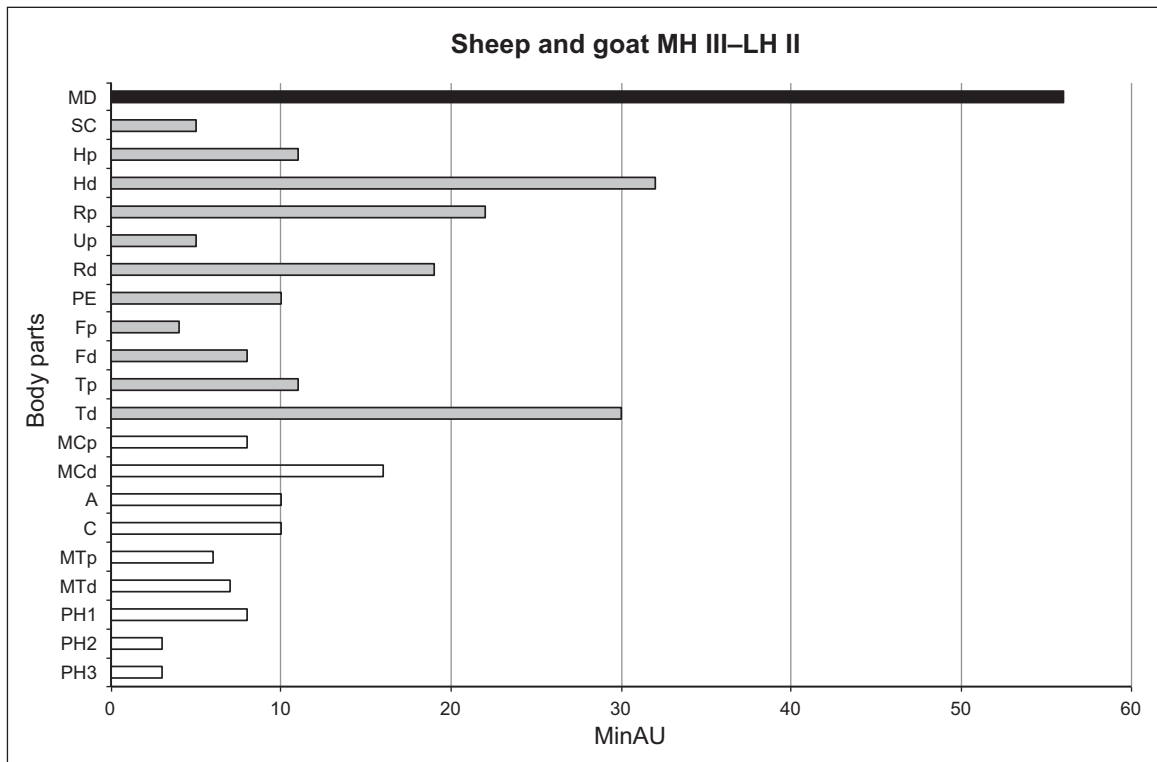


FIGURE 17.5. Anatomical representation of MH III-LH II and LH III sheep and goat. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

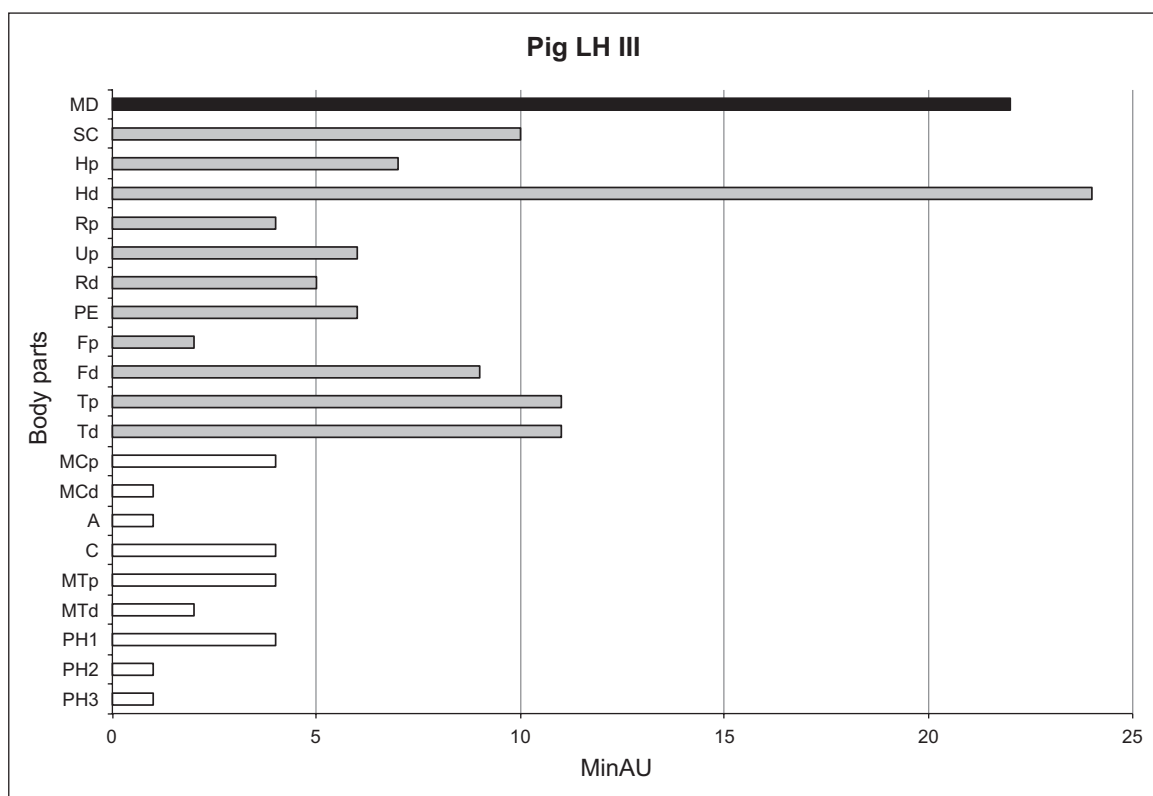
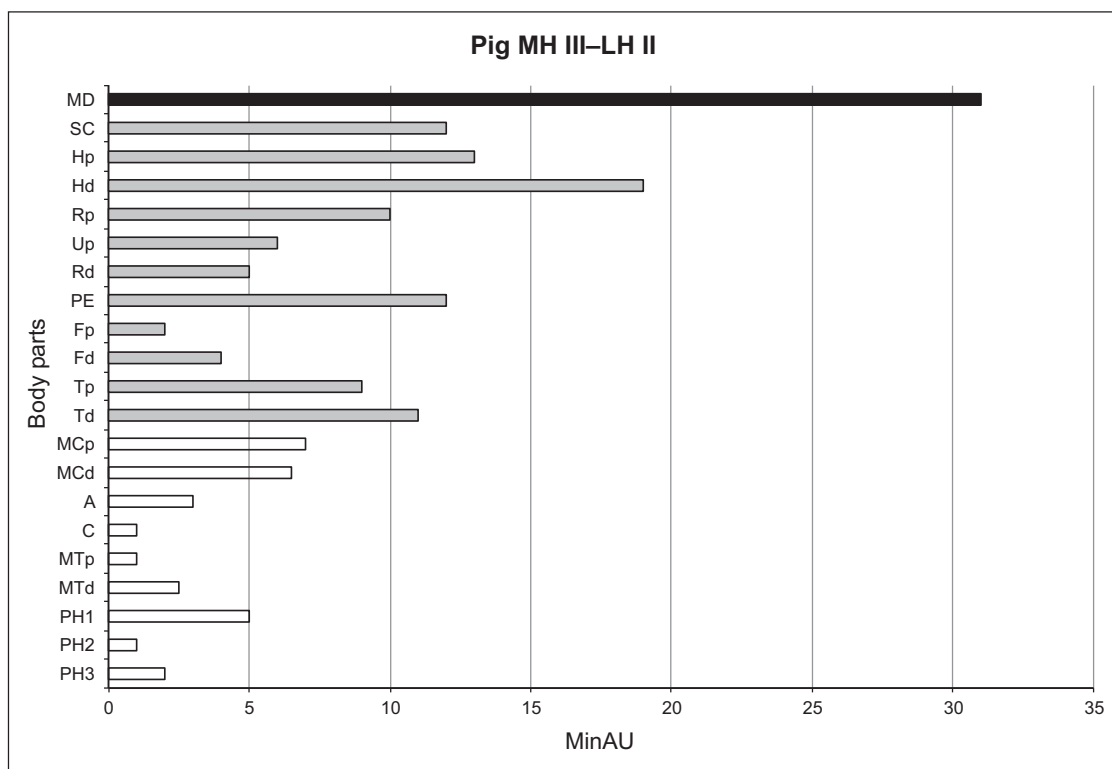


FIGURE 17.6. Anatomical representation of MH III-LH II and LH III pig. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

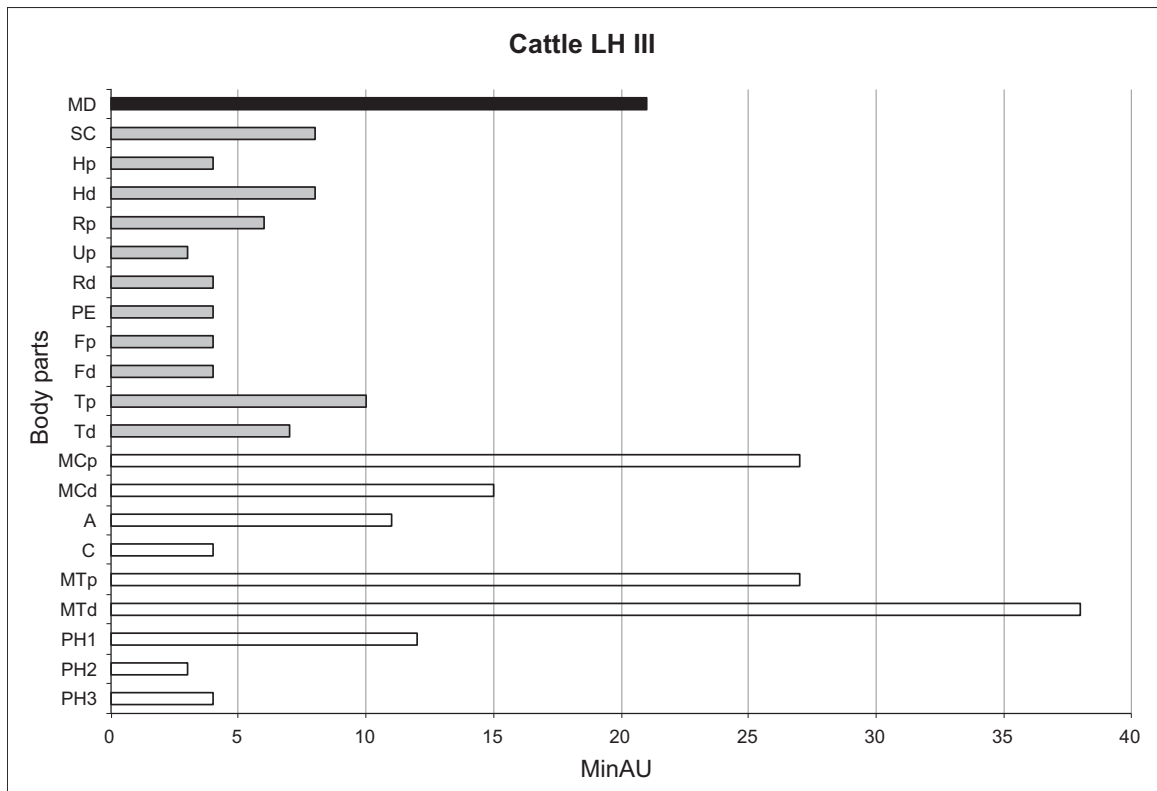
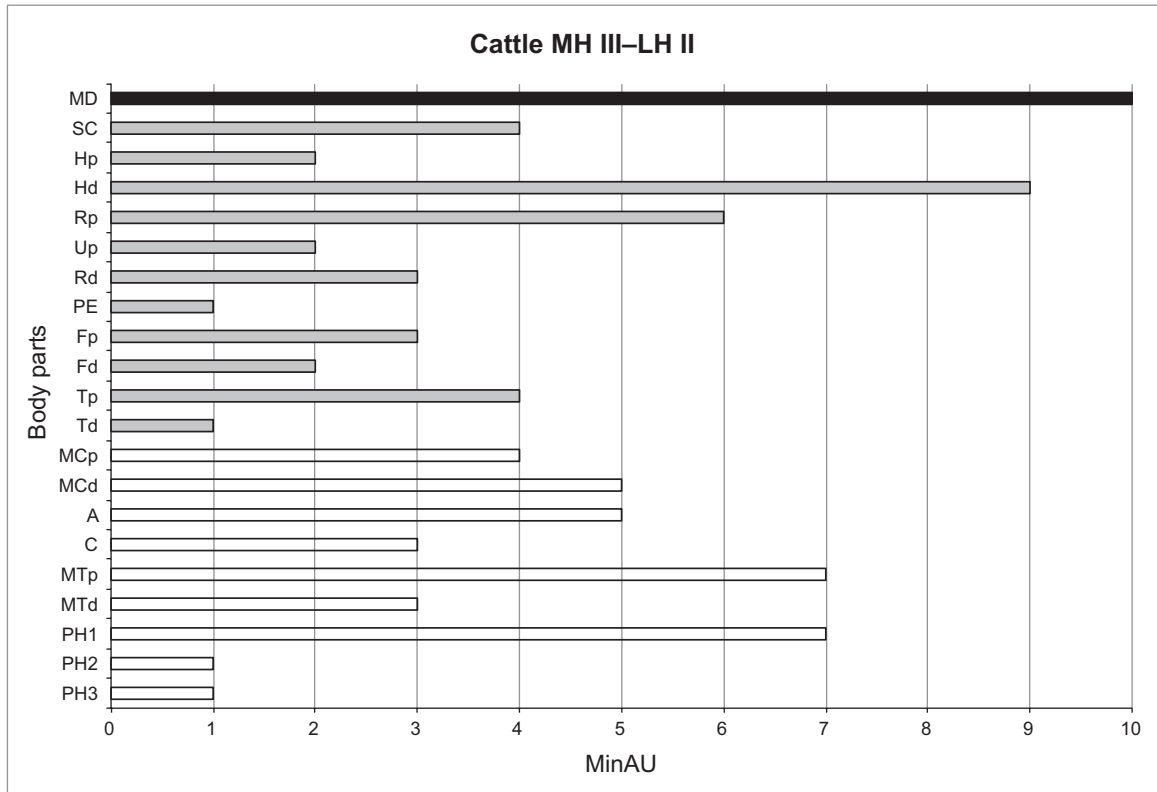


FIGURE 17.7. Anatomical representation of MH III-LH II and LH III cattle. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

TABLE 17.35. INCIDENCE OF BUTCHERY MARKS BY AGE CATEGORY AND TAXON IN MH AND LH FAUNAL REMAINS

Age	Butchery	Cattle		Pig		Sheep + Goat		Dog	Horse	Donkey	Red Deer	Roe Deer	Hare	Fox	Hedgehog	Tortoise	All Taxa	
		MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU	MaxAU
MH III-LH II																		
Postneonatal	Uncut	104	89.7	172	95.0	320	94.7	8	3	2	21	1	5	2	1	14	653	93.6
	Cut	12	10.3	9	5.0	18	5.3	–	2	–	3	–	1	–	–	–	45	6.4
	χ^2 test	$\chi^2 = 4.375, p = 0.112$																
Neonatal	Uncut	–	–	57	96.6	34	94.4	–	–	–	–	–	–	–	–	–	91	95.8
	Cut	–	–	2	3.4	2	5.6	–	–	–	–	–	–	–	–	–	4	4.2
	χ^2 test	$\chi^2 = 0.260, p = 0.610$																
All	Uncut	104	89.7	229	95.4	354	94.7	8	3	2	21	1	5	2	1	14	744	93.8
	Cut	12	10.3	11	4.6	20	5.3	–	2	–	3	–	1	–	–	–	49	6.2
	χ^2 test	$\chi^2 = 5.090, p = 0.078$																
LH III																		
Postneonatal	Uncut	236	87.4	152	94.4	281	95.9	16	4	17	10	–	6	1	–	4	727	92.6
	Cut	34	12.6	9	5.6	12	4.1	1	–	–	2	–	–	–	–	–	58	7.4
	χ^2 test	$\chi^2 = 15.640, p = 0.000$																
Neonatal	Uncut	5	100.0	23	100.0	10	100.0	–	–	–	–	–	–	–	–	–	38	100.0
	Cut	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0.0
	χ^2 test	–																
All	Uncut	241	87.6	175	95.1	291	96.0	16	4	17	10	–	6	1	–	4	765	93.0
	Cut	34	12.4	9	4.9	12	4.0	1	–	–	2	–	–	–	–	–	58	7.0
	χ^2 test	$\chi^2 = 17.162, p = 0.000$																

Note: Excluding loose teeth.

intensity of butchery, since skilled work may not leave detectable marks, while attrition has doubtless obscured many traces, especially those inflicted around articular ends during dismembering. The incidence of recorded cut marks is thus not inconsistent with the earlier argument that the later Bronze Age faunal assemblages overwhelmingly represent animals butchered by humans.

Knife marks inflicted during skinning, dismembering, or filleting and chop marks probably related to skinning, pot-sizing, or marrow extraction were observed on postneonatal specimens of cattle, sheep, goat, pig, dog, horse, red deer, and hare (Table 17.36). Roe deer is represented only by one fragment of a *shed* antler, presumably collected as raw material for working or perhaps even as a “trophy” of a kill that did not take place, but the absence of cut marks on hedgehog (one mandible), fox (three phalanges), and tortoise (only fragments of carapace) may not be meaningful, for reasons of small sample size and/or the body parts identified. Donkey is represented by 18 specimens (amounting to 19 MaxAU), including parts of eight long bones, all broken in antiquity. These 18 specimens were widely scattered, through eight different contexts and 16 different SUs, and derived from at least three individual animals, as indicated by the presence of three right-sided scapulae, while two distal tibiae were both left-sided and thus also from different individuals. If these remains represented natural deaths, discarded intact but without burial (given the dispersal of bones), they should arguably have attracted unusually high levels of gnawing, which is not the case (Table 17.28). Despite the absence of cut marks, therefore, the fragmentation, dispersal, and frequency of gnawing of donkey remains are more compatible with discarded waste from butchery and consumption, than with the dumping of intact, dead beasts of burden. Cut marks observed on a few neonatal specimens of pig and sheep/goat, albeit only of MH III–LH II date, confirm that at least some of these youngest remains were also by-products of human butchery activity.

Observed butchery marks (Table 17.36) also confirm the suggestion, based on anatomical representation, that all stages of carcass processing for at least some animals took place on-site. Knife marks attributed to skinning were observed around the base of one sheep and one goat horncore and across the shaft of metacarpals, metatarsals, and first phalanges of both cattle and sheep/goats. Chop marks to the base of horncores of cattle, sheep, and goats were probably inflicted in removing the horns, whether for working or to facilitate skinning of the head; the chopped goat horn also carries knife marks from skinning, while one of the chopped cattle horns was additionally worked by sawing. In practice, horns may have been removed for both purposes, so chopped specimens are treated as evidence for skinning in Table 17.36. Dismembering knife marks indicate partitioning of cattle forelimbs at the elbow (between distal humerus and proximal radius/ulna) and both upper foot (between distal radius and proximal metacarpal) and lower foot (between distal metacarpal and anterior first phalanx) and of cattle hind limbs at the hip (between acetabulum of pelvis and proximal femur), ankle (between distal tibia and proximal metatarsal), and lower foot. Pig forelimbs were partitioned at least at the shoulder (between scapula and proximal humerus) and elbow and pig hind limbs at the hip, knee (between distal femur and proximal tibia), and ankle, while sheep/goat carcasses were partitioned at least at the elbow, hip, ankle, and lower foot. Cut marks indicating the filleting of meat have been recorded, among postneonatal bones, on the hind limb of cattle and both the forelimb and hind limb of pig and sheep/goat and, among neonatal bones, on the hind limb of both pig and sheep/goat. Finally, chop marks to bone shafts, indicating how and perhaps why a few specimens were broken, are discussed below, together with the more abundant evidence of fragmentation patterns.

In contrast with the FN–EH assemblage, the incidence of MH III–LH II and LH III butchery marks (Table 17.35) is consistently and, in LH III, very significantly higher in

TABLE 17.36. BREAKDOWN OF MH AND LH BUTCHERY MARKS BY TAXON, ANATOMICAL LOCATION, AND INFERRED PURPOSE (MAXAU)

Location/Purpose	MH III–LH II								LH III						
	Cattle	Pig	Sheep	Sheep/ Goat	Goat	Horse	Red Deer	Hare	Cattle	Pig	Sheep	Sheep/ Goat	Goat	Dog	Red Deer
H/A	Ch2, Saw1		Ch1, Sk1		Ch+Sk1		W4								W2
MD					F1					F1					
MD hinge															
SC blade															
SC/Hp										D1					
H shaft															
Hd/Rp/Up	D2	D2	D3	D1	D1		F1	D1	D4	D1	D1	D2	D2		
R shaft		F1											F1		
Rd/MCp						D1			D1						
MC shaft									Sk3		Sk1				
MCd	Sk2								D1						
PE				F1						F1	F1				
PE/Fp	D1				D1				D2	D2				D1	
F shaft		F1+1N		F1N					F1			F1			
Fd/Tp	D1									D2					
T shaft										F1					
Td/A/C/MTp	D2	D2	D3						D7		D1		D1		
MT shaft				Sk1					Sk4, ChM1						
MTd	D1				D1				D2						
PH1			Sk1						D1, Sk2, ChM1						
PH2															
PH3															
Skin	4		5						9		1				
D	7	4	10			1		1	18	6	7			1	
Fillet		2+1N	2+1N					1	1	3	3				
Marrow									Ch2						
Work	1						4								2
%	Sk9 (23.1%), D23 (59.0%), F5+2N (17.9%)								Sk10 (19.6%), D32 (62.7%), F7 (13.7%), ChM2 (3.9%)						

Note: Ch = chop mark; D = dismembering; F = filleting; M = marrow extraction; N = neonatal (otherwise postneonatal); Saw = saw mark (otherwise knife mark); Sk = skinning; W = working; for anatomical abbreviations, see Table 17.19. Chopped horncores of cattle, sheep, and goat are attributed here to skinning and a sawn horncore to working (see p. 1118). MaxAU = numbers of units exhibiting each type of cut rather than numbers of cuts inflicted; some totals exceed those in Table 17.35 because individual specimens bear more than one type of cut mark.

cattle (10% and 13%, respectively, of postneonatal specimens, excluding loose teeth) than in pigs (5% and 6%) and sheep/goats (5% and 4%). As in the FN–EH, the representation of successive stages of butchery differs strikingly between taxa (Table 17.36), with traces of skinning relatively common and of filleting relatively rare in cattle, while evidence of dismembering is most frequent in all three taxa. These differences must again be evaluated, however, in the light of contrasting patterns of anatomical representation and fragmentation. Dismembering marks tend to be located around articulations and filleting traces on bone shafts, so the frequency of both will depend *inter alia* on patterns of attrition and fragmentation. The more intensive splintering of long bone articulations and especially long bone shafts has thus doubtless reduced the recorded frequency of traces of dismembering and especially filleting in the case of cattle, even when only those body parts and long bone fragment types are considered that are most likely to bear traces of each stage of butchery (Tables 17.37, 17.38). In practice, traces of filleting are slightly less frequent in cattle than in pigs and sheep/goats, in both MH III–LH II and LH III, and traces of dismembering are slightly more frequent. If the assemblages were large enough to quantify dismembering traces only on *complete* articulations, and filleting traces only on *complete* bone shafts, therefore, it would probably be evident that cattle were both dismembered and filleted significantly more intensively than sheep/goats and pigs. Less intensive dismembering and filleting of the latter would be unsurprising, given their smaller size, but would contrast with FN–EH butchery, which apparently yielded relatively as well as absolutely smaller joints and fillets of sheep/goats and pigs that were presumably cooked quite differently from the larger sections of cattle carcasses.⁴⁵ In the later Bronze Age, the smaller domesticates were apparently butchered less intensively than in FN–EH into pieces closer in absolute size to portions of beef and were perhaps cooked in a similar way. It is unknown whether the less intensive butchery of sheep/goats and pigs in the later Bronze Age reflects a change in the scale or form of commensality and/or the use of larger cooking vessels, perhaps including metal cauldrons.⁴⁶

While poor recovery of phalanges of the smaller domesticates may have contributed to the greater abundance of evidence for skinning in cattle, it does not account for the greater frequency of such traces on metacarpals and metatarsals of cattle than of the smaller taxa. Interestingly, FN–EH skinning marks on cattle feet were restricted to the first (two cases) and second phalanx (one case), but MH III–LH II and LH III marks occur on the shaft of the metacarpal/metatarsal (nine cases) and first phalanx (two cases), suggesting a shift over time toward less painstaking and less thorough removal of the hide, as also reported between the Neolithic period and later Bronze Age at Knossos on Crete.⁴⁷ In the case of pigs, metacarpals and metatarsals, as well as phalanges, are poorly represented, but the lack of any skinning cuts in FN–EH, MH III–LH II, or LH III alike might reflect cooking of the predominantly young piglets without prior skinning, as is the norm today. In the case of sheep/goats, however, suitable metacarpal and metatarsal surfaces for detection of skinning traces are (allowing for less intensive fragmentation) probably more or less as common as for cattle in the combined later Bronze Age assemblages, potentially implying that the smaller domestic ruminants were skinned down to the underrepresented phalanges and thus more painstakingly than cattle. This suggestion—admittedly from absence of evidence in a small sample—could be reconciled with the apparently contradictory indications from anatomical representation that the entire foot was often discarded during initial carcass-dressing of sheep and goats, if the skinned metapodials were often immediately processed for snacking on the marrow, and

45. Halstead 2011, p. 777.

46. E.g., Wright 2004c.

47. Isaakidou 2007a.

TABLE 17.37. INCIDENCE OF FILLETING MARKS IN SELECTED POSTNEONATAL SPECIMENS OF MH AND LH PRINCIPAL DOMESTICATES

Taxon	MH III–LH II				LH III			
	Filleted		Not Filleted		Filleted		Not Filleted	
	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%
Cattle	–	–	35	100.0	1	1.6	63	98.4
Pig	3	3.0	96	97.0	2	2.2	87	97.8
Sheep + goat	1	0.6	162	99.4	3	2.3	129	97.7
χ^2 test	$\chi^2 = 3.249, p = 0.197$				$\chi^2 = 0.118, p = 0.943$			

Note: Based on whole bones and specimens with old breaks including part or all of the shaft of scapula, humerus, radius, ulna, pelvis, femur, and tibia.

TABLE 17.38. INCIDENCE OF DISMEMBERING MARKS IN SELECTED POSTNEONATAL SPECIMENS OF MH AND LH PRINCIPAL DOMESTICATES

Taxon	MH III–LH II				LH III			
	Dismembered		Not Dismembered		Dismembered		Not Dismembered	
	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%
Cattle	3	11.1	24	88.9	5	10.4	43	89.6
Pig	2	4.0	48	96.0	4	7.5	49	92.5
Sheep + goat	7	10.6	59	89.4	4	6.2	60	93.8
χ^2 test	$\chi^2 = 1.935, p = 0.380$				$\chi^2 = 0.668, p = 0.716$			

Note: Excluding head and foot; based on whole bones and specimens with old breaks including part or all of the articular area.

so discarded together with the phalanges and separately from the rest of the carcass. More significantly, this interpretation of the anatomical and cut-mark data implies that slaughtered cattle were treated differently from sheep/goats (and perhaps pigs), perhaps for reasons of social context rather than merely of the costs and benefits of processing carcasses of contrasting size.

Finally, a few specimens may be interpreted as by-products of the working of horn or antler (Table 17.39). One cattle horncore in a LH I context had been removed from the skull by chopping at the base and had also been sawn through transversely to remove the upper part of the horn. The sawing is attributed to craft working on the basis partly of its location and partly of the absence of any trace of the use of saws in food-related carcass processing (as elsewhere⁴⁸). The evidence is most abundant for red deer, with five of the nine MH III–LH II and two of the four LH III fragments bearing traces of chopping, cutting, or sawing that presumably represent successive stages in the roughing out and working of this raw material. In addition, one shed antler each of red and roe deer had been collected and brought to Tsoungiza, perhaps for working, although use as fraudulent hunting trophies cannot be precluded, while traces of working on the remaining antler fragments may well have been lost or obscured postdepositionally. In either case, it seems that most red deer antler was worked. The two shed antlers were recovered from the same context, the LH IIB dump in spaces 8 and 9 in EU 2, although burning of the roe deer specimen hints at divergent

48. E.g., Isaakidou 2007b.

TABLE 17.39. EVIDENCE OF MH AND LH HORN AND ANTLER WORKING BY TAXON AND CONTEXT

<i>Species</i>	<i>Date</i>	<i>Context</i>	<i>Description</i>
Cattle	LH I	EU 8, exterior surface	Sawn transversely
Red deer	MH III	EU 2, exterior surface	Transverse chop marks on tine
	LH I	EU 7, room 6, East Building	Transverse knife marks
	LH I	EU 8, exterior surface	Sawn tine
	LH IIA	EU 10 dump	Cut strip
	LH IIB	EU 2, spaces 8 and 9 dump	Shed—collected for working(?)
	LH IIIB1	EU 8 fill	Chopped tine
	LH IIIB2	EU 10, space 7 destruction	Sawn segments
Roe deer	LH IIB	EU 2, spaces 8 and 9 dump	Shed—collected for working(?)

treatment. The remainder of the cut or worked antler is widely distributed temporally and contextually, offering no hint of debris from specialized workshops.

We may now return to deliberate bone breakage and its attribution to pot-sizing and/or marrow extraction, both of which are broadly compatible with the more intensive fracturing of cattle and adult than of pig, sheep/goat, and immature bones. Chop marks, probably from metal cleavers, were observed on the shafts of two cattle bones: the previously discussed metatarsal from the LH IIIA2 fill in EU 7, which had been heated presumably to facilitate marrow extraction, given how little flesh this element bears; and a first phalanx from a LH IIIA2 deposit in EU 2, which, although apparently unburnt, is even less likely to have been broken during pot-sizing. In addition, a proximal cattle femur from LH IIIA2–B2 pit 3 in EU 8 displayed a blunt impact scar close to the midshaft fracture, while the placement of knife marks suggests that the bone was broken after filleting, and so not in pot-sizing for cooking of meat on the bone. In this case, given the lack of burning traces, the marrow was perhaps exploited by adding the broken bone to the cooking pot, possibly with the filleted meat, rather than by heating it for immediate snacking.

To explore further the culinary contexts and purposes of bone breakage, Table 17.40 examines the incidence of burning traces, for each of the three commonest domestic taxa, in five anatomical groupings: mandibles, metapodials, and other long bones, all of which contain more or less substantial amounts of marrow; and the remaining upper limb (scapula, ulna, pelvis) and small ankle/foot (tarsals, phalanges) bones, which are less attractive in this respect.⁴⁹ With the exception of MH III–LH II cattle, anatomical variation in the incidence of burning is very significant for each taxon in both periods. Burning is in fact most frequent in pig mandibles of both periods (69% in MH III–LH II and 63% in LH III) and was perhaps a prelude to marrow extraction rather than a result of roasting the head on a fire, since burnt tooth rows or tips of canines were not noted. Burning is also relatively frequent for both periods in mandibles of sheep/goats (28% and 33%) and, albeit based on very small samples, cattle (38% and 27%). One young sheep/goat mandible from a LH I destruction deposit in EU 7 with a completely burnt tooth row had evidently undergone prolonged, presumably nonculinary (or failed culinary), exposure to fire, and one MH III loose sheep/goat tooth might have been burnt during roasting of the head or after discard, but the lack of other recorded cases is again compatible with most mandibles being heated for marrow extraction. Intriguingly, among LH III postcranial bones, burning is frequent in cattle metapodials

49. E.g., Binford 1978, p. 24, table 1.6.

TABLE 17.40. ANATOMICAL DISTRIBUTION OF BURNING AMONG POSTNEONATAL MATERIAL OF MH AND LH PRINCIPAL DOMESTICATES

<i>Anatomical Unit</i>	<i>Burning</i>	<i>MH III–LH II</i>						<i>LH III</i>					
		<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>		<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>	
		<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>
Mandible	Unburnt	5	62.5	10	31.2	31	72.1	8	72.7	11	36.7	20	66.7
	Burnt ¹	3	37.5	22	68.8	12	27.9	3	27.3	19	63.3	10	33.3
Metapodials (MC, MT)	Unburnt	23	88.5	18	78.3	40	80.0	68	61.3	14	93.3	49	90.7
	Burnt ¹	3	11.5	5	21.7	10	20.0	43	38.7	1	6.7	5	9.3
Other long bones (H, R, F, T)	Unburnt	34	89.5	64	83.1	148	92.5	60	93.8	72	94.7	124	94.7
	Burnt ¹	4	10.5	13	16.9	12	7.5	4	6.2	4	5.3	7	5.3
Remaining upper limb bones (SC, Up, PE)	Unburnt	8	100.0	25	83.3	22	81.5	18	100.0	23	100.0	25	89.3
	Burnt ¹	–	0.0	5	16.7	5	18.5	–	0.0	–	0.0	3	10.7
Small ankle/foot bones (A, C, PH1–3)	Unburnt	26	92.9	17	89.5	40	81.6	58	93.5	15	88.2	37	97.4
	Burnt ¹	2	7.1	2	10.5	9	18.4	4	6.5	2	11.8	1	2.6
χ^2 test		$\chi^2 = 7.105,$ $p = 0.130$		$\chi^2 = 37.693,$ $p = 0.000$		$\chi^2 = 14.644,$ $p = 0.005$		$\chi^2 = 43.397,$ $p = 0.000$		$\chi^2 = 61.642,$ $p = 0.000$		$\chi^2 = 25.158,$ $p = 0.000$	

Note: Excluding horns and loose teeth. For anatomical abbreviations, see Table 17.19.

¹ Including specimens both gnawed and burnt.

(39%), but is otherwise uncommon (0%–12%) in metapodials of sheep/goats and pigs and in the other long bones, remaining upper limb bones, and small ankle/foot bones of all three taxa. Conversely, among MH III–LH II postcranial bones, the incidence of burning is fairly consistent within taxa and fairly consistently higher than in LH III: 0%–12% in cattle (and scarcely higher in metapodials than other long bones), 11%–22% in pigs, and 8%–20% in sheep/goats. A plausible interpretation of the LH III data is that cattle metapodials were frequently heated to extract marrow, whereas other postcranial bones tended to be cooked (presumably boiled) with meat on the bone (other long bones; perhaps scapula, ulna, and pelvis) or to be discarded without cooking or marrow extraction (perhaps most tarsals and phalanges). By the same logic, heating of MH III–LH II postcranial bones to extract marrow was more frequent and less anatomically selective than in LH III for all three common taxa.

To some extent, this interpretation can be tested by examining the anatomical and taxonomic distribution of specimens that exhibit traces of both burning and gnawing. These are less likely to display marked anatomical selectivity if burnt *after* discard and gnawing, and, conversely, if heavily burnt before discard, they are unlikely to have attracted dogs. If merely heated to facilitate breakage, however, and if marrow was then removed mechanically without boiling, these bones would have retained fats and adhering soft tissue that might well have interested dogs. Overall, nearly 4% of MH III–LH II and 5% of LH III specimens (MaxAU, excluding loose teeth; not tabulated) bear traces of both gnawing and burning, but these specimens are distributed very unevenly (Table 17.41). They are absent in LH III cattle mandibles, but otherwise present in 9%–38% of this body part, while they make up 14% of LH III cattle metapodials, but otherwise only 0%–6% of each postcranial category for all taxa. Thus burning and gnawing co-occur especially in those body parts—mandibles and LH III cattle metapodials—for which heating to facilitate mechanical removal of marrow is argued to have been most common. This lends support to the proposed interpretation of taxonomic and anatomical variation in bone fragmentation and burning, while also providing a plausible and parsimonious rationale for the otherwise enigmatic variation in the distribution of gnawing.

To summarize the evidence for carcass processing, all stages from skinning to breakage for marrow extraction are represented on-site during both MH III–LH II and LH III, but bone weights, frequencies of identified bones, butchery marks, and traces of exposure to fire indicate differences between taxa and periods. First, the tentative suggestion that small sheep/goats were skinned more carefully (recovering more of the hide) than large cattle would run counter to “practical reason” or what might be expected on the basis of returns on labor expended. This *might* reflect a contrast between domestic slaughter and consumption of the smaller domesticates and some form of collective or public slaughter and consumption of cattle, as was argued (on different grounds) for FN–EH butchery. Second, in MH III–LH II, the bone discarded seems—with allowance for partial retrieval and survival—to be derived from the processing and consumption of whole or, at least in the case of sheep/goats and perhaps pigs, dressed carcasses. Conversely, in LH III, a stark contrast is evident between the smaller domesticates and cattle, with the former again exhibiting some bias toward dressed carcasses and the latter represented very disproportionately by primary dressing waste. At least in LH III, therefore, the spatial organization, if not the form, of carcass processing and discard seems to have diverged for the larger and smaller domesticates.

While there are obvious practical benefits to carrying out the messy slaughter of (especially large) animals and dressing of carcasses—perhaps involving discard of heads and/or feet—off-site, the reverse seems to have occurred in the case of LH III cattle with the on-site discard of dressing waste (and implied slaughter nearby). Despite the relative paucity of surviving architectural remains, the abundance of other cultural materials implies that LH III cattle

TABLE 17.41. ASSOCIATION OF GNAWING AND BURNING BY ANATOMICAL GROUP IN POSTNEONATAL MATERIAL OF MH AND LH PRINCIPAL DOMESTICATES

<i>Anatomical Unit</i>	<i>Gnawing/Burning</i>	<i>MH III-LH II</i>						<i>LH III</i>					
		<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>		<i>Cattle</i>		<i>Pig</i>		<i>Sheep + Goat</i>	
		<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>	<i>MaxAU</i>	<i>%</i>
Mandible	Unmodified	5	62.5	8	25.0	22	51.2	8	72.7	11	36.7	17	56.7
	Gnawed	–	0.0	2	6.3	9	20.9	–	0.0	–	0.0	3	10.0
	Burnt	2	25.0	10	31.2	8	18.6	3	27.3	12	40.0	5	16.7
	Burnt and gnawed	1	12.5	12	37.5	4	9.3	–	0.0	7	23.3	5	16.7
Metapodials (MC, MT)	Unmodified	17	65.4	14	60.9	23	46.0	31	27.9	8	53.3	25	46.3
	Gnawed	6	23.1	4	17.4	17	34.0	37	33.3	6	40.0	24	44.4
	Burnt	3	11.5	5	21.7	9	18.0	27	24.3	1	6.7	5	9.3
	Burnt and gnawed	–	0.0	–	0.0	1	2.0	16	14.4	–	0.0	–	0.0
Other long bones (H, R, F, T)	Unmodified	19	50.0	26	33.8	89	55.6	40	62.5	34	44.7	77	58.8
	Gnawed	15	39.5	38	49.4	59	36.9	20	31.3	38	50.0	47	35.9
	Burnt	3	7.9	9	11.7	10	6.3	2	3.1	4	5.3	5	3.8
	Burnt and gnawed	1	2.6	4	5.2	2	1.2	2	3.1	–	0.0	2	1.5
Remaining upper limb bones (SC, Up, PE)	Unmodified	5	62.5	4	13.3	10	37.0	16	88.9	9	39.1	13	46.4
	Gnawed	3	37.5	21	70.0	12	44.4	2	11.1	14	60.9	12	42.9
	Burnt	–	0.0	5	16.7	5	18.5	–	0.0	–	0.0	3	10.7
	Burnt and gnawed	–	0.0	–	0.0	–	0.0	–	0.0	–	0.0	–	0.0
Small ankle/toe bones (A, C, PH1–3)	Unmodified	10	35.7	11	57.9	29	59.2	33	53.2	7	41.2	21	55.3
	Gnawed	16	57.1	6	31.6	11	22.4	25	40.3	8	47.1	16	42.1
	Burnt	1	3.6	1	5.3	9	18.4	4	6.5	1	5.9	1	2.6
	Burnt and gnawed	1	3.6	1	5.3	–	0.0	–	0.0	1	5.9	–	0.0
χ^2 test		$\chi^2 = 18.306,$ $p = 0.107$		$\chi^2 = 74.274,$ $p = 0.000$		$\chi^2 = 30.005,$ $p = 0.003$		$\chi^2 = 65.512,$ $p = 0.000$		$\chi^2 = 70.969,$ $p = 0.000$		$\chi^2 = 44.682,$ $p = 0.000$	

Note: For anatomical abbreviations, see Table 17.19.

feet were discarded in an area of fairly intensive human activity, raising the possibility that cattle were slaughtered here to provide a public spectacle rather than to minimize unpleasant smells. The concentration of cattle foot bones on-site, suggesting clear segregation of slaughter and primary butchery from subsequent consumption, also perhaps enhanced the formality of the occasion.⁵⁰ In either event, the scarcity of meat-bearing parts of LH III cattle suggests *consumption* elsewhere—perhaps because the scale of commensality demanded a large open space. The faunal evidence offers no clue as to whether the locus of consumption was near or distant, although the former is arguably the more parsimonious solution.

CONTEXTUAL VARIATION

The MH III–LH II and LH III faunal assemblages in aggregate represent somewhat different carcass-processing stages and discard contexts, but to what extent are they derived from *consistently* distinctive forms of human activity in at least the excavated parts of Tsoungiza? To explore this issue, Table 17.42 presents the incidence of gnawing, burning, fragmentation, and butchery traces and the anatomical and taxonomic composition of the principal domesticates for the five MH III–LH II and five LH III contexts with 50+ identified postneonatal MaxAU (Table 17.1). Together these ten subassemblages make up more than half of both the MH III–LH II and LH III material (in bone weight, MaxAU and MinAU alike), but individually they all fall below the desirable threshold for robust quantitative analysis of identified specimens.

The incidence of gnawing differs significantly between both MH III–LH II and LH III contexts, with values of around 50% in the LH I exterior surface and fill in EU 8, the LH IIIA2 lower “feasting” dump in EU 9, and the LH IIIB2 destruction deposit in space 7 in EU 10, but 31%–37% of identified bone in the remaining contexts is also gnawed (Table 17.42). Thus scavengers had ready access to all the major surviving lots of discarded bone, implying that at least the larger groups of butchery and consumption refuse were discarded on living surfaces or open middens rather than buried immediately. The incidence of recorded burning differs very significantly, between 5% and 24% in MH III–LH II and between 3% and 31% in LH III contexts, but this may partly be attributable to nondiagnosis (and perhaps misdiagnosis) as a result of brief exposure to fire for marrow extraction coupled with variable dark mineral staining. The incidence of old breaks differs very significantly between MH III–LH II contexts, but not between LH III contexts, and in every case complete postneonatal long bones are either absent or very rare, replicating the overall pattern in both period assemblages. Finally, the incidence of cut marks in individual contexts ranges between 2% and 15%, but differences are not significant for either period. Despite evident fine-grained variation in the incidence of both pre- and postdiscard bone modifications, consistently high levels of bone fragmentation coupled with sparser cut marks leave little doubt that the faunal content of each context was dominated by waste from butchery and/or consumption, while frequent traces of gnawing indicate that most of the bone was accessible to scavengers between discard and final burial. There is thus no reason to expect variable taphonomic histories to have *created* radical contrasts between contexts in anatomical or taxonomic composition.

Taxonomic composition varies significantly between MH III–LH II contexts, and very significantly between LH III contexts (Tables 17.43, 17.44), although in the earlier period

50. Halstead and Isaakidou 2011b; Isaakidou and Halstead 2013.

TABLE 17.42. INCIDENCE OF GNAWING, BURNING, FRAGMENTATION, AND BUTCHERY BY CONTEXT
IN MH AND LH POSTNEONATAL MATERIAL

Context	Gnawing				Burning				Fragmentation ¹				Butchery			
	Ungnawed		Gnawed		Unburnt		Burnt		Whole		Old break		Uncut		Cut	
	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%	MaxAU	%
MH III-LH II																
MH III EU 2, exterior surface	77	63.1	45	36.9	114	93.4	8	6.6	-	0.0	67	100.0	114	93.4	8	6.6
LH I EU 8, exterior surface	26	49.1	27	50.9	44	83.0	9	17.0	2	8.3	22	91.7	49	92.5	4	7.5
LH I EU 8, fill	37	52.1	34	47.9	55	77.5	16	22.5	6	17.1	29	82.9	66	93.0	5	7.0
LH IIA EU 10, dump	41	64.1	23	35.9	61	95.3	3	4.7	-	0.0	21	100.0	63	98.4	1	1.6
LH IIB EU 2, spaces 8 and 9, dump	97	69.3	43	30.7	107	76.4	33	23.6	11	14.3	66	85.7	127	90.7	13	9.3
χ^2 test	$\chi^2 = 10.017, p = 0.040$				$\chi^2 = 23.091, p = 0.000$				$\chi^2 = 14.880, p = 0.005$				$\chi^2 = 4.144, p = 0.387$			
LH III																
LH IIIA2 EU 9, "feasting," lower dump	54	47.0	61	53.0	85	73.9	30	26.1	2	3.1	62	96.9	109	94.8	6	5.2
LH IIIA2-B2 EU 8, pit 3	42	64.6	23	35.4	45	69.2	20	30.8	-	0.0	47	100.0	55	84.6	10	15.4
LH IIIB1 EU 2, pit 1	70	64.2	39	35.8	95	87.2	14	12.8	4	6.6	57	93.4	97	89.0	12	11.0
LH IIIB1 EU 8, fill	54	66.7	27	33.3	65	80.2	16	19.8	-	0.0	45	100.0	77	95.1	4	4.9
LH IIIB2 EU 10, space 7 destruction	39	52.0	36	48.0	73	97.3	2	2.7	-	0.0	39	100.0	70	93.3	5	6.7
χ^2 test	$\chi^2 = 12.271, p = 0.015$				$\chi^2 = 25.825, p = 0.000$				$\chi^2 = 8.047, p = 0.090$				$\chi^2 = 8.226, p = 0.084$			

Note: Excluding loose teeth.

¹ Long bones, excluding loose epiphyses.

TABLE 17.43. ANATOMICAL AND TAXONOMIC COMPOSITION BY CONTEXT OF POSTNEONATAL MATERIAL OF MH III-LH II PRINCIPAL DOMESTICATES (MINAU)

Anatomical Unit	MH III EU 2, Space 1, Floor			LH I EU 8, Exterior Surface			LH I EU 8, Fill			LH IIA EU 10, Dump			LH IIB EU 2, Spaces 8 and 9, Dump		
	Cattle	Pig	Sheep/Goat	Cattle	Pig	Sheep/Goat	Cattle	Pig	Sheep/Goat	Cattle	Pig	Sheep/Goat	Cattle	Pig	Sheep/Goat
H/A	1	–	1	2	–	1	2	–	1	1	–	1	–	–	–
MD	–	7	14	1	5	3	1	4	9	2	–	3	2	3	8
SC	–	3	2	–	1	–	–	1	–	2	2	2	2	1	1
Hp	–	2	1	–	–	1	–	1	–	–	1	2	–	3	1
Hd	1	4	6	–	1	1	2	–	2	1	1	4	1	6	7
Rp	1	4	4	–	–	–	1	1	3	1	–	–	–	–	6
Up	1	1	–	–	–	1	–	1	–	–	1	1	1	1	–
Rd	1	2	4	1	–	–	1	–	5	–	–	–	–	–	2
MCp	1	1	2	–	–	1	1	1	–	1	1	–	–	1	2
MCd	1	1	2	1	–	2	–	1	1	–	1	–	1	1.5	6
PE	–	2	1	–	1	1	–	2	1	1	2	1	–	1	2
Fp	–	–	–	–	–	–	–	1	–	2	–	–	1	–	1
Fd	–	1	2	–	–	–	1	2	–	1	–	–	–	1	4
Tp	–	1	2	1	–	1	–	–	1	–	1	–	1	3	4
Td	–	2	2	–	1	4	–	–	2	–	–	1	–	3	9
A	1	1	–	–	2	–	1	–	–	–	–	1	1	–	4
C	–	–	3	1	–	–	–	–	–	–	–	1	–	1	2
MTp	2	–	1	–	1	–	–	–	2	1	–	–	1	–	–
MTd	1	–	–	–	2	–	–	–	–	–	–	1	–	0.5	3
PH1	–	4	2	2	1	–	1	–	1	4	1	1	2	2	3
PH2	–	–	–	–	–	–	–	–	–	–	–	1	–	1	2
PH3	1	–	2	–	–	–	–	–	–	–	1	1	–	1	1
Total	12	36	51	9	15	16	11	15	28	17	12	21	13	30	68
%	12.1	36.4	51.5	22.5	37.5	40.0	20.4	27.8	51.9	34.0	24.0	42.0	11.7	27.0	61.3
χ^2 test	$\chi^2 = 19.283, p = 0.013$														

Note: For anatomical abbreviations, see Table 17.19.

TABLE 17.44. ANATOMICAL AND TAXONOMIC COMPOSITION BY CONTEXT OF POSTNEONATAL MATERIAL OF LH III PRINCIPAL DOMESTICATES (MINAU)

<i>Anatomical Unit</i>	<i>LH IIIA2 EU 9, "Feasting," Lower Dump</i>			<i>LH IIIA2-B2 EU 8, Pit 3</i>			<i>LH IIIB1 EU 2, Pit 1</i>			<i>LH IIIB1 EU 8, Fill</i>			<i>LH IIIB2 EU 10, Space 7 Destruction</i>		
	<i>Cattle</i>	<i>Pig</i>	<i>Sheep/Goat</i>	<i>Cattle</i>	<i>Pig</i>	<i>Sheep/Goat</i>	<i>Cattle</i>	<i>Pig</i>	<i>Sheep/Goat</i>	<i>Cattle</i>	<i>Pig</i>	<i>Sheep/Goat</i>	<i>Cattle</i>	<i>Pig</i>	<i>Sheep/Goat</i>
H/A	2	–	2	–	–	–	–	–	–	–	–	2	–	–	1
MD	3	3	7	4	2	4	6	–	11	2	6	1	1	3	15
SC	1	2	–	1	–	–	–	–	2	–	3	–	1	–	1
Hp	–	1	–	1	–	1	–	–	2	–	3	1	1	–	–
Hd	–	2	3	3	2	3	3	1	5	1	4	2	–	4	2
Rp	–	–	–	1	1	1	2	–	2	–	1	2	–	–	2
Up	–	2	3	–	1	–	–	1	1	2	–	1	–	1	1
Rd	–	1	1	–	2	4	1	1	1	1	–	1	2	–	1
MCp	8	–	–	3	–	1	3	1	–	3	–	1	2	1	–
MCd	8	–	–	–	–	1	2	–	2	–	–	–	0.5	–	2
PE	1	–	1	–	–	1	1	1	–	2	–	4	–	–	3
Fp	–	–	1	2	1	–	1	–	–	–	–	1	–	–	2
Fd	1	1	2	1	2	1	1	1	–	–	2	1	–	1	–
Tp	3	1	4	1	–	–	1	–	1	1	2	–	–	2	3
Td	2	1	4	–	1	–	1	1	2	1	–	4	1	3	2
A	2	–	1	2	–	–	1	1	2	–	–	–	2	–	2
C	1	–	–	–	–	–	–	1	1	1	–	1	–	1	–
MTp	6	–	2	4	–	2	7	–	1	1	1	2	–	–	4
MTd	6	–	3	7	–	–	9	–	1	3	–	–	0.5	–	1
PH1	5	–	–	1	–	–	4	–	1	2	2	1	–	1	3
PH2	1	–	–	–	–	–	1	–	1	1	1	–	–	–	–
PH3	3	–	–	–	–	–	3	1	–	–	–	1	–	–	–
Total	53	14	34	31	12	19	47	10	36	21	25	26	11	17	45
%	52.5	13.9	33.7	50.0	19.4	30.6	50.5	10.8	38.7	29.2	34.7	36.1	15.1	23.3	61.6
χ^2 test	$\chi^2 = 46.816, p = 0.000$														

Note: For anatomical abbreviations, see Table 17.19.

TABLE 17.45. ANATOMICAL COMPOSITION (WEIGHT) BY CONTEXT AND PERIOD OF BRONZE AGE FAUNAL MATERIAL

<i>Phases and Contexts with 50+ MaxAU</i>	<i>Trunk</i>		<i>Head</i>		<i>Limb</i>		<i>Total</i>
	<i>Wt. (g)</i>	<i>%</i>	<i>Wt. (g)</i>	<i>%</i>	<i>Wt. (g)</i>	<i>%</i>	<i>Wt. (g)</i>
FN-EH total	3,145	11.3	9,305	33.6	15,270	55.1	27,720
MH III-LH II total	1,720	8.4	8,485	41.5	10,250	50.1	20,455
MH III EU 2, exterior surface	190	5.7	1,440	43.2	1,705	51.1	3,335
LH I EU 8, exterior surface	195	6.2	2,055	65.7	880	28.1	3,130
LH I EU 8, fill	255	8.3	1,070	34.9	1,745	56.8	3,070
LH IIA EU 10, dump	230	11.1	730	35.1	1,120	53.8	2,080
LH IIB EU 2, spaces 8 and 9, dump	320	11.8	990	36.5	1,400	51.7	2,710
LH III total	1,380	4.8	10,440	36.3	16,955	58.9	28,775
LH IIIA2 EU 9, "feasting," lower dump	165	3.5	1,650	35.4	2,845	61.1	4,660
LH IIIA2-B2 EU 8, pit 3	220	6.0	1,250	33.9	2,215	60.1	3,685
LH IIIB1 EU 2, pit 1	130	3.0	1,620	36.8	2,650	60.2	4,400
LH IIIB1 EU 8, fill	55	2.1	1,040	39.0	1,575	59.0	2,670
LH IIIB2 EU 10, space 7 destruction	170	7.7	770	34.7	1,280	57.7	2,220

sheep/goats are most numerous and cattle least numerous in four of the five contexts. In the later period, cattle are predominant followed by sheep/goats and then pigs in the LH IIIA2 "feasting" dump in EU 9, the LH IIIA2-B2 fill of pit 3 in EU 8, and the LH IIIB1 fill of pit 1 in EU 2, whereas sheep/goats predominate followed by pigs and then cattle in the LH IIIB1 fill in EU 8 and the LH IIIB2 destruction deposit in space 7 in EU 10. The LH III contexts with the highest (LH IIIA2 "feasting" dump) and lowest (LH IIIB2 destruction) proportions of cattle are those with the highest frequencies of gnawing, confirming that variation in taxonomic composition is not merely a taphonomic artifact.

Turning to anatomical representation, the proportion of trunk material by weight (Table 17.45) ranges between 6% and 12% in MH III-LH II (overall average 8%) and between 2% and 8% in LH III (overall average 5%). The proportion of limb bones by weight is also consistently lower in MH III-LH II than in LH III contexts, albeit normally by a small margin.

Among identified specimens (Figs. 17.8-17.25; Tables 17.43, 17.44), MH III-LH II cattle (Figs. 17.8-17.10) are too scarce for analysis beyond the observation that all five contexts include both meat-rich upper limb bones and meat-poor feet, although primary butchery waste is represented by the *horse* forefoot, with dismembering marks around the carpals and adjacent proximal metacarpal, from the LH I fill in EU 8. Conversely, in the case of MH III-LH II sheep/goats (Figs. 17.11-17.13) and pigs (Figs. 17.14-17.16), the best represented body parts in every context are the mandible and one or other of the meat-rich upper limb bones, while foot bones are less frequent. In the LH IIIB2 destruction deposit in space 7 in EU 10, anomalous in terms of the relatively high contribution of trunk to bone weight, scarce cattle bones again include both meat-rich upper limbs and meat-poor feet (Fig. 17.19), but in the remaining four LH III contexts cattle are more abundant, and in each case metacarpals and/or metatarsals are best represented (Figs. 17.17, 17.18). Moreover, the same pattern is evident in the LH IIIB destruction in spaces 1 and 3 in EU 2, which yielded too few identified specimens for presentation in Table 17.44, but included the previously discussed bovine hindfoot, the dismembering of which from the left leg is indicated by transverse knife marks

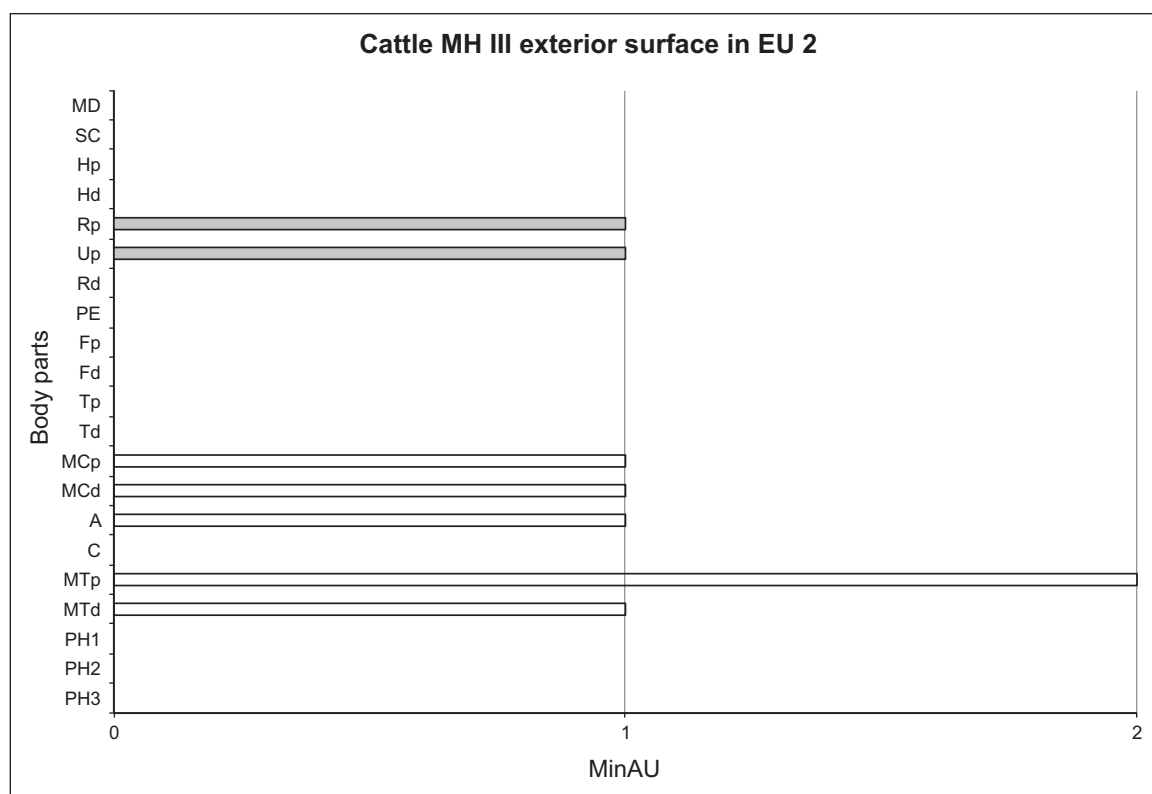


FIGURE 17.8. Anatomical representation of cattle: MH III exterior surface in EU 2. Gray fill indicates the meat-rich upper limb bones and white fill the meat-poor foot bones. *P. Halstead*

on the proximal metatarsal. In the case of sheep/goat, mandibles overwhelmingly dominate the sample from the “anomalous” LH IIIB2 destruction (Fig. 17.22), while mandibles and/or meat-rich upper limbs are best represented in the remaining four LH III contexts (Figs. 17.20, 17.21). Finally, although more or less scarce in all five contexts, pig bones are consistently dominated by mandibles and/or meat-rich upper limbs in LH III (Figs. 17.23–17.25). In sum, with the repeated caveat that the ten contexts selected for separate analysis each contain only 40–111 MinAU of postneonatal cattle, pigs, and sheep/goats *combined*, the five MH III–LH II contexts seem to replicate the pattern of anatomical representation observed for the earlier period as a whole, while four of the five LH III contexts likewise replicate the aggregate pattern for the later period. The LH IIIB2 destruction, with its atypically high proportion of trunk and low proportion of cattle for LH III, and its unusually high frequency of sheep/goat mandibles, is the only context that deviates consistently from the aggregate pattern for its period.

While small sample sizes and the generally heavy incidence of scavenger attrition complicate interpretation, the selective deposition of cattle feet (parts typically discarded in initial carcass dressing), previously identified for the LH IIIA2 “feasting” dump,⁵¹ seems to have prevailed temporally, spatially, and contextually across most of the LH III deposits excavated at Tsoungiza and contrasts with the more inclusive discard of MH III–LH II cattle. Conversely, in the case of sheep/goats and perhaps pigs, refuse from the consumption of dressed carcasses seems to have predominated in both periods, with the further and important

51. Dabney, Halstead, and Thomas 2004.

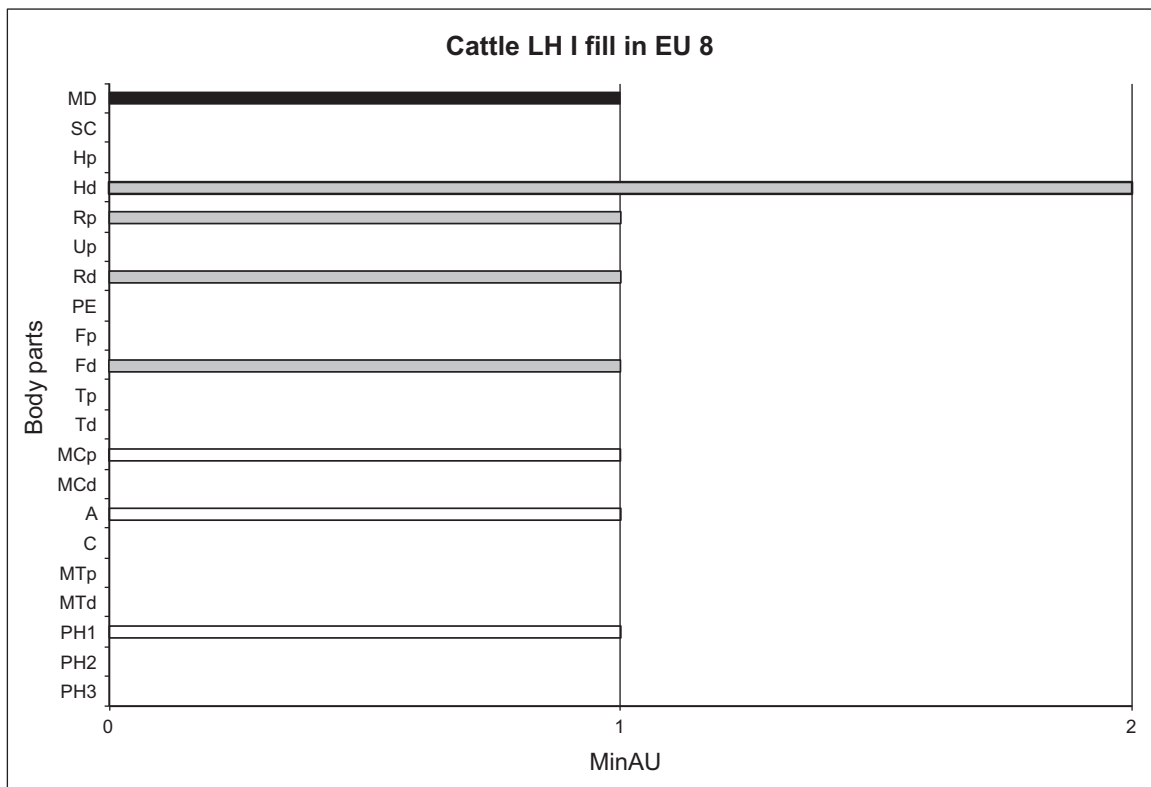
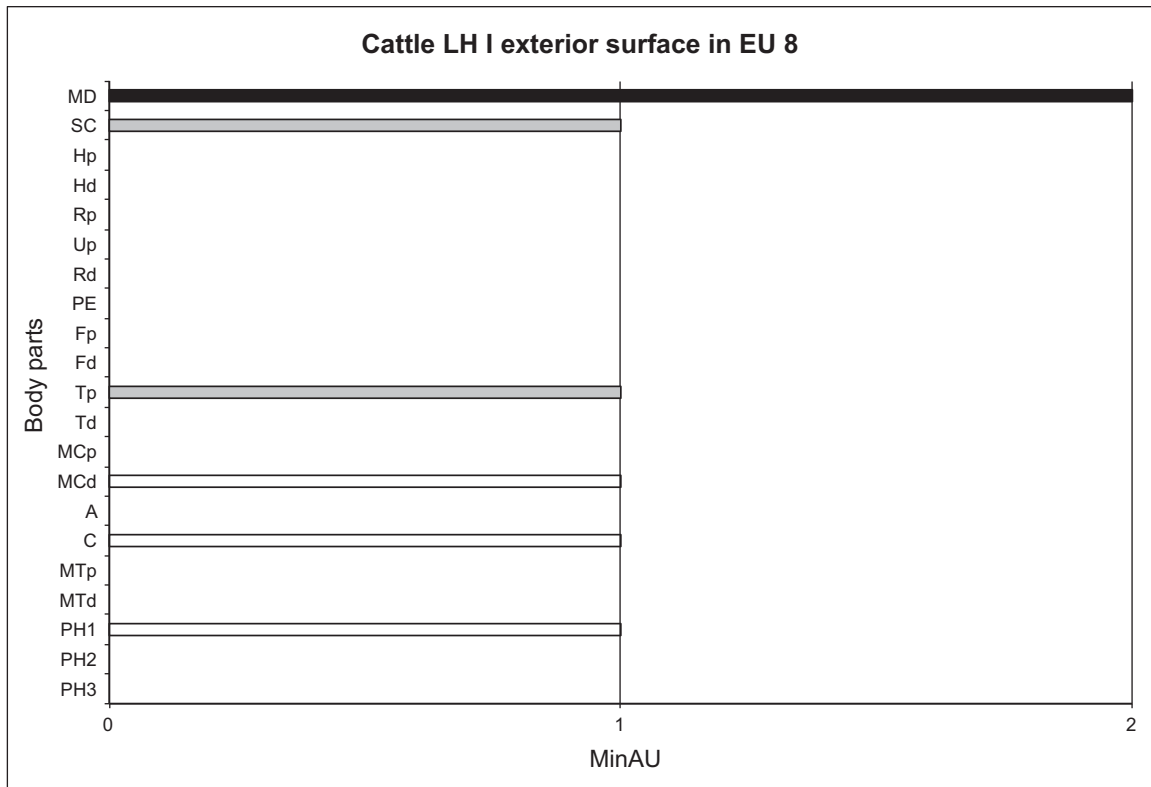


FIGURE 17.9. Anatomical representation of cattle: LH I exterior surface in EU 8 and LH I fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

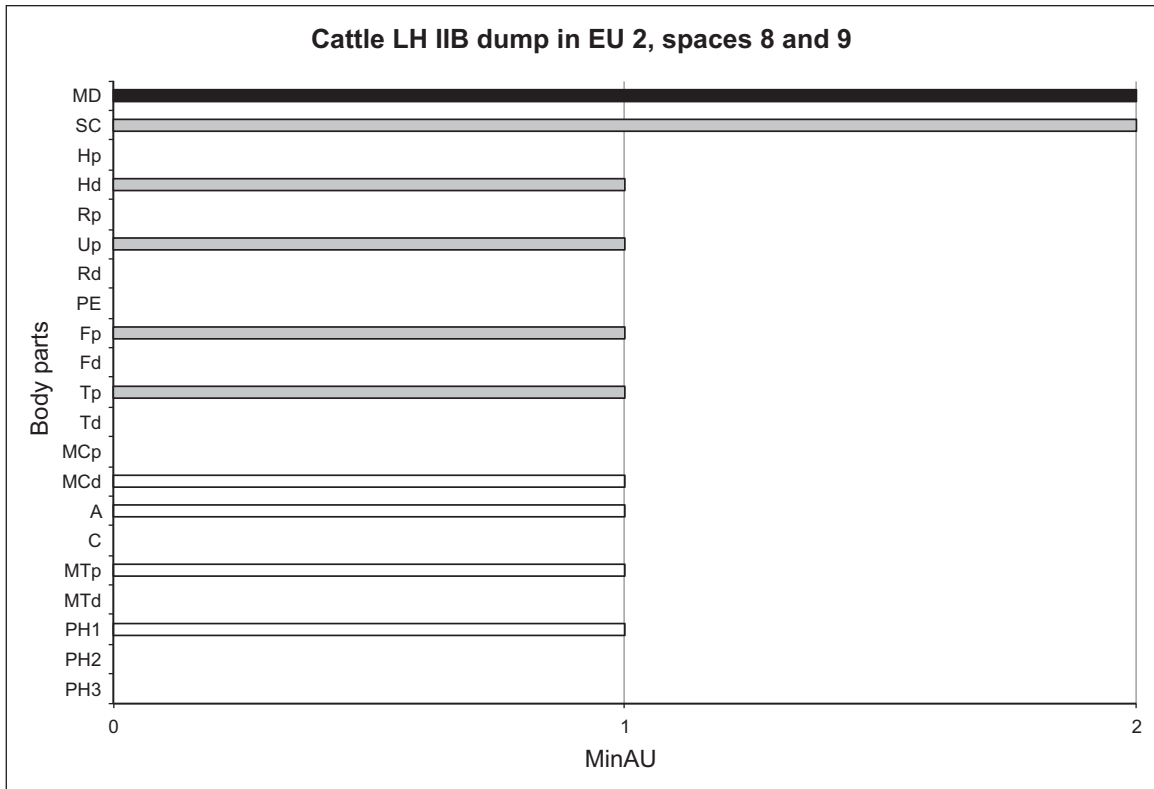
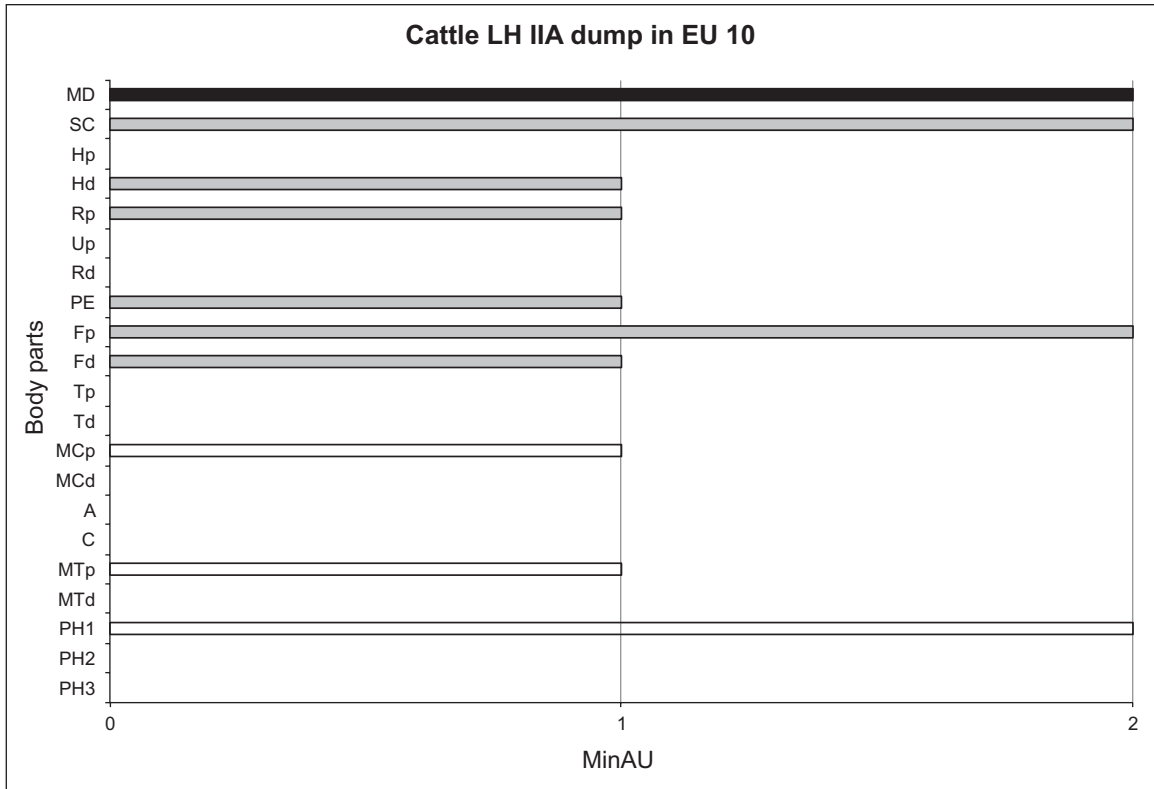


FIGURE 17.10. Anatomical representation of cattle: LH IIA dump in EU 10 and LH IIB dump in EU 2, spaces 8 and 9. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

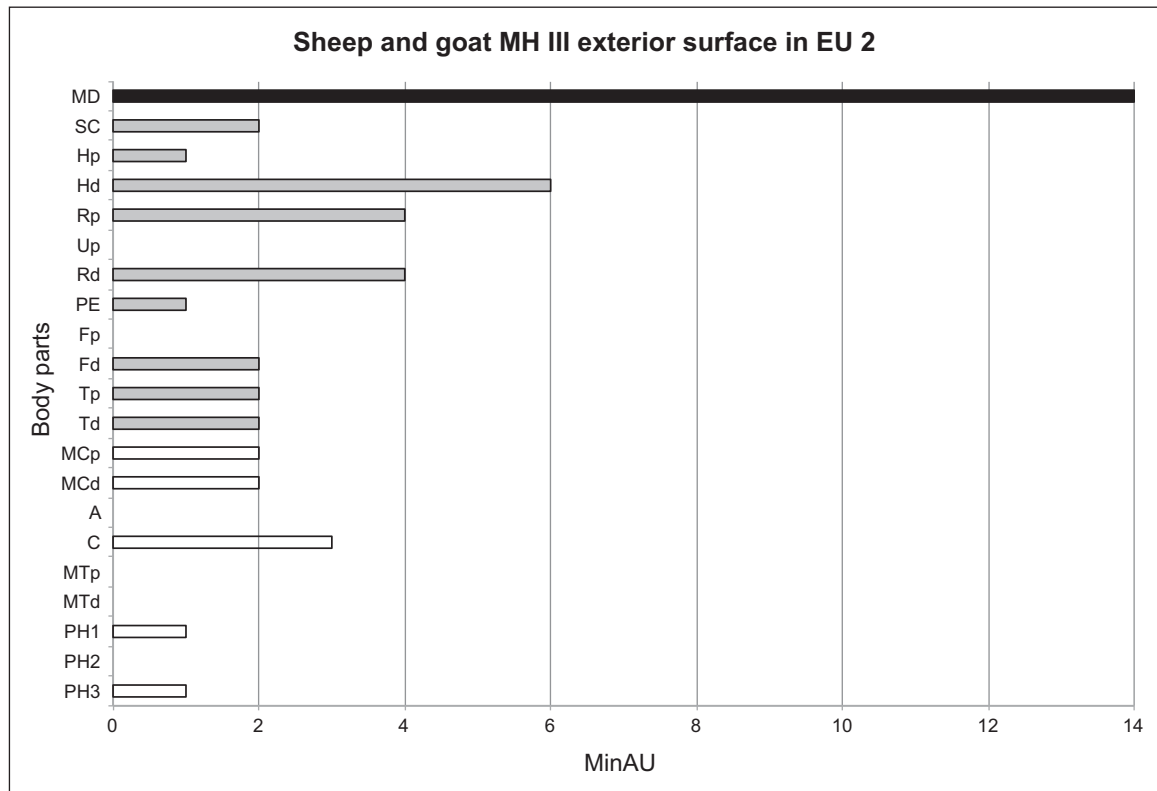


FIGURE 17.11. Anatomical representation of sheep and goats: MH III exterior surface in EU 2. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones.

P. Halstead

implication that, at least in LH III, cattle and the smaller domesticates followed spatially distinct pathways of carcass reduction and discard, and so were probably consumed in different social contexts.

Finally, discussion of these ten major depositional contexts would not be complete without consideration, albeit rather inconclusive, of the scale of commensality potentially represented by each. To this end, Table 17.46 sets out the estimated minimum numbers of individual animals represented in each of these contexts by identified body parts (excluding horns and antlers, which may have been present as debitage from craft working rather than food preparation). The total numbers of animals represented range from a minimum of 14 in the LH I exterior surface in EU 8 to a maximum of 26 in the MH III floor in space 1 in EU 2, but these range from small game (hare and tortoise) and tiny newborn domesticates (lambs/kids and piglets) to large adult cattle, horses, and red deer. In terms of potential meat weight, LH IIIB1 pit 1 in EU 2 is perhaps most impressive with remains of at least 24 animals, including three adult, one immature, and one indeterminate-age cattle, two adult pigs, six adult sheep and goats, one adult horse, one indeterminate-age donkey, and one indeterminate-age red deer. The LH IIIA2 lower “feasting” dump yielded remains of at least 21 animals, including two adult, one juvenile, and two indeterminate-age cattle, three adult pigs, four adult sheep and goats, two indeterminate-age donkeys, and one indeterminate-age red deer, while LH IIIA2–B2 pit 3 in EU 8 contained parts of at least 16 animals, including one adult, two juvenile, and three indeterminate-age cattle, two adult pigs, two adult sheep/goats, and one adult donkey. The animals represented in every one of the ten selected deposits could have generously hosted a gathering of hundreds of guests if the animals

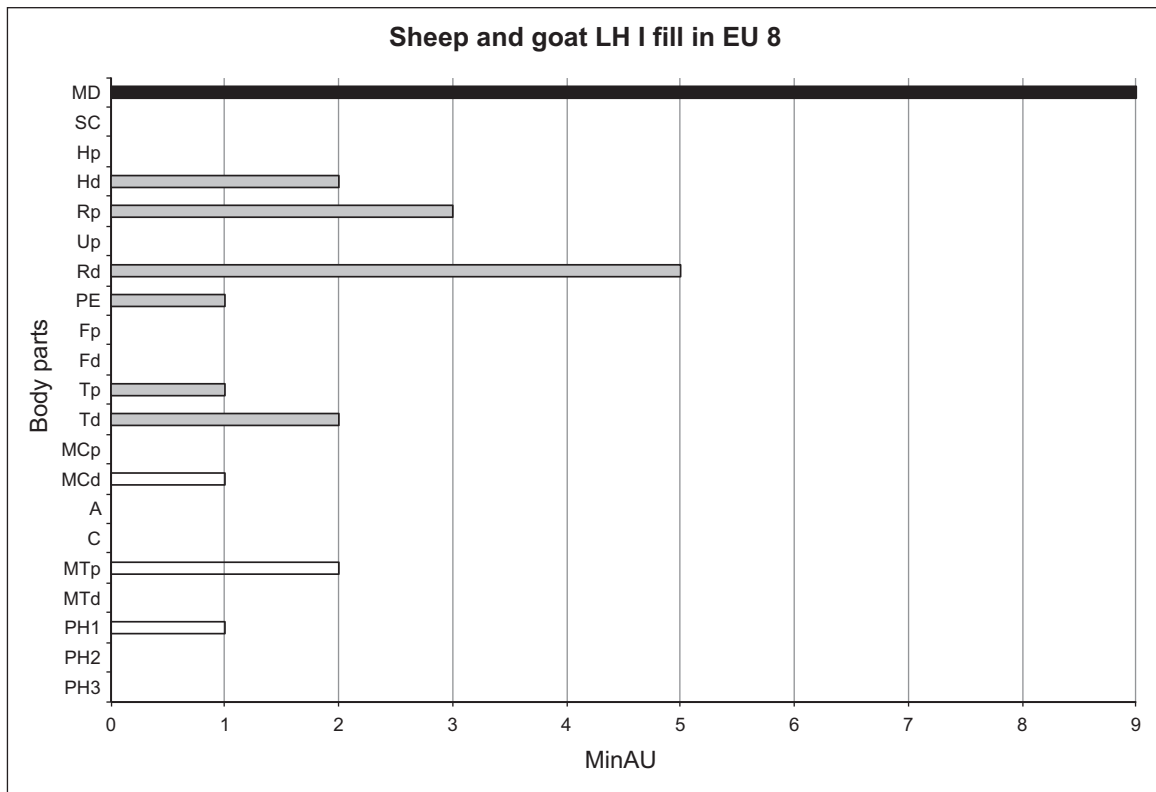


FIGURE 17.12. Anatomical representation of sheep and goats: LH I exterior surface in EU 8 and LH I fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

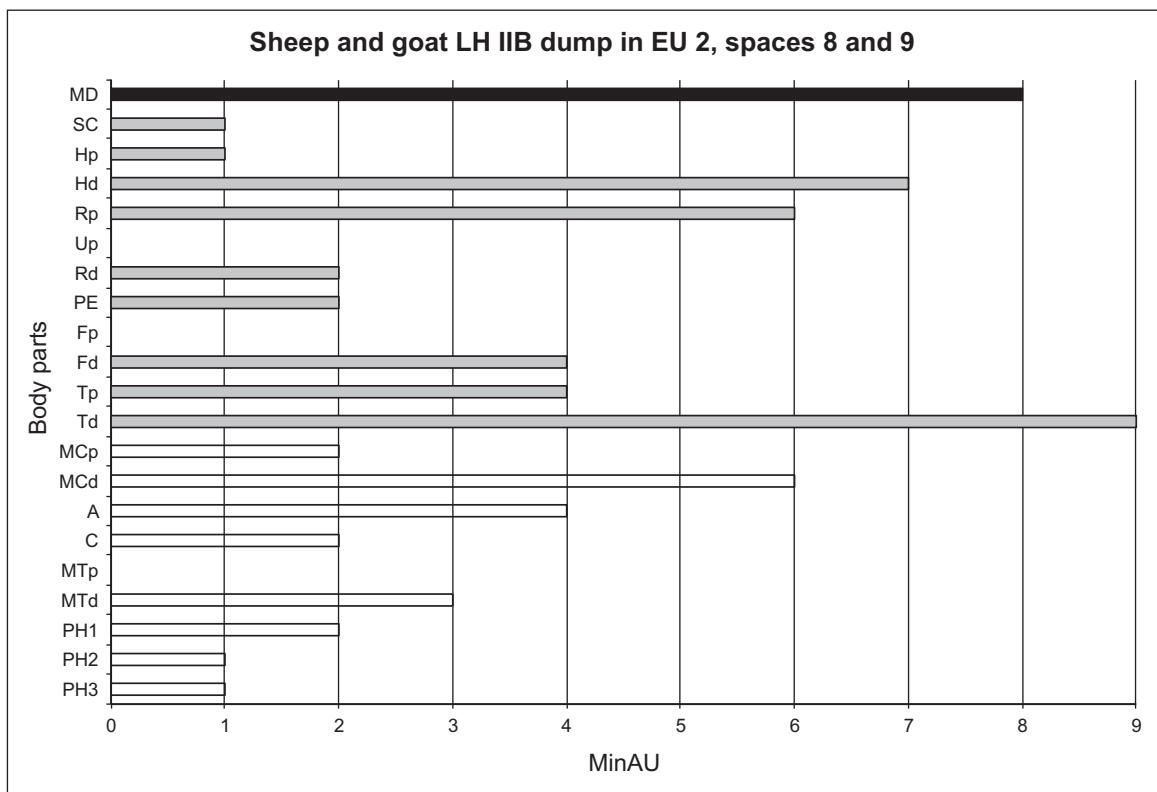
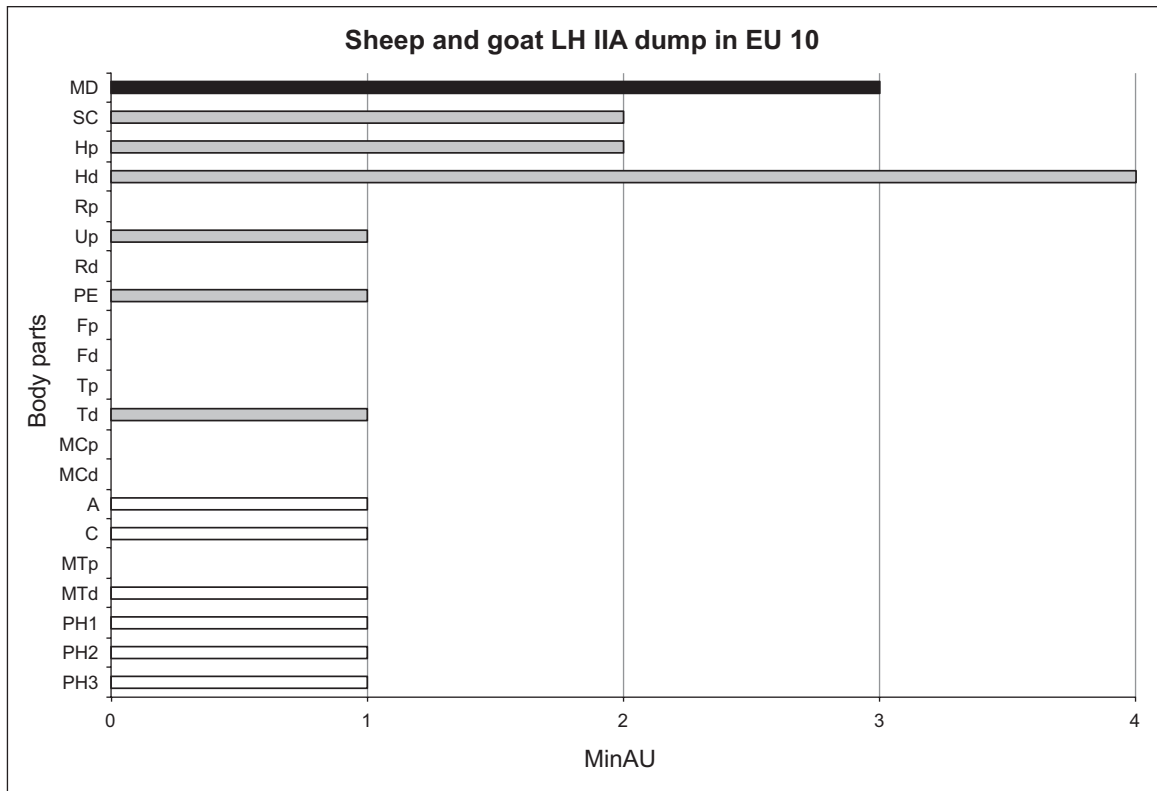


FIGURE 17.13. Anatomical representation of sheep and goats: LH IIA dump in EU 10 and LH IIB dump in EU 2, spaces 8 and 9. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

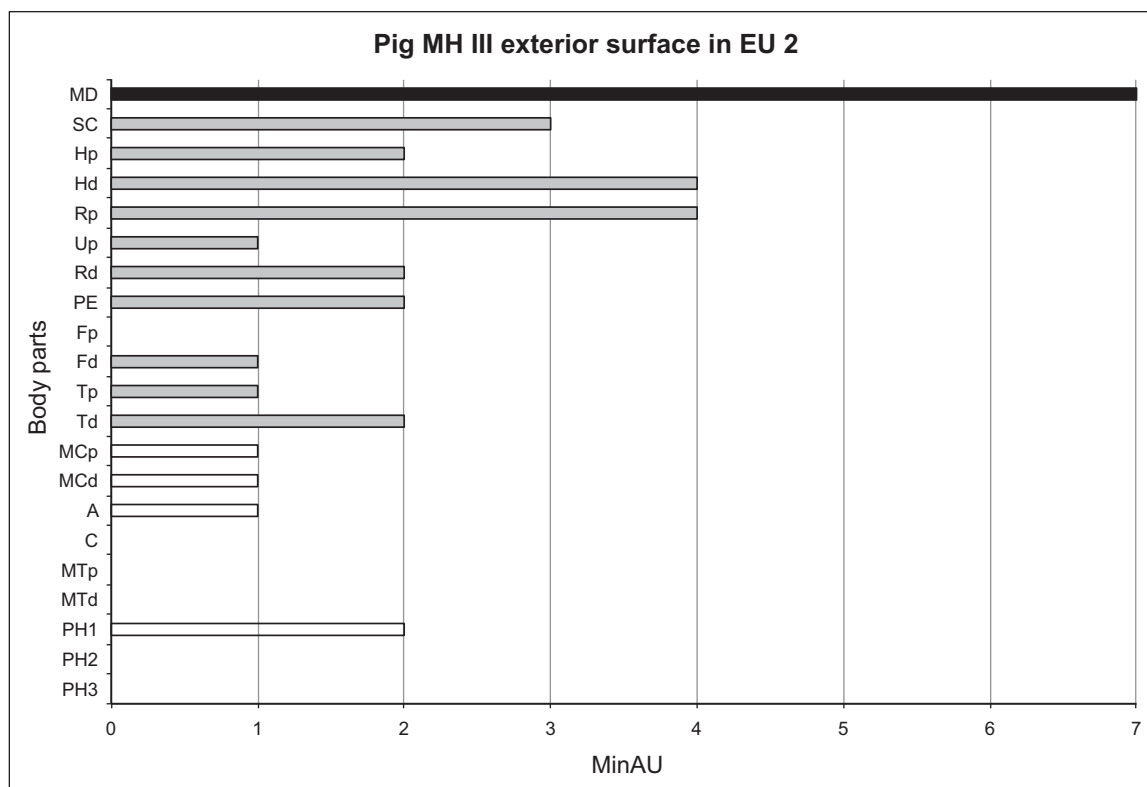


FIGURE 17.14. Anatomical representation of pigs: MH III exterior surface in EU 2. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

represented were consumed in their entirety at a single event. In practice, however, the only largely complete skeleton was that of the burnt neonatal piglet from the LH IIB dump in spaces 8 and 9 in EU 2, little if any of which was probably consumed, and it has already been argued that these deposits may contain mixed refuse from both domestic and collective commensality. Conversely, it has been argued that the LH III accumulations of cattle feet do represent just the waste fraction from large-scale commensality, and it is perfectly possible that these deposits contain remains of just a small fraction of the animals slaughtered and consumed in the events that contributed to their filling. Any attempt to estimate quantities of meat consumed at single events could thus err dramatically in either direction. Nonetheless, judging by the rarity with which cattle were consumed in Greek villages in the days before refrigeration, their slaughter at the modest later Bronze Age settlement of Tsoungiza must surely have marked occasions of some note, which were probably enjoyed by more than local residents.

SEASON(S) OF CONSUMPTION AND OCCUPATION

Some insight is provided into the temporal context of carcass processing and bone deposition by the remains of animals dying in the first few months of life, when the margins of error in estimates of age at death are relatively modest. Deaths within a few weeks of the birth season are represented by neonatal (perhaps including fetal) postcranial remains of cattle, sheep/goats, and pigs (Table 17.12) and by mandibles with erupting or unworn deciduous

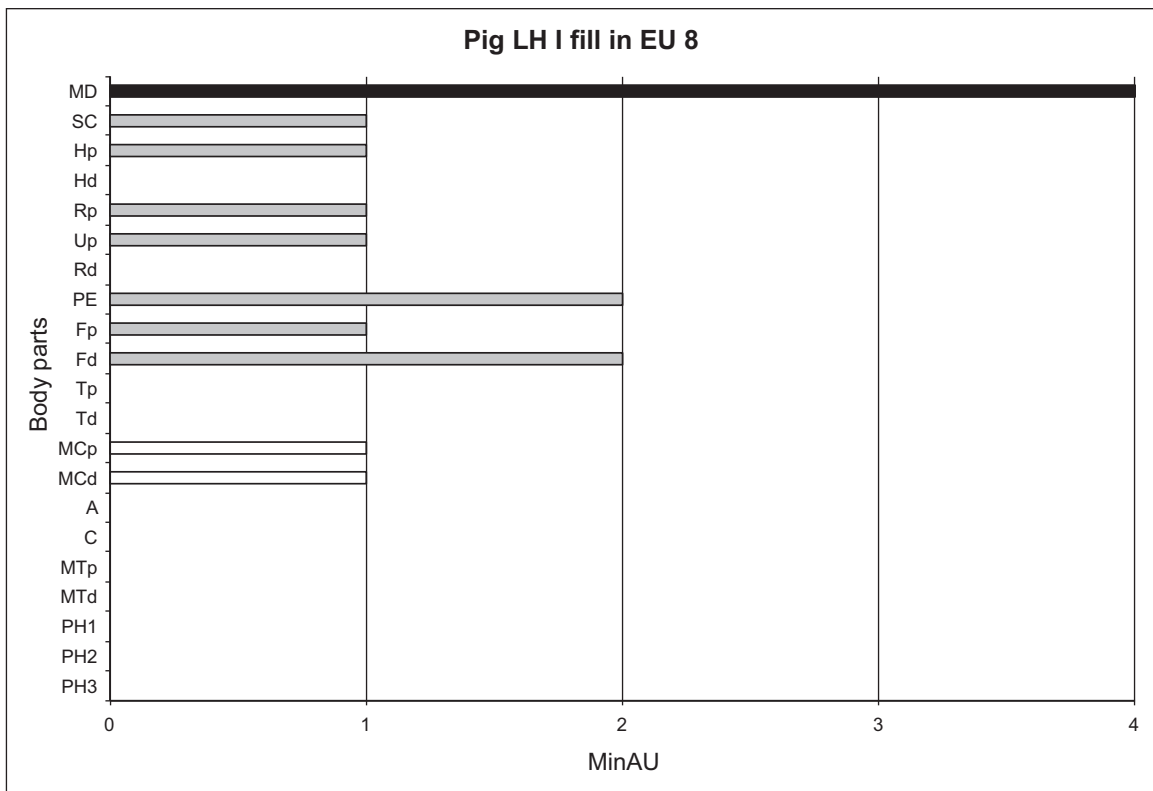
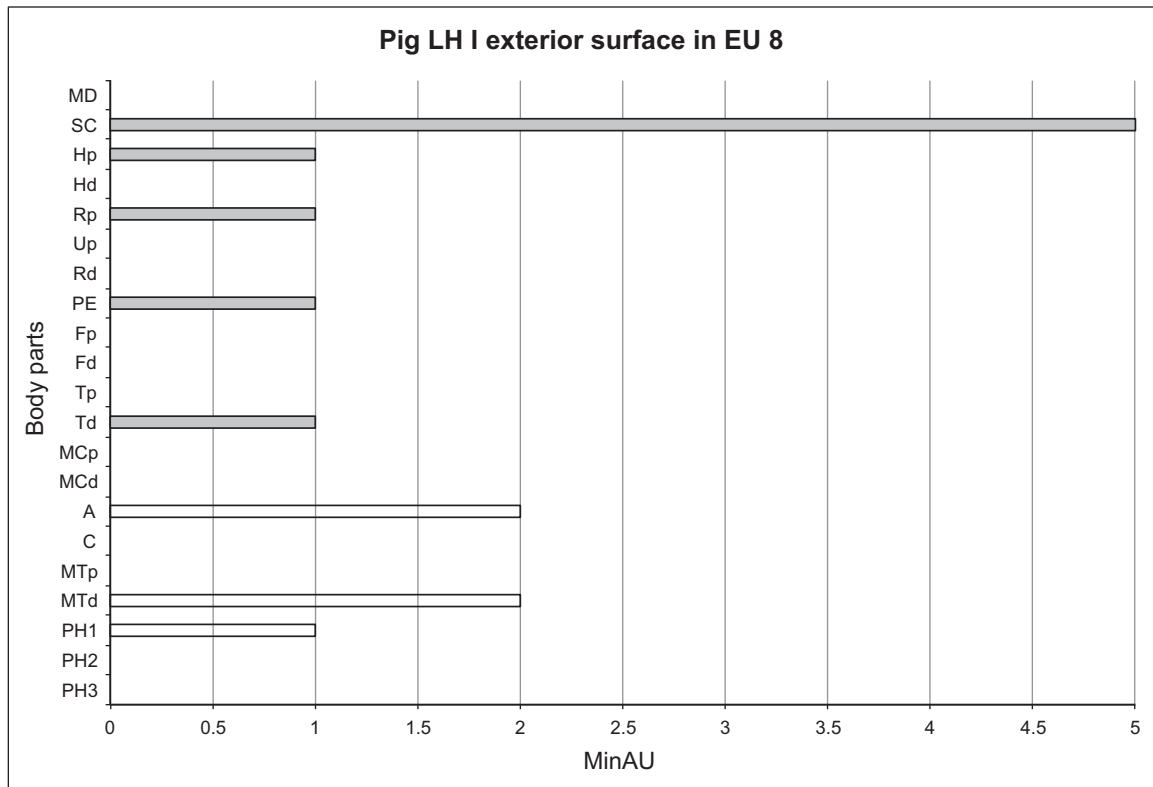


FIGURE 17.15. Anatomical representation of pigs: LH I exterior surface in EU 8 and LH I fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

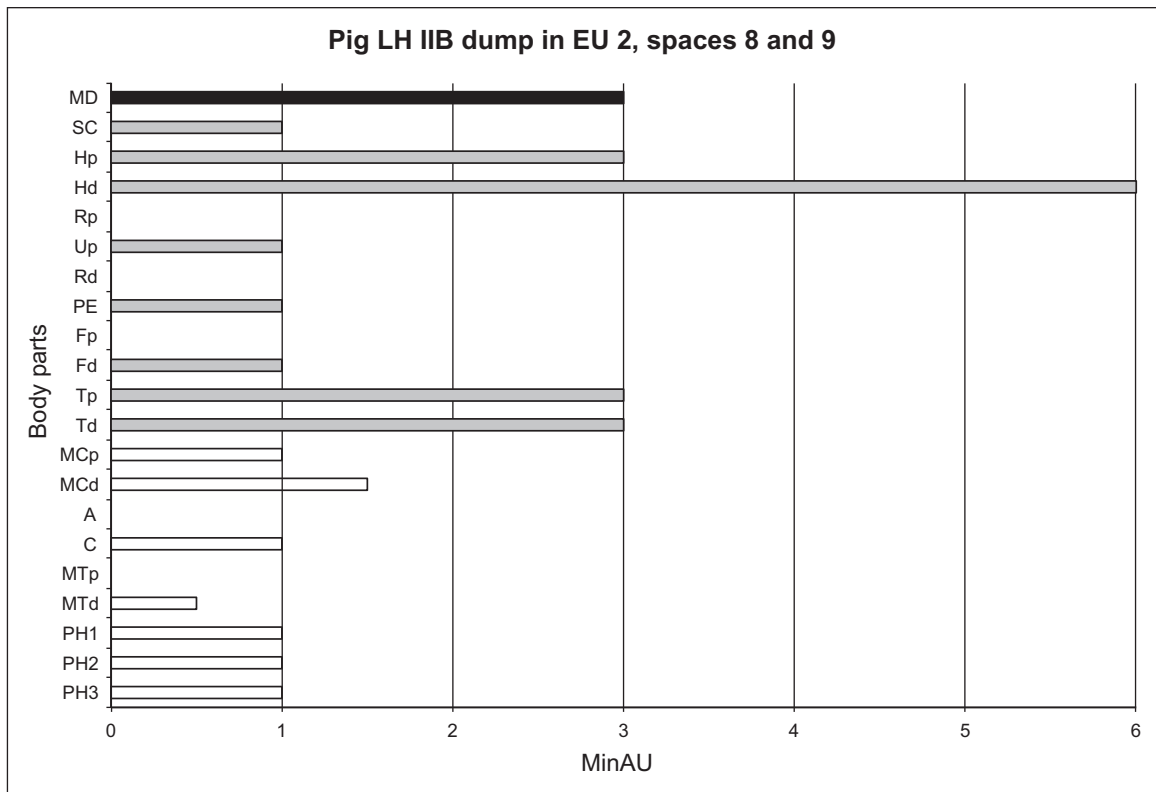
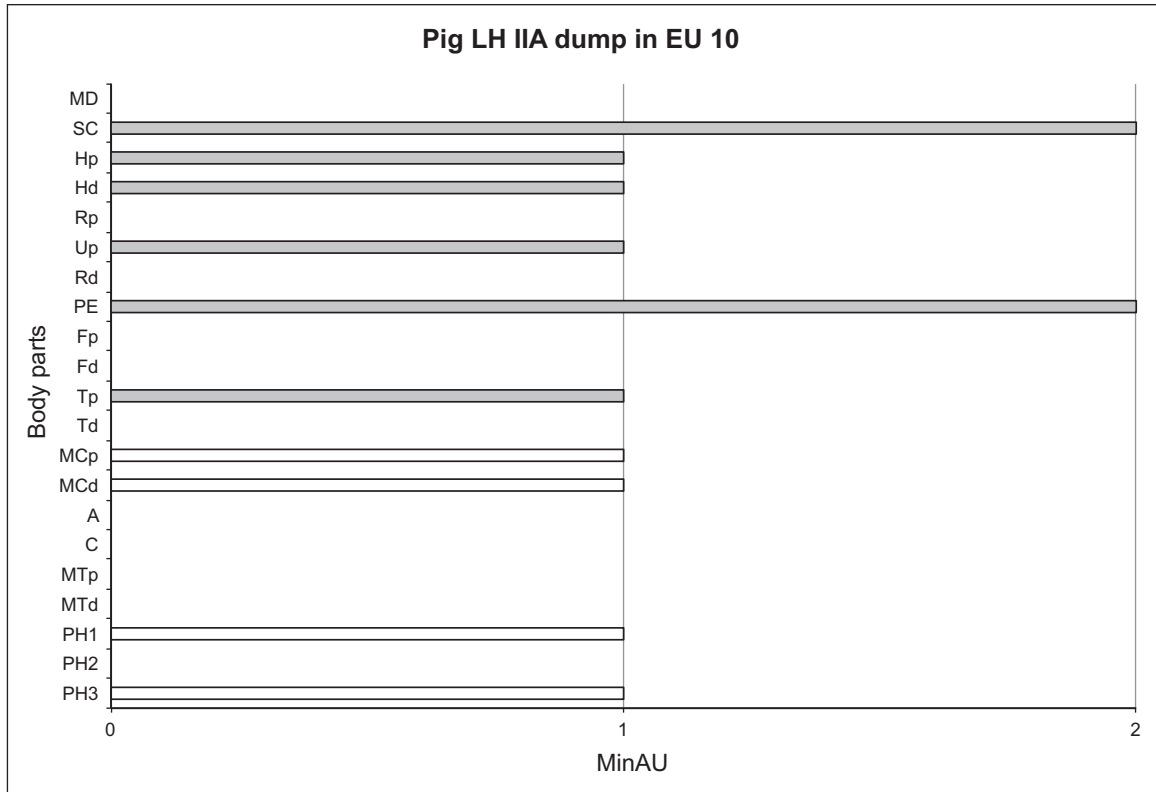


FIGURE 17.16. Anatomical representation of pigs: LH IIA dump in EU 10 and LH IIB dump in EU 2, spaces 8 and 9. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

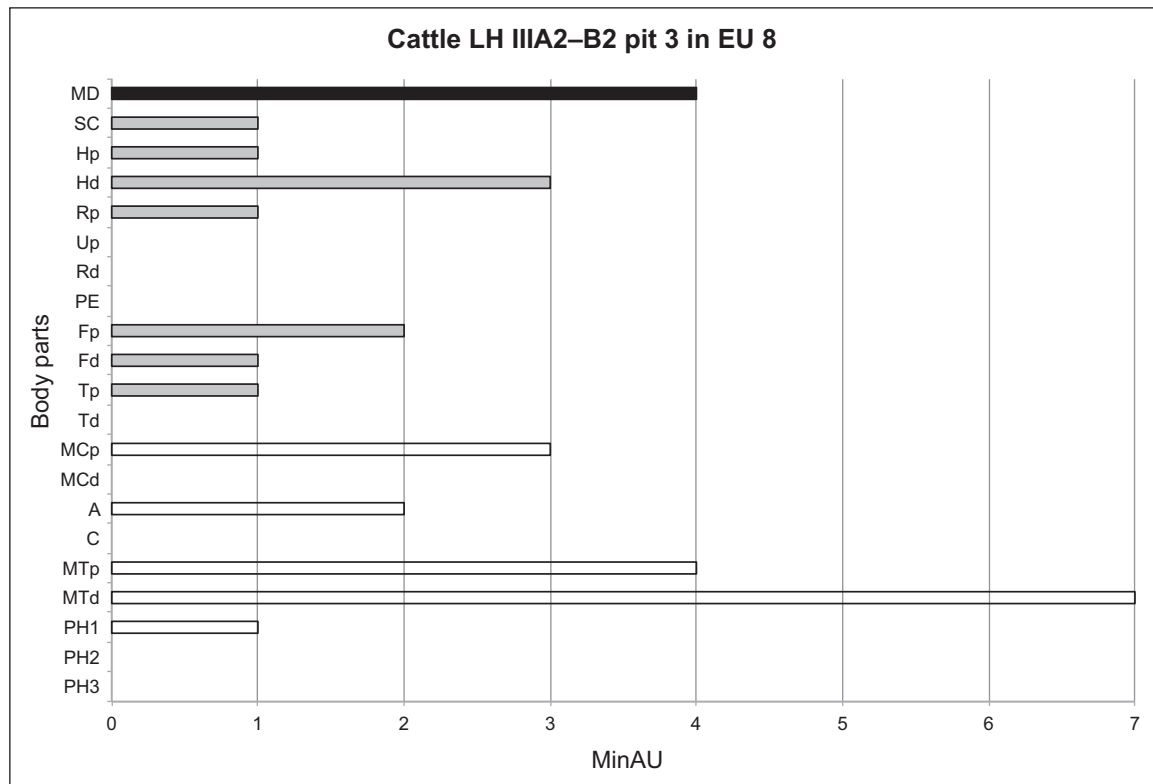
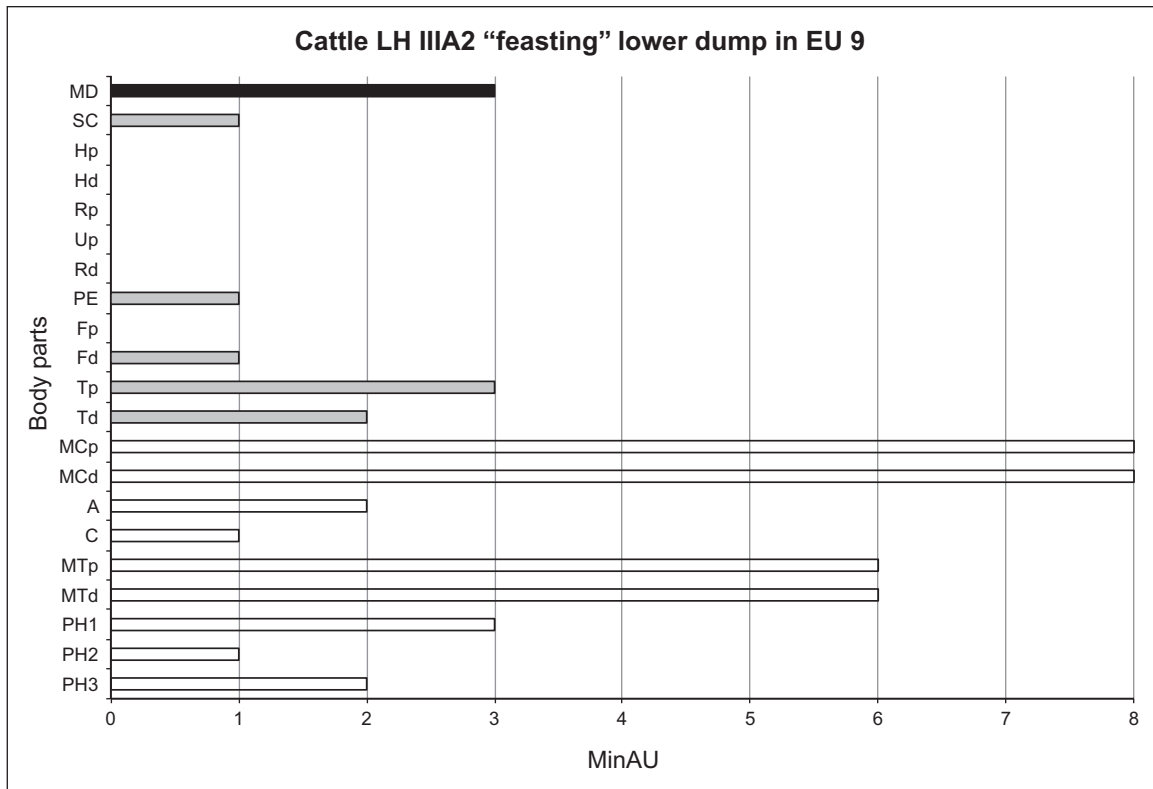


FIGURE 17.17. Anatomical representation of cattle: LH IIIA2 "feasting" lower dump in EU 9 and LH IIIA2-B2 pit 3 in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

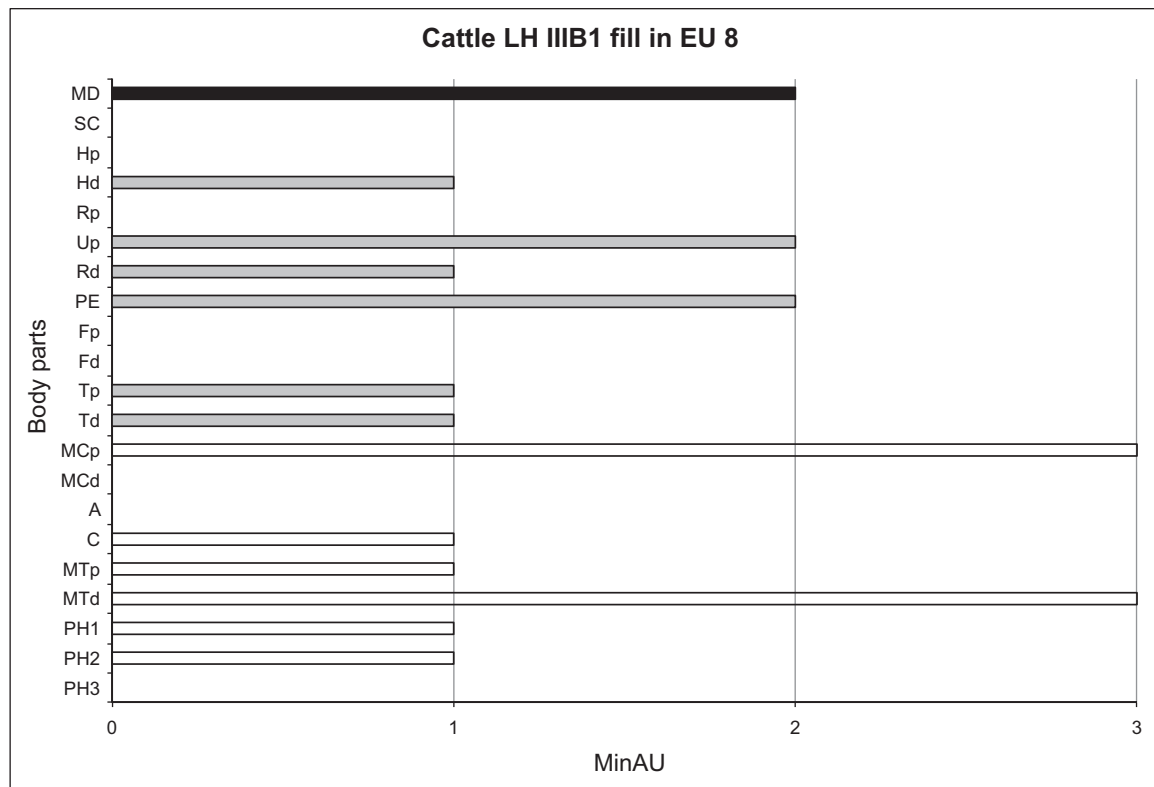
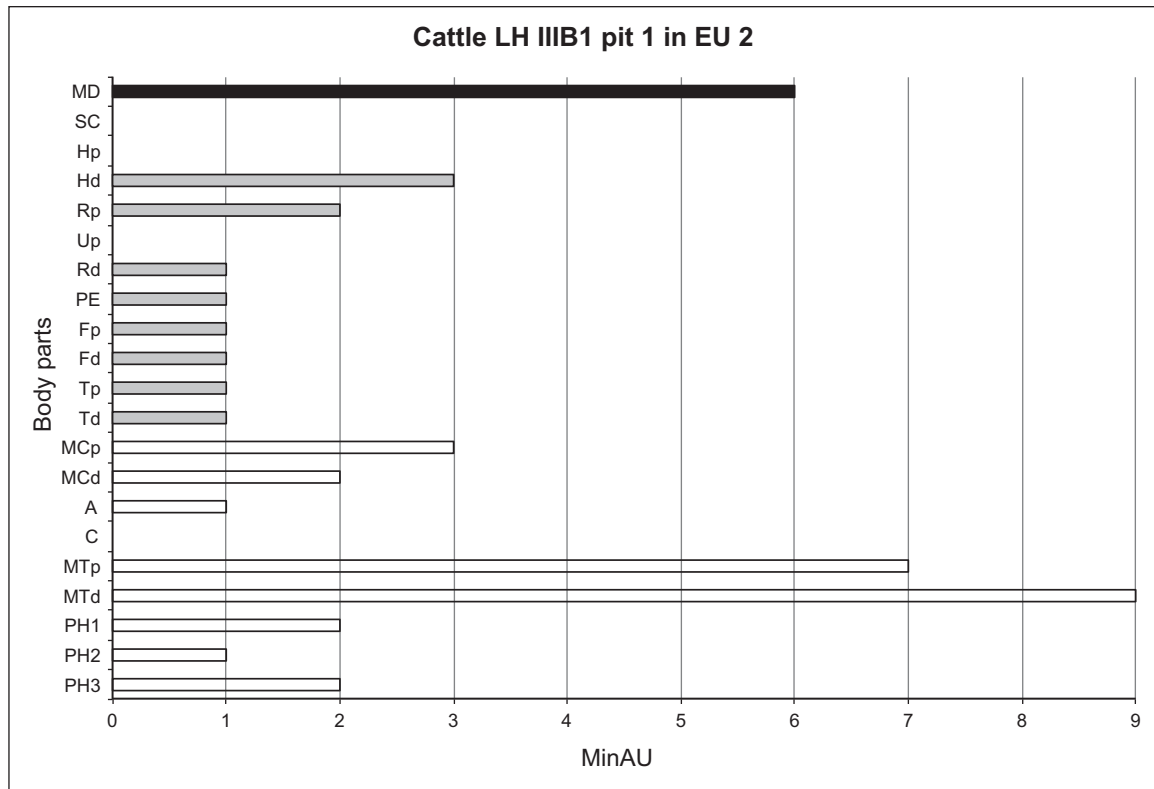


FIGURE 17.18. Anatomical representation of cattle: LH IIIB1 pit 1 in EU 2 and LH IIIB1 fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

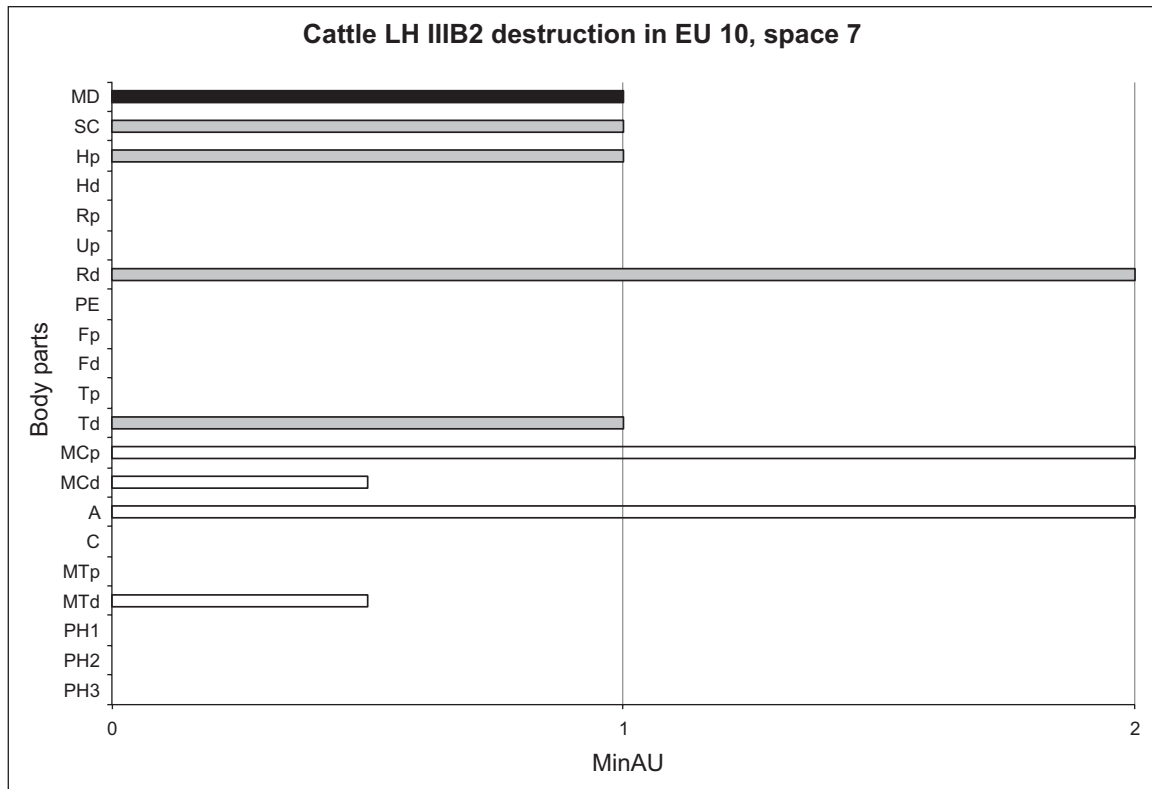


FIGURE 17.19. Anatomical representation of cattle: LH IIB2 destruction in EU 10, space 7. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

teeth of sheep and pigs (Tables 17.17, 17.18). Lambing/kidding may plausibly be assigned to around December–January, the “traditional” birth season in southern Greece for ovicaprids largely raised on natural pasture. The “traditional” farrowing season for pigs in southern Greece seems to have been more variable—not least because pigs can farrow twice in the same year, making season of death more difficult to determine for piglets than for lambs or kids.⁵² Calving too was less strongly seasonal in the recent past, although this may in part be due to human manipulation of diet and/or mating.

Neonatal remains of sheep/goats and perhaps cattle (aged between, say, birth and one month) thus imply a human presence at MH III–LH II and LH III Tsoungiza around December–February. Thereafter, a LH III sheep mandible with unworn first molar implies death in spring, while a few MH III–LH II and LH III mandibles of both sheep and goats with unworn second molar should represent deaths in the latter half of the first year.⁵³ These few young mandibles could be derived from unusually early or late births or from individuals with unusually early or late tooth eruption, and, even disregarding these possibilities, they could have been discarded during rare visits to the site at the seasons in question. On the other hand, it is extremely difficult to demonstrate year-round occupation from domesticated faunal remains, given the imprecision with which even young deaths can be aged, and the tendency for slaughter of livestock of different species, ages, and sexes to be highly seasonal for reasons unrelated to the degree of sedentism of human occupation. While the faunal

52. Halstead and Isaakidou 2011a.

53. Cf. Deniz and Payne 1982; Jones 2006.

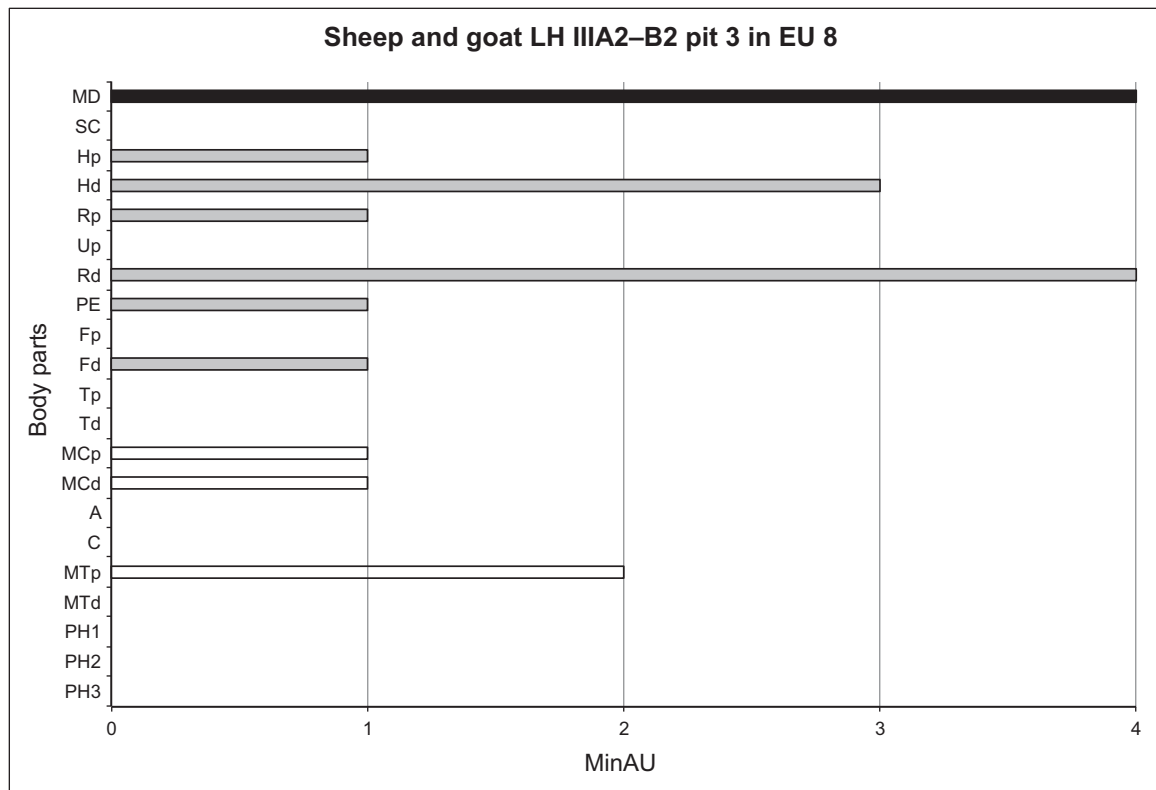
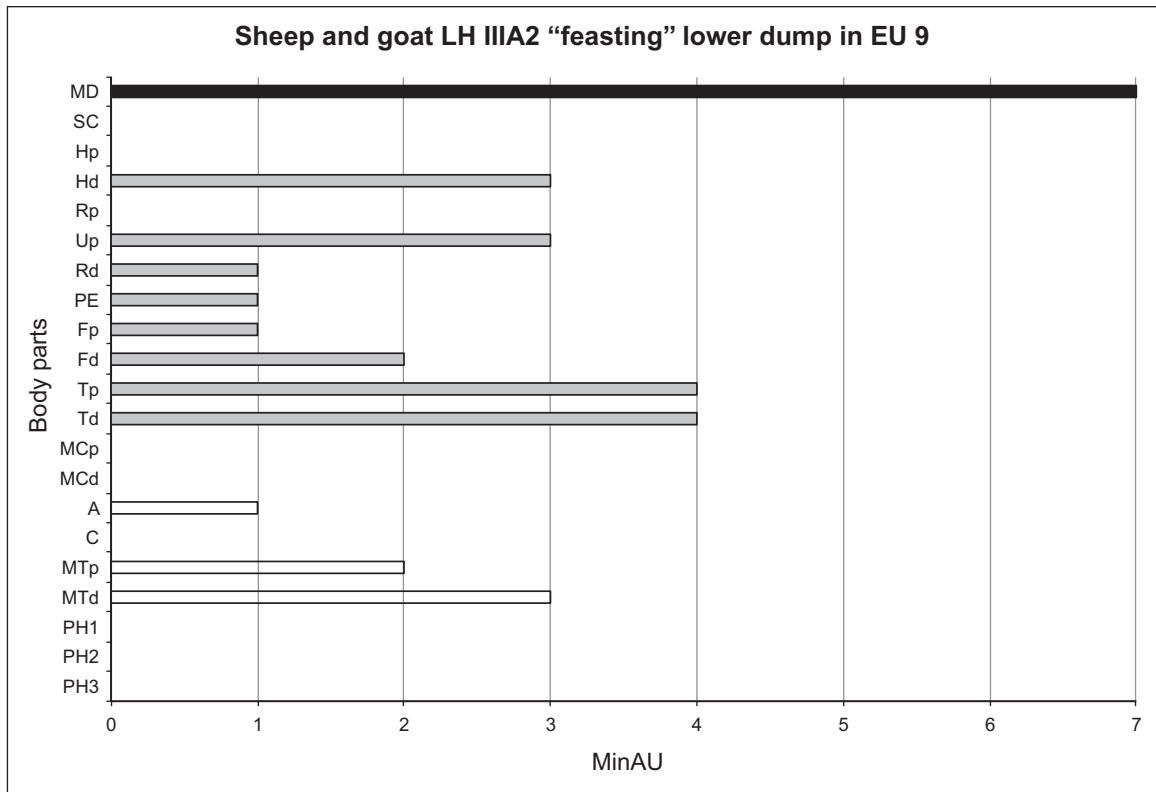


FIGURE 17.20. Anatomical representation of sheep and goats: LH IIIA2 "feasting" lower dump in EU 9 and LH IIIA2-B2 pit 3 in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

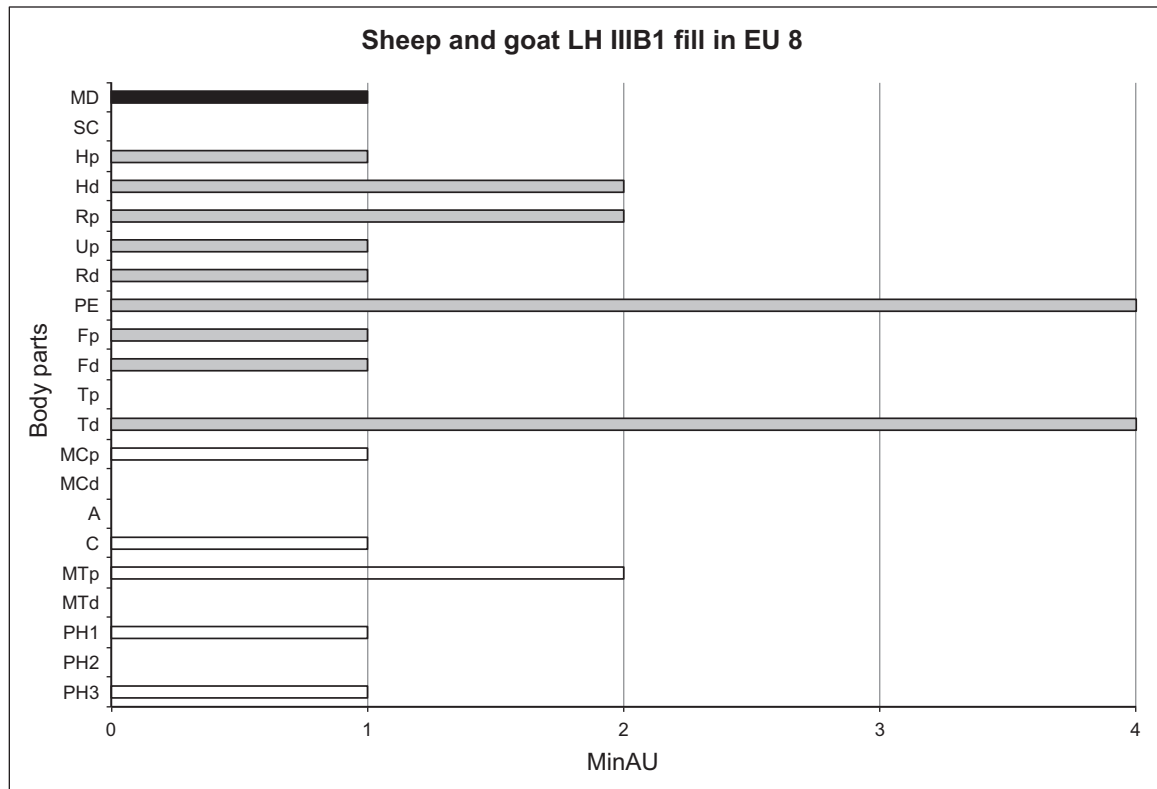
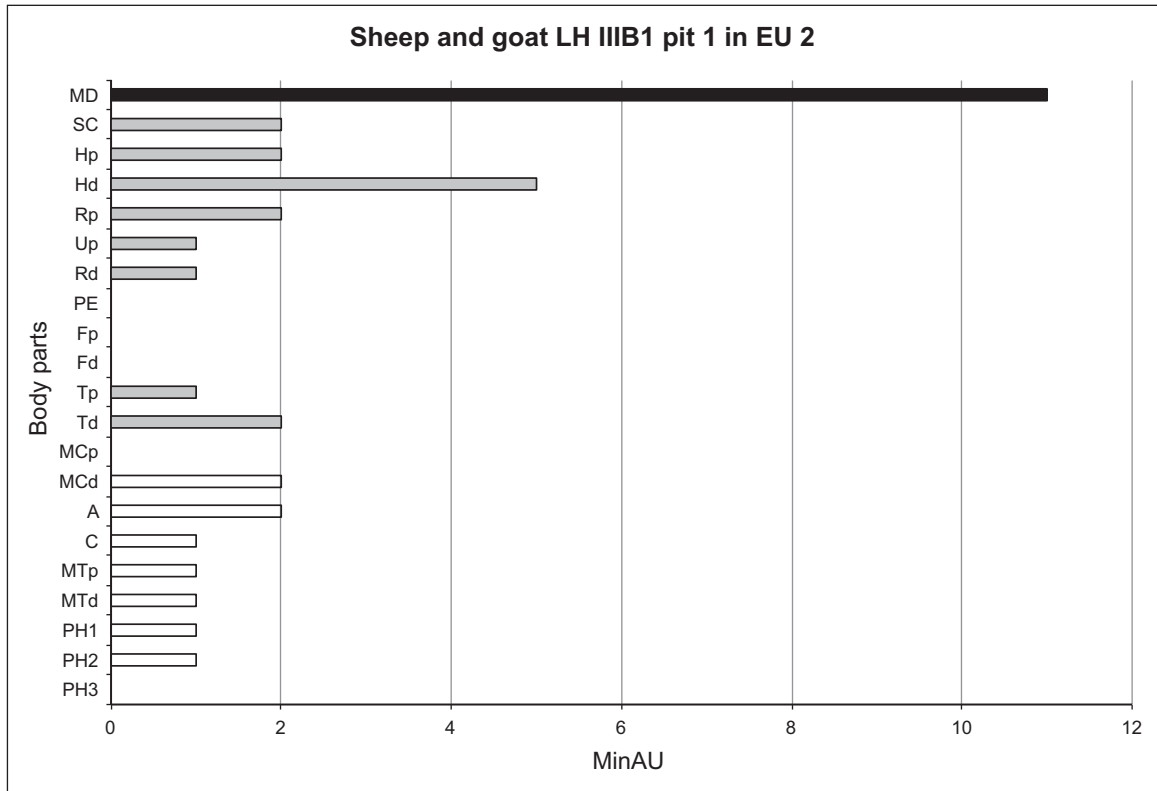


FIGURE 17.21. Anatomical representation of sheep and goats: LH IIIB1 pit 1 in EU 2 and LH IIIB1 fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

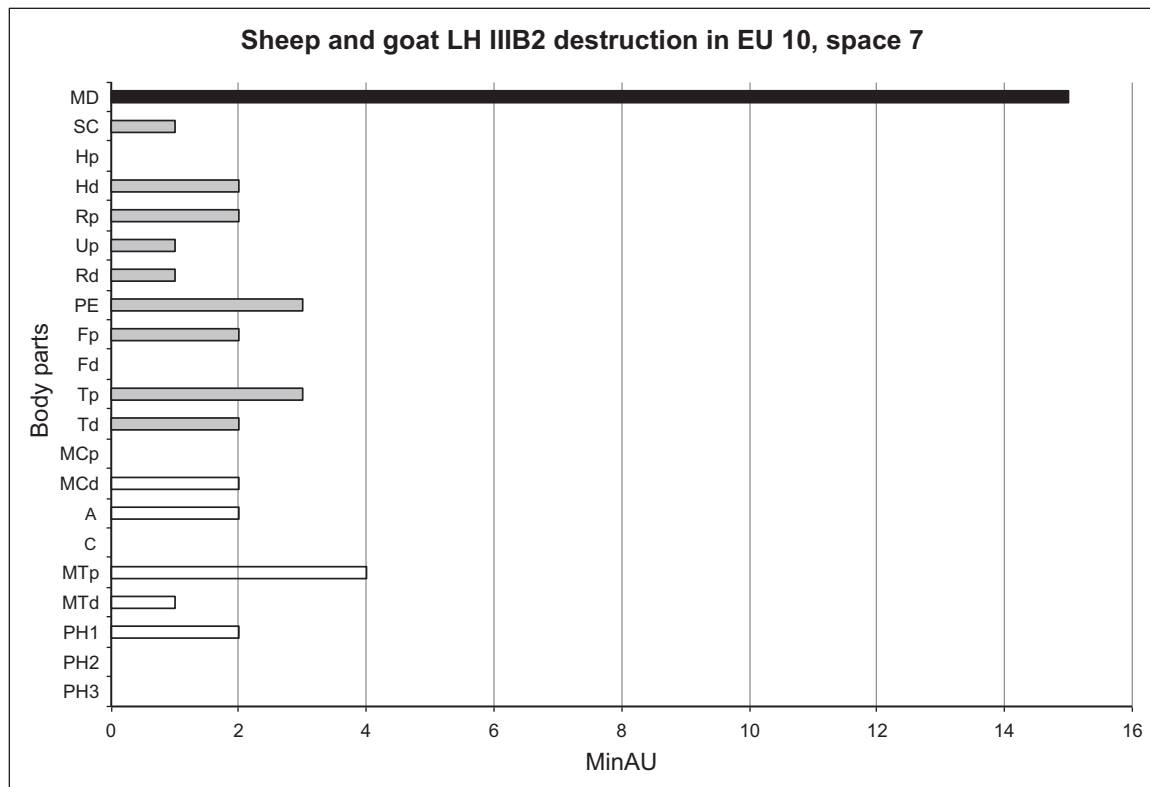


FIGURE 17.22. Anatomical representation of sheep and goats: LH IIB2 destruction in EU 10, space 7. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

evidence is insufficient to demonstrate year-round occupation at later Bronze Age Tsoungiza, it offers no hint of only seasonal activity at the site. The evidence for year-round activity is also marginally stronger for LH III than MH III–LH II.

MORTALITY PATTERNS AND MANAGEMENT STRATEGIES

Patterns of mortality in the commonest domestic taxa can be inferred from four complementary sources: the relative proportions of neonatal and postneonatal postcranial remains (Table 17.12); the ratio of fused to unfused specimens among postcranial units fusing at successive postneonatal stages up to the beginning of skeletal maturity (Tables 17.13–17.15); and the numbers of mandibles assigned to successive stages from infancy to senility (Tables 17.16–17.18), although dental ageing is more accurate for immature animals, based largely on tooth eruption, than adults, based on tooth wear, which reflects the abrasiveness of the diet as well as age. In addition, sex ratios in erupted mandibular canines of pigs (Table 17.47), in fused pelves of cattle, sheep, and goats (Table 17.48), and as inferred from postcranial metrical data (Tables 17.2–17.5) provide some indications of differential survival of males and females at various age stages.

Neonatal specimens make up 0% of MH III–LH II and 2% of LH III postcranial MinAU in cattle, 13% and 4%, respectively, in sheep/goat, and 29% and 16%, respectively, in pig. The neonatal sheep/goat specimens include tentative attributions to goat in MH III–LH II and to sheep in LH III, while there are secure identifications of infant sheep mandibles from

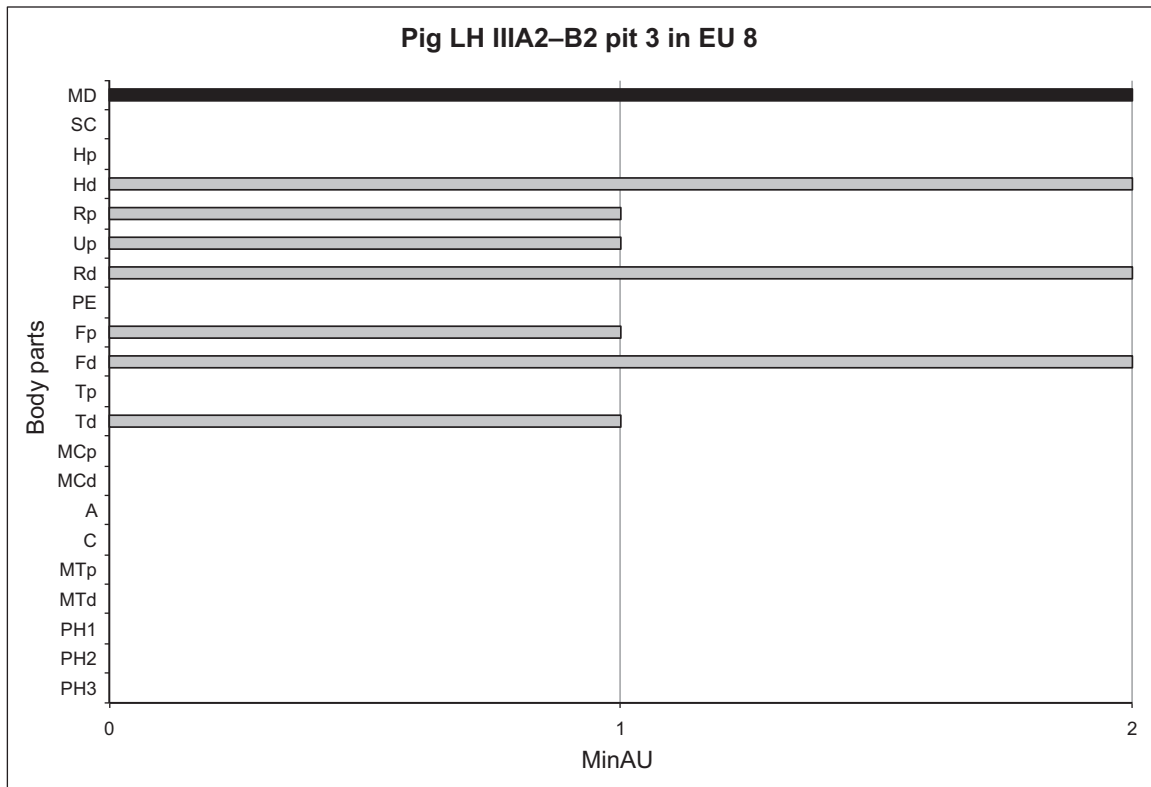
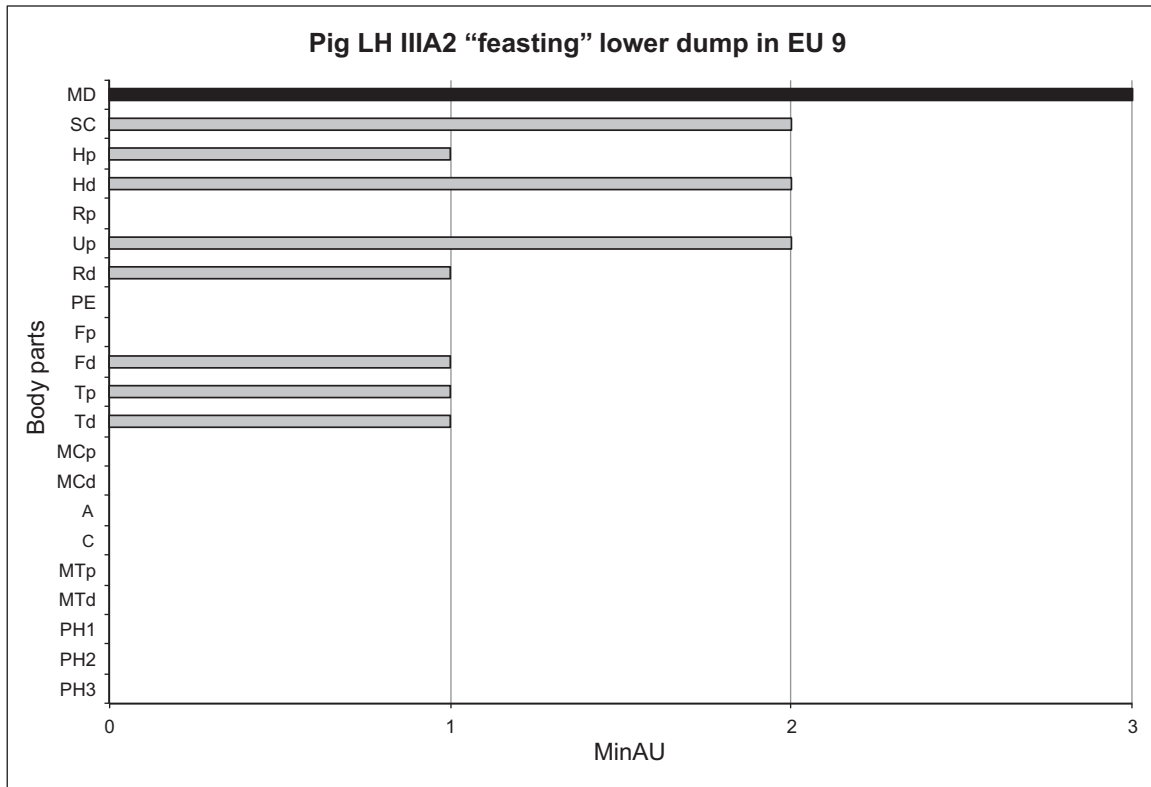


FIGURE 17.23. Anatomical representation of pigs: LH IIIA2 "feasting" lower dump in EU 9 and LH IIIA2-B2 pit 3 in EU 8. Black fill indicates the head and gray fill the meat-rich upper limb bones.

P. Halstead

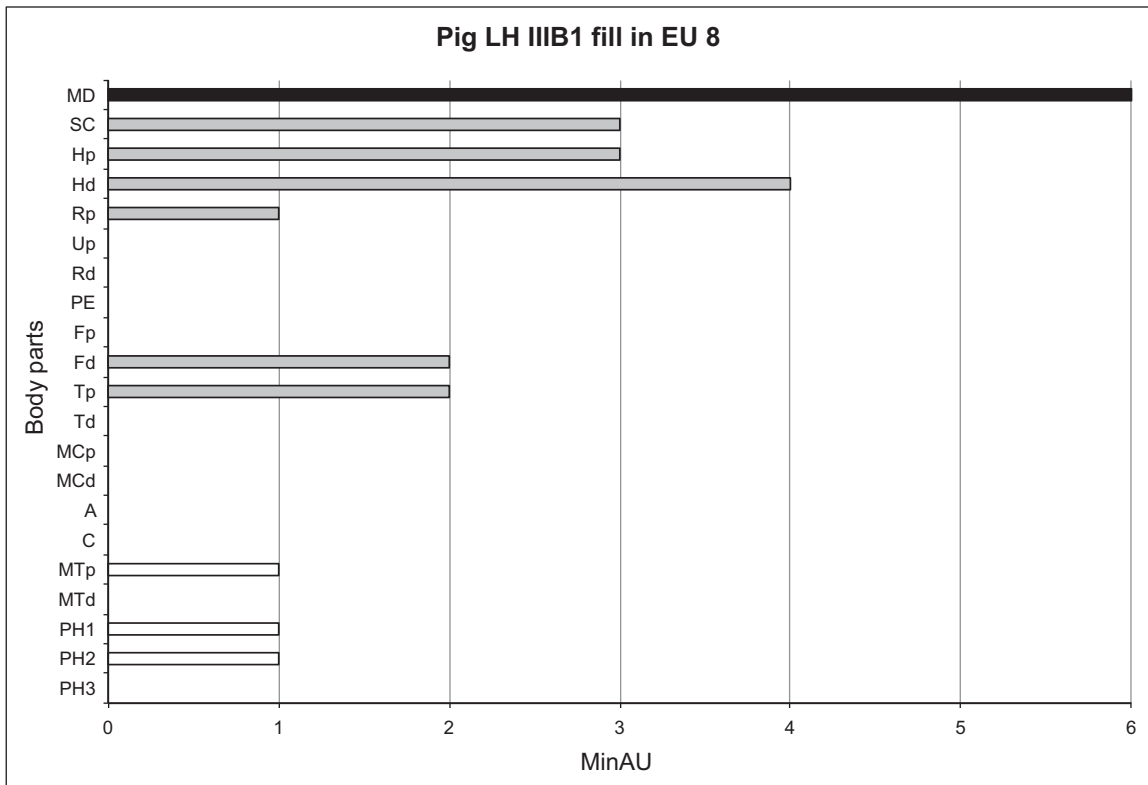
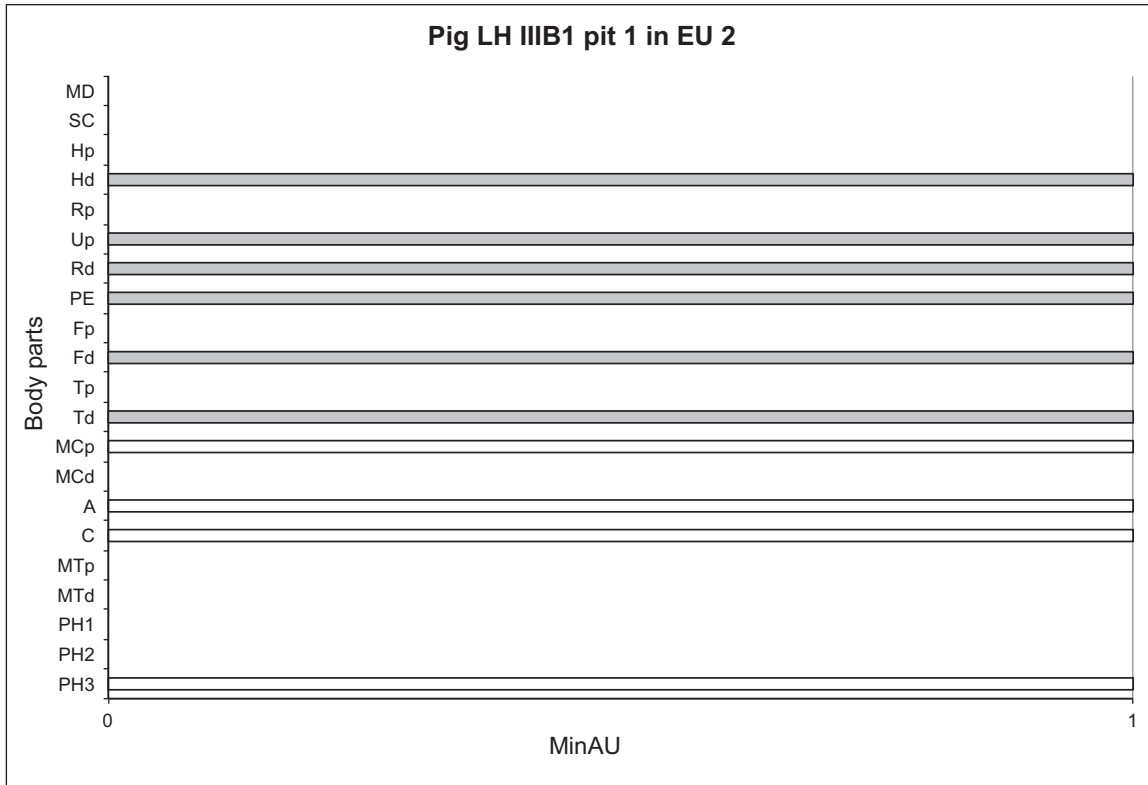


FIGURE 17.24. Anatomical representation of pigs: LH IIIB1 pit 1 in EU 2 and LH IIIB1 fill in EU 8. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones.

P. Halstead

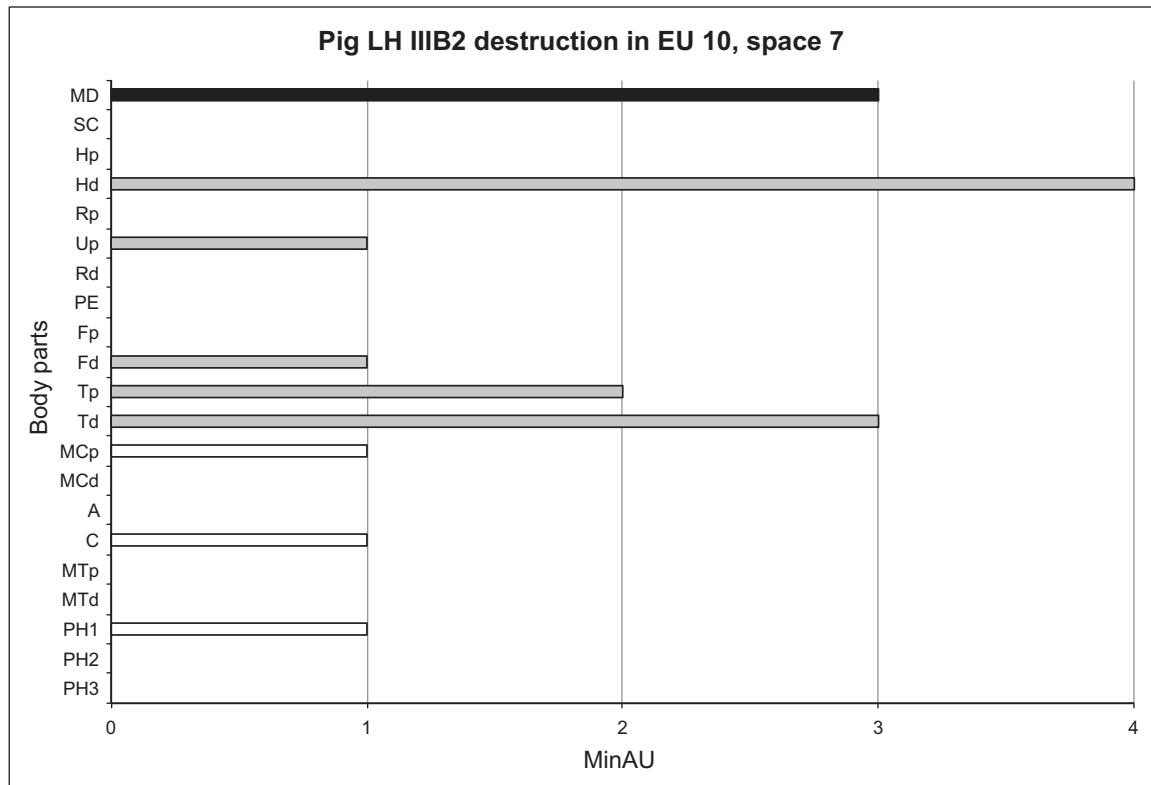


FIGURE 17.25. Anatomical representation of pigs: LH IIB2 destruction in EU 10, space 7. Black fill indicates the head, gray fill the meat-rich upper limb bones, and white fill the meat-poor foot bones. *P. Halstead*

both periods. The very high figure for MH III–LH II pig is *partly* due to the relatively intact burnt piglet found in the LH IIB dump in EU 2. The contrasting frequencies for the three taxa broadly parallel those for FN–EH (2% in cattle, 7% in sheep/goat, and 33% in pig⁵⁴) and run counter to the expectations of retrieval loss, which should be less severe in cattle than in sheep/goat and pig, and instead match potential birth rates and thus likely natural infant mortality (particularly in the case of pigs, which bear litters less developed at birth than lambs, kids, or calves). It would be unsafe, therefore, to interpret the contrasting frequency of neonatal remains of cattle, pigs, and sheep/goats in terms of divergent patterns of intentional human management, although observed cut marks suggest that at least some of these animals were butchered (including removal of meat rather than just skins) rather than merely discarded following natural deaths. On a more positive note, the presence of neonatal remains suggests that cattle, sheep/goats, and pigs alike were reared, as well as consumed, at later Bronze Age Tsoungiza.

Among animals surviving beyond the first few weeks of life, pigs display much younger mortality than cattle and sheep/goats. In only 18% of MH III–LH II and 10% of LH III pig mandibles is the most posterior and latest erupting part of the third molar in wear (representing full adults from at least the latter part of the third year), whereas the corresponding figures (representing animals in at least their fourth year) are 78% and 54%, respectively, for cattle and 43% and 65%, respectively, for sheep/goats. In the corresponding FN–EH figures,⁵⁵

54. Halstead 2011, p. 754, table 13.12.

55. Halstead 2011, pp. 756–757, tables 13.16–13.18.

TABLE 17.46. ESTIMATED MINIMUM NUMBERS OF INDIVIDUALS BY CONTEXT AT MH AND LH TSOUNGIZA

<i>Context</i>	<i>Cattle</i>		<i>Pig</i>		<i>Sheep/Goat</i>		<i>Dog</i>	<i>Horse</i>	<i>Donkey</i>	<i>Red Deer</i>	<i>Hare</i>	<i>Fox</i>	<i>Tortoise</i>	<i>Total</i>
	<i>Neonatal</i>	<i>Postneonatal</i>	<i>Neonatal</i>	<i>Postneonatal</i>	<i>Neonatal</i>	<i>Postneonatal</i>	<i>Postneonatal</i>							
MH III EU 2, exterior surface	–	1j, 1a	2	4j, 1a	2	6j, 6a	1a	–	–	1?	–	–	1?	26
LH I EU 8, exterior surface	–	1j, 1a	–	1j, 4a	1	1j, 3a	1a	–	–	1a	–	–	–	14
LH I EU 8, fill	–	1j, 1a	–	1j, 3a	1	5j, 4a	–	1?	–	1?	–	–	1?	19
LH IIA EU 10, dump	–	2a	2	2j, 1a	1	1j, 5a	1?	–	1?	1j, 1a	–	–	1?	19
LH IIB EU 2, spaces 8 and 9, dump	–	2j, 1a	3	2j, 1a	2	3j, 5a	1a	–	–	–	1a	1j	1?	23
LH IIIA2 EU 9, “feasting,” lower dump	1	1j, 2a, 2?	1	1j, 3a	–	1j, 4a	2?	–	2?	1?	–	–	–	21
LH IIIA2–B2 EU 8, pit 3	1	2j, 1a, 3?	–	2a	–	2j, 2a	1?	–	1a	–	–	–	1?	16
LH IIIB1 EU 2, pit 1	1	1j, 3a, 1?	–	1j, 2a	–	3j, 6a	1?	1a	1?	1?	1?	–	1?	24
LH IIIB1 EU 8, fill	–	2j, 2a	1	2j, 2a	1	1j, 3?	1?	–	1a	–	1?	–	–	17
LH IIIB2 EU 10, space 7, destruction	–	1j, 1a,	–	2j, 3a	1	8j, 4a	–	–	–	1j	–	–	–	21

Note: j = immature; a = adult; ? = indeterminate postneonatal. Estimates take into account all recorded variables (taxon, body part, side of body, age, sex); horn/antler are excluded.

TABLE 17.47. SEXED MANDIBULAR CANINES OF MH AND LH PIGS (MINAU)

	<i>MH III–LH II</i>		<i>LH III</i>	
	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
Mandible	–	4	5	2
Loose canine	2	8	3	6

TABLE 17.48. SEXED PELVES OF MH AND LH CATTLE, SHEEP, AND GOATS (MINAU)

	<i>MH III–LH II</i>		<i>LH III</i>	
	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
Cattle	–	–	1	1
Sheep	1	1	1	1
Goat	1	–	–	–

Note: Excluding unfused specimens.

pigs (3%) diverge even more markedly from cattle (53%) and sheep/goats (59%). Likewise, only 4% of MH III–LH II and 11% of LH III late-fusing pig limb bones exhibited epiphyseal fusion, and so represent adults (conventionally fourth year or older), whereas the corresponding figures are 33% and 50%, respectively, for cattle (conventionally fourth year or older) and 29% and 58%, respectively, for sheep/goats (conventionally latter third year or older). The corresponding FN–EH figures⁵⁶ are 6% for pigs, 60% for cattle, and 22% for sheep/goats. All these figures are to varying degrees based on unsatisfactorily small samples, but the consistent contrast in mortality between pigs and the domestic ruminants is too large to be fortuitous and matches the former's large litter size and lack of potential secondary products. Different secondary products are offered by sheep (milk, wool) and goats (milk, hair), but mandibles assigned to each species offer no hint of differential mortality in either MH III–LH II (43% adult sheep, 42% adult goats) or LH III (68% adult sheep, 64% adult goats), and both these and the corresponding FN–EH figures (56% adult sheep, 36% adult goats) are based on samples too small to be reliable. Unfortunately, epiphyseal fusion data cannot be compared between the two species, since most unfused specimens were (as usual) identifiable only to the generic category sheep/goat. Overall, the data for cattle are too few and inconsistent to shed light on possible diachronic change in management, while the higher proportion of adults in later Bronze Age than FN–EH pigs might be attributable to the increased incidence of gnawing. Perhaps more secure is the mandibular evidence, for sheep and goats combined, of a rise in adult mortality from MH III–LH II to LH III, although in this respect the FN–EH data match the later period. The interpretation of these mortality data is discussed below after first considering the evidence for differences in survivorship between males and females.

In pigs, the male mandibular canine grows to a much larger size than the female, creating a recovery bias in the case of loose teeth, so Table 17.47 distinguishes between loose canines and those still embedded in the mandible. Of the canines with preserved occlusal surface, one male and one female specimen of LH III date were just coming into wear, and the remainder were worn. One of the specimens coming into wear was loose and one embedded in a mandible together with an erupting P4, while the worn canines were associated with P4s

56. Halstead 2011, pp. 754–755, tables 13.13–13.15.

in wear. The worn pig canines are thus probably derived from animals killed in the latter second year or later, and so imply that the minority of pigs slaughtered as adults (Table 17.17) included (ex-breeding?) sows as well as boars. Morphological evidence for the sex of domestic *ruminants* is extremely sparse (Table 17.48) and merely confirms that both male and female cattle and sheep and at least female goats were slaughtered as adults.

Biometric evidence for differential mortality of the sexes is more abundant and more informative. For all the domestic species, Tsoungiza measurements fall almost without exception within the ranges for animals of similar date at nearby Tiryns, offering no hint of differences in size between later Bronze Age livestock at the two sites. On this basis, the Tsoungiza metrical data can be interpreted in the light of comparison with the much larger samples from Tiryns. Of the measurements available for Tsoungiza pigs (Table 17.3), the distal breadth of the humerus is probably most sexually dimorphic.⁵⁷ In the LH sample from Tiryns,⁵⁸ this measurement displays a bimodal distribution in which the more numerous group of smaller specimens overlaps with the less numerous larger specimens at values around 37–38 mm. If these groups represent females and males, respectively, then most of the Tsoungiza pigs (with maximum distal breadth 37.2 mm) surviving to the second year or later were probably females.

For Tsoungiza cattle, fused distal metacarpals and metatarsals for which the breadth of the articulation could be measured have tentatively been labeled in Table 17.2 as female or male (or indeterminate) on metrical grounds, by comparison with sex attributions in the larger LH Tiryns sample.⁵⁹ On this basis, the female:male ratio in metacarpals and metatarsals of Tsoungiza cattle is 2:0 and 0:1, respectively, in MH III–LH II, and 3:2 and 8:6 in the larger LH III sample.

In the case of sheep and goats, the Tiryns measurements were, with the exception of those for first phalanx, published for EH and LH combined, but EH specimens are very few in number, and their LH counterparts heavily dominate the data set, making up 94% of sheep and 91% of goat first phalanx measurements.⁶⁰ For both sheep and goats, Tiryns measurements are consistently skewed to the left,⁶¹ as reflected in Tables 17.4 and 17.5 by mean values consistently lower than the midpoint of the range of measurements, and in general they are more strongly skewed leftward in the more sexually dimorphic forelimb measurements. Moreover, in first phalanx measurements, EH specimens are concentrated in the upper half of the LH range, so the leftward skewing for LH should be underestimated in other body parts for which EH and LH metrical data are not distinguished. The implication is that females clearly outnumbered males among adult deaths at LH Tiryns in both species (the more balanced published ratios of 3:2 for sheep and 2–3:1 for goats⁶² include horncores, which exaggerate the proportion of males). At later Bronze Age Tsoungiza, most measurements for both species fall below the Tiryns means, and so should overwhelmingly represent adult females.

We may now return to the evidence for age at death, which indicates strikingly older mortality throughout the Bronze Age for the domestic ruminants compared to pigs, and older mortality in LH III than MH III–LH II for combined sheep/goats (and perhaps also separately for sheep and goats). Adult mortality in the ruminants is high enough to suggest some exploitation of secondary products, especially (and probably increasing from MH III–LH II to LH III) in sheep and goats, but also tentatively (given the very small samples) in cattle.

57. Payne and Bull 1988.

58. Von den Driesch and Boessneck 1990, p. 161, fig. 9.

59. Von den Driesch and Boessneck 1990, pp. 133, 156, fig. 1, table 32:l-m.

60. Von den Driesch and Boessneck 1990, pp. 159–160,

figs. 7, 8.

61. Von den Driesch and Boessneck 1990, pp. 135–137, table 34.

62. Von den Driesch and Boessneck 1990, p. 99, table 10.

TABLE 17.49. MH AND LH “PATHOLOGICAL” FAUNAL SPECIMENS

<i>Species</i>	<i>Age</i>	<i>Sex</i>	<i>Body Part</i>	<i>Description</i>	<i>Date</i>	<i>Context</i>
Cattle	Distal unfused	–	Metacarpal	Healed(?) fracture	LH IIIA2	EU 9, “feasting,” lower dump
Cattle	Distal fused	F	Metatarsal	Healed, infected(?) compound fracture	LH IIIA2–B2	EU 8, pit 3
Cattle	Distal fused	M	Metatarsal ¹	Bony growth on plantar face of distal shaft, extension of distal articulation	LH IIIB	EU 2
	Proximal fused	–	Two phalanx 1 (pair?) ¹	Bony growths around proximal shaft, extension of proximal articulation		
Cattle	–	–	Metatarsal	Extension of proximal articulation	LH IIIB1	EU 2, pit 1
Cattle	Proximal fused	–	Phalanx 1	Bony growth on distal articulation	MH late–LH II	EU 7
Cattle	Proximal fused	–	Phalanx 1	Bony growth around distal articulation, extension of proximal articulation	LH I	EU 8, exterior surface
Cattle	Proximal fused	–	Phalanx 1	Extension of proximal articulation	LH IIIA1–2	EU 7
Pig	Fused	–	Scapula	–	LH IIIA2–B1	EU 2
Pig	–	–	Ulna	Healed(?) fracture	LH IIIA2	EU 9, “feasting,” lower dump
Goat	Proximal fused	F?	Phalanx 1	Bony growth on lateral/plantar + medial/plantar shaft	LH IIIB	EU 2
Dog	–	–	Pelvis	–	LH IIIA2	EU 9, “feasting,” lower dump

¹ Metatarsal and pair(?) of phalanx 1 probably from same foot.

The most plausible secondary products in this case would have been draft (in cattle) and fiber (in sheep and goats) rather than milk, given the low MH III–LH II and especially LH III frequencies of very young remains (neonatal limb bones and Stage A or B mandibles) from these three species.⁶³ In the case of sheep and goats, the metrical evidence that adult deaths were overwhelmingly female does not support specialization in fiber production. In the case of cattle, however, use for draft is tentatively supported by the metrical suggestions of a roughly even sex ratio and also by evidence of bone remodeling or pathology. Cattle foot bones account for 9 of the 13 recorded “pathological” specimens from later Bronze Age Tsoungiza (Table 17.49). Of these nine, one is an immature metacarpal with a healed fracture and one a mature female metatarsal with an infected but ultimately healed compound fracture, while the remainder are skeletally mature (i.e., fused) foot bones (two metatarsals and five first phalanges) with bony growths to the shaft and/or extension of the proximal or distal articulation. While bony growths might reflect advanced age, extension of the articulation implies that the joints affected were under stress from excessive weight or exertion, and is certainly compatible with animals used for draft.⁶⁴ One of the two metatarsals with extended articulation is from a LH IIIB mature male, but the mature LH IIIA2–B2 female with compound fracture may also have been injured during work. In the recent past, both cows and oxen (i.e., castrated males) were used for draft across the Mediterranean, the former mainly by small-scale farmers and the latter by large-scale cultivators or specialized haulers.⁶⁵

One obvious difficulty with the previous discussion of animal management is that the Tsoungiza faunal assemblages are, as usual, debris from *consumption*, and it has been argued, on the basis of anatomical representation, that they represent mixed refuse from smaller-

63. Cf. Higham 1968; Payne 1973; Legge 1981.

64. Baker and Brothwell 1980; Bartosiewicz, van Neer, and

Lentacker 1997.

65. Cf. Isaakidou 2006, 2011; Halstead 2014.

scale “domestic” and larger-scale “collective/public” commensal episodes, especially in LH III. It is possible that older and larger animals were selected for slaughter at the larger-scale events, but this would not account for the older mortality of LH III sheep/goats if these have rightly been assigned to “domestic” commensality. It seems more likely that many of the animals slaughtered for “domestic” and “collective/public” events alike in LH III had previously served for breeding and or secondary products exploitation—adult draft cattle, and adult female sheep and goats presumably used previously for breeding (and conceivably milking). These animals could have been mobilized, especially for large-scale commensal events, from the wider region—for example, by the nearby palatial center at Mycenae—and were thus potentially unrepresentative of local herd structures. For example, while the injured cow (if used for draft) would have been suited to small-scale cultivation, perhaps close to Tsoungiza, the (presumably castrated) male with suspected “traction pathology” might plausibly have been culled from palatial plow oxen that perhaps worked large blocks of arable land on the plain near Mycenae or Tiryns.⁶⁶ On the other hand, LH III neonatal remains imply local herding of at least some of the slaughtered cattle, pigs, and sheep. Perhaps the most parsimonious interpretation, therefore, is that the animals slaughtered at LH III Tsoungiza (mostly) represented culls from local herds, albeit with the distinct possibility that the apparently missing male sheep and goats had been dispatched for consumption elsewhere in the region—for example, at Mycenae (but not Tiryns, judging by the sex ratio data from that site). If so, the age of these missing males—whether immature/subadult and reared for meat, or mature and slaughtered after yielding wool or hair for several years—cannot be determined from the evidence of the Tsoungiza faunal assemblage.

DIACHRONIC AND INTER-SITE VARIATION

Among postneonatal material of FN–EH date, the representation of pigs declined steadily from 49% in FN–EH I to 26% in EH III, while that of cattle increased from 9% in FN–EH I to 26% in EH III; the representation of sheep/goat was relatively stable, with goats slightly outnumbering sheep. Because taxonomic composition also varied markedly between different types of depositional context, and the latter were unevenly distributed between phases, however, the apparent diachronic trend in pig and cattle frequencies may have been, at least in part, an artifact of contextual variation.⁶⁷ The frequency of cattle continues to rise from MH III–LH II to LH III, but at the expense equally of pigs and sheep/goats, and a steady trend of increasing cattle and decreasing pigs is exhibited only if the various FN–EH phases are combined. In addition, the contrast between MH III–LH II and LH III in anatomical representation of cattle again cautions that differences in the spatial organization of predepositional or depositional activities may have influenced assemblage composition as much as or more than temporal changes in local or regional livestock frequencies. Comparison of anatomical representation between sheep and goat is difficult, because many specimens are identified only to indeterminate sheep/goat, and some body parts are more distinctive in one of the two species. There is thus no evidence that the shift from FN–EH predominance of goats over sheep to the reverse in both later Bronze Age assemblages is an artifact of differential carcass treatment between these species. It is tempting to attribute any increase in the relative frequency of sheep during the Bronze Age to increasing exploitation of their

66. Cf. Killen 1993, 1998.

67. Halstead 2011.

wool for textiles, but at later Bronze Age Tsoungiza the predominance of females among adult deaths, coupled with the hint from small samples that adult survivorship increases equally in sheep and goats in LH III, does not offer support for specialization in this particular secondary product.

Some light might be shed on the articulation of animal consumption at Tsoungiza with the wider regional economy by comparison with the multiperiod faunal assemblages from Lerna and Tiryns, located some 25–30 km to the southeast and, like Tsoungiza, possibly falling under some form of political and economic control by the palatial center at Mycenae during LH III.⁶⁸ As regards such potential regional hierarchy, prepalatial EH, MH, and MH late–LH early Lerna, EH and LH early (“Early Mycenaean”) Tiryns, and FN–EH and MH III–LH II Tsoungiza are widely regarded as “independent,” while LH IIIB Tiryns and LH III Tsoungiza represent the period of suspected control from Mycenae, and “postpalatial” LH IIIC Tiryns conventionally postdates such putative subordination. In comparing the faunal assemblages from these three sites, MaxAU figures are cited for Tsoungiza, as these are more comparable than MinAU to the “numbers of identified specimens” (NISP) reported for both Lerna and Tiryns (Table 17.50). Nonetheless, inter-site comparison must be undertaken with caution, given that recovery was much more intensive, recording of identified specimens was much more selective, and available information on depositional contexts is much more detailed at Tsoungiza than Lerna or Tiryns.

Wild mammals (excluding rodents and insectivores to minimize the effects of differential recovery) make up 2%–4% of the Bronze Age assemblages from Tsoungiza and 1%–2% of those from Tiryns, but 5%–8% in the case of Lerna—conceivably reflecting the location of Lerna at the foot of dissected hills with access to a consequently more diverse catchment than Tiryns in the plain. Among the domesticates, both donkey and horse are present at low levels in both MH III–LH II and LH III assemblages at Tsoungiza, as also at MH late–LH early Lerna and at LH early, LH IIIB, and LH IIIC Tiryns, with traces of butchery for consumption on both species at Tiryns,⁶⁹ on horse at Tsoungiza, and perhaps on donkey at Lerna.⁷⁰ Dog, too, was evidently consumed at all three sites. Of the four common livestock species, cattle are far less frequent in EH (14%) and MH III–LH II Tsoungiza (15%) and also in MH late–LH early Lerna (11%) than in EH (28%) and MH (26%) Lerna or in Bronze Age levels at Tiryns (27%–39%). This contrast is probably due, at least in part, to differences in recovery standards, while the raised frequency in LH III Tsoungiza (32%) seems to reflect particular contexts of commensality with distinctive discard practices. Pigs are fairly consistently abundant over time at Tsoungiza (22%–38%), Lerna (29%–37%), and Tiryns (20%–26%) alike. The published relative frequencies of sheep and goats for Lerna and Tiryns have been recalculated in Table 17.50 with horncores reassigned to sheep/goat (because some sheep are hornless, and horns of goat are far more durable than those of sheep), while it must be borne in mind that the Lerna fauna was studied before publication of now standard diagnostic criteria for differentiating these species. Tsoungiza and Tiryns present a clear contrast, however, which is not obviously explicable in terms of discrepant recovery procedures or identification methods. At Tsoungiza, the sheep:goat ratio is relatively balanced at 0.8:1 in FN–EH, 1.5:1 in MH III–LH II, and 1.4:1 in LH III—a pattern reminiscent of earlier cave sites and small open settlements in agriculturally “marginal” locations.⁷¹ Conversely, at Tiryns, remains of sheep outnumber those of goat by 3.3:1 in EH, 3.1:1 in LH IIIB, and 3.8:1 in LH IIIC (the 34 LH early specimens identified to species are too few to be meaningful), as is usual in Bronze Age Greece in locations favorable to cultivation. Tsoungiza lies among rolling hills

68. E.g., Wright 1987, 2006.

69. Von den Driesch and Boessneck 1990, p. 96.

70. *Lerna I*, p. 37.

71. Halstead 1996, pp. 30–31.

TABLE 17.50. TAXONOMIC COMPOSITION OF BRONZE AGE ASSEMBLAGES FROM TSOUNGIZA (MAXAU), LERNA (NISP), AND TIRYNS (NISP)

Site	Period		Cattle	Pig	Sheep ¹	Sheep/ Goat	Goat ¹	Dog	Horse	Donkey	Wild ²	Total
Tsonggiza	FN-EH	MaxAU	133	359	83	226	106	20	–	–	25	952
		%	14.0	37.7	19.1	–	24.4	2.1	0.0	0.0	2.6	–
	MH III– LH II	MaxAU	126	259	104	243	71	9	5	2	33	852
		%	14.8	30.4	29.1	–	19.9	1.1	0.6	0.2	3.9	–
	LH III	MaxAU	292	198	84	211	60	18	4	17	19	903
		%	32.3	21.9	22.9	–	16.4	2.0	0.4	1.9	2.1	–
Lerna	EH	NISP	1,382	1,480	15	1,490	227	163	–	12	258	5,027
		%	27.5	29.4	2.1	–	32.4	3.2	0.0	0.2	5.1	–
	MH	NISP	1,276	1,539	152	1,130	173	193	11	–	357	4,831
		%	26.4	31.9	14.1	–	16.0	4.0	0.2	0.0	7.4	–
	MH late– LH early	NISP	125	407	9	427	9	33	1	3	91	1,105
		%	11.3	36.8	20.1	–	20.1	3.0	0.1	0.3	8.2	–
Tiryngs	EH	NISP	1,215	1,157	288	1,577	88	53	3	–	62	4,443
		%	27.3	26.0	33.7	–	10.3	1.2	0.1	0.0	1.4	–
	LH early	NISP	166	110	20	102	14	7	1	1	9	430
		%	38.6	25.6	18.6	–	13.0	1.6	0.2	0.2	2.1	–
	LH IIIB	NISP	5,830	3,776	1,312	5,218	429	205	211	110	382	17,473
		%	33.4	21.6	30.0	–	9.8	1.2	1.2	0.6	2.2	–
LH IIIC	NISP	8,769	4,860	1,602	7,152	425	245	297	97	582	24,029	
	%	36.5	20.2	30.2	–	8.0	1.0	1.2	0.4	2.4	–	

Note: Data for Tiryngs after von den Driesch and Boessneck 1990; that for Lerna after *Lerna I*.

¹ Percentages for sheep and goat include *pro rata* assignment of specimens identified to sheep/goat; for all three sites, horncores are here attributed to sheep/goat.

² Mammals only, excluding rodents and insectivores.

offering fertile land well suited both to cultivation, and thus grazing by sheep, and to extensive rough pasture better suited to goats, whereas Tiryns commands a much larger arable hinterland. The contrast in the ratio of sheep to goats thus plausibly matches *locally* available pasture around the two sites, while there is no indication of changes in the relative proportions of domestic animal species in response to a realignment of *regional* political economy such as might have followed the putative subordination of both sites to a palatial authority at Mycenae. On the contrary, apart from the very small LH early sample identified to sheep or goat, the relative proportions of the four principal domesticates exhibit only modest variation between the “prepalatial” EH and LH early, “palatial” LH IIIB, and “postpalatial” LH IIIC at Tiryns.

Detailed comparison of mortality patterns is problematic because the dental age stages used for Tsoungiza, Lerna, and Tiryns are incompatible, while the sex data for Tsoungiza are too sparse to analyze by period and those for Tiryns are presented for the Bronze Age as a whole (but must overwhelmingly refer to LH IIIB and LH IIIC). Nonetheless, at both Tsoungiza and Tiryns pigs were clearly killed much younger than the domestic ruminants, and, among animals reaching adulthood, pigs and (albeit very tentatively at Tsoungiza) cattle included substantial proportions of both males and females, whereas females were heavily predominant (perhaps more strongly so at Tsoungiza) among adult sheep and goats. Within the Tiryns mandibular material, the EH is much smaller than the LH IIIB and LH IIIC assemblages, while LH early specimens (and also EH cattle) are too sparse for meaningful analysis. There is no clear contrast between palatial LH IIIB and postpalatial LH IIIC mortality for pigs, cattle, or combined sheep/goats, however, although young deaths are a little more frequent among prepalatial EH pigs and sheep/goats.⁷² Thus, while there is evidence for older mortality in sheep and goats from MH III–LH II to LH III at Tsoungiza, Tiryns exhibits relatively stable patterns. Of course, the periods compared are not the same at the two sites, and the older mortality at LH III Tsoungiza may reflect contextual variation rather than diachronic change. On the other hand, as discussed above, the raised average age of slaughter at Tsoungiza may reflect the removal of younger sheep and goats, at least, for consumption elsewhere and thus represent the elusive trace of the subordination of animal husbandry around the site to the demands of a regional political economy. The same may also be indicated for pigs, but starting in MH III–LH II.

DISCUSSION AND CONCLUSION

Although modest in size, the faunal assemblages from later Bronze Age Tsoungiza benefited from more rigorous (if inevitably partial) retrieval and closer contextual control than most contemporary assemblages in Greece, including those from nearby Tiryns and Lerna. Unfortunately, the nature of the later Bronze Age deposits encountered and their proximity in some cases to the modern ground surface did not permit such a clear distinction between pits, fills, and surfaces as for FN–EH Tsoungiza. Attrition by dogs contemporaneous with the deposition of the bones has modified the assemblages significantly, but the latter overwhelmingly represent the debris from human processing of animal carcasses for consumption, and indeed variable treatment of different carcass parts seems to have helped shape the anatomically uneven distribution of gnawing traces.

72. Von den Driesch and Boessneck 1990, p. 131, tables 29–31; summary data in Halstead 2002, p. 175, table 7.

All stages of carcass processing, from skinning through dismembering and filleting to the extraction of marrow and working of horn and antler, took place on-site—at least for some of the animals consumed. Cut marks suggest that, as elsewhere, people ate dogs and horses as well as cattle, pigs, goats, sheep, red deer, and hare, while the breakage and dispersal of bones suggest that the same may be true for donkey. Butchery was carried out mainly with metal knives, with occasional evident use of heavier cleavers to remove horns and to break open bones for marrow. Saws were probably used only in working of antler and horn raw material. Later Bronze Age cut marks were less frequent overall than in the FN–EH assemblage and, in apparent contrast to the latter, were not distributed evenly between taxa, but were more frequent in cattle than the smaller domestic taxa. Since visible cut marks are more likely to be inflicted in butchering raw than cooked meat, this suggests that carcasses may have been “pot-sized” for rather larger cooking vessels, perhaps including metal cauldrons, than at FN–EH Tsoungiza. After dismembering and perhaps filleting, most of the long bones were broken open, presumably to extract marrow, and many bear traces of light and patchy burning consistent with brief placement on the edge of the fire to make the bone more brittle and the marrow more liquid. Most such breakage did not leave obvious chop marks, and so was probably achieved with a blunt object, such as a heavy stone, another bone, or even the back of a cleaver. As with knife butchery, bone breakage was more intensive for the larger cattle and perhaps least so for young pigs, *inter alia* probably making the more intact bones of the smaller taxa and younger age groups more attractive to scavengers.

In common with dismembering and filleting, skinning seems to have been less intensive (recovering the hide from less of the foot) in the later Bronze Age than in the FN–EH assemblage, at least in the case of cattle. Evidence for skinning of pigs and sheep/goats is sparser, possibly for taphonomic reasons, but raises the possibility that sheep/goats at least were skinned to farther down the foot than cattle, with the missing skinning marks potentially inflicted on phalanges discarded elsewhere or lost in excavation. More careful skinning of the smaller domesticates runs counter to cost:benefit expectations and also to the apparently more intensive processing of large animals for meat and marrow extraction. Perhaps large and small domesticates were slaughtered and consumed in different social contexts—for example, of “collective” and “domestic” commensality, respectively, such that painstaking skinning of the larger animal might have undermined a desired display of largesse or benefited third parties rather than the skinner. This very tentative suggestion receives some support from variability in later Bronze Age anatomical composition. Although all stages of carcass processing are represented in both the later Bronze Age assemblages, cattle bones of LH III date are heavily biased toward discarded feet with the more meat-rich parts very underrepresented, whereas those of MH III–LH II date apparently lack such anatomical selectivity. Conversely, sheep/goats and perhaps pigs of both periods seem to be represented in large measure by the remains of dressed carcasses, with the feet often missing. One implication of the divergent discard pathways of large and small domesticates is, again, that they tended to be consumed in different social contexts. The LH III discard of primary butchery waste from cattle on-site and of the smaller sheep/goats and perhaps pigs off-site (or in different on-site contexts not conducive to survival of bone) perhaps runs counter to what might be expected on the basis of practical considerations and conceivably reflects an element of “theater” in the slaughter and processing of the larger animals. It is now clear that the distinctively selective deposition of cattle feet, previously discussed in the context of the LH IIIA2 “feasting” dump,⁷³ was typical of all but one of the larger faunal groups at LH III Tsoungiza, implying that large-scale feasting in a possibly religious context was a dominant feature of

73. Dabney, Halstead, and Thomas 2004.

local animal consumption and social life in the long term. At the same time, smaller sheep, goats, and pigs seem to have been consumed in smaller-scale commensal events, consistent with the evidence of architecture and portable material culture that the site continued to be the focus of routine habitation as well as (presumably) periodic ceremonies. Strikingly, debris from the meat-rich parts of the LH III cattle is very underrepresented, but the faunal assemblage offers no indication as to whether the meat was consumed in the vicinity of Tsoungiza or at a distance.

Mortality data are too sparse for detailed reconstruction of livestock husbandry. As in FN–EH, however, Tsoungiza pigs were slaughtered much younger than sheep, goats, and cattle. Pigs have large litters and offer no secondary products, whereas adult survivorship in sheep and goats (especially in LH III) and perhaps in cattle was high enough to be compatible with emphasis on secondary products, and probably not milk given the relatively sparse evidence for infant deaths. In cattle, the presence of both female and male adults, coupled with a few cases of potential “traction pathology,” is compatible with use for draft. In sheep and goats, the heavy predominance of females among adults does not support specialization in wool and hair production, but raises the question of the fate of the “missing” male offspring. If these were exported for consumption elsewhere, were they juveniles reared just for meat or adult castrates that had been clipped a few times for wool and hair? In either event, answers cannot be gleaned from the Tsoungiza material.

The possible export of male sheep and goats from Tsoungiza, and perhaps even of young pigs (but from a rather earlier date), raises the issue of the possible integration of Tsoungiza during the LH III “palatial” period within a regional political economy, centered probably (given other evidence from the excavations) on Mycenae. Even more speculatively, the LH IIIB deposition of at least one male possible draft ox, perhaps better suited to working the extensive arable land in the Argive Plain than the smaller areas around Tsoungiza, might conceivably represent a contribution by a regional authority to feasting at Tsoungiza. On the other hand, the relative frequencies of the principal livestock species are more or less unchanging at the major center of Tiryns between the prepalatial, palatial, and postpalatial periods, while they differ between Tiryns and Tsoungiza in ways that seem responsive to local environmental potential. Neither of these observations suggests that the emergence of a regional political economy had a major impact on local patterns of animal husbandry and consumption. Faunal evidence from additional sites in this region, ideally including Mycenae, might be more informative.