McDONALD INSTITUTE MONOGRAPHS

Consuming passions and patterns of consumption

Edited by Nicky Milner & Preston Miracle

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with contributions by Umberto Albarella, Hamish Forbes, Annie Grant, Martin Jones, Finbar McCormick, Alan K. Outram, Gustavo G. Politis, Nicholas J. Saunders, Dale Serjeantson & Sandra Montón Subías

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Fractured pig humerus from Durrington Walls (see Fig. 5.11).
Nukak men eating white-lipped peccary (see Fig. 10.2).

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Chapter 1

Introduction: Patterning Data and Consuming Theory

Nicky Milner & Preston Miracle

It is fascinating to see how attitudes towards food change through time. It could be argued fifty years ago that the English cared little about the taste of their food, in comparison with today. For example, in 1949 Raymond Postgate, a radical journalist, classicist and social historian proposed the Society for the Prevention of Cruelty to Food, he was so fed up with terrible meals (Paxman 1998). In contrast, in the last decade, we have metaphorically had food thrust down our throats, as it appears to become ever increasingly popular in the media and our daily lives. Television chefs are plentiful; there is even a satellite channel that dedicates half a day to cooking programs. Not only do these cooks provide recipes from the basic to the exotic but they may also make an issue of the whole consumption process, from procuring the foodstuffs to dining practises, unusual and bizarre included, which puts the food into some sort of context. We also experience it first hand with a greater number of people dining out, whether at power breakfasts, pub lunches, themed venues like medieval banqueting halls, fast food outlets, or Italian, Thai, Ethiopian, Indian, or Chinese restaurants (naming only a few of the available options). Although food choice has become more varied in recent times, and people are more aware of food from different cultures, other aspects of consumption were considered more important fifty years ago. Eating together as a family was a more common occurrence then than now, and the home-cooked Sunday lunch shared by the extended family is being replaced by the 'off-the-shelf' meal eaten on the run with a television for company.

This brief perusal of popular culture and the media confirms the banal observation that food is both sustenance and symbol. The intimate and necessary link between food and life makes the former an ubiquitious variable and/or proxy measure in evolutionary studies of behaviour as well as throughout many disciplines of the medical and life sciences. Not surprisingly and quite appropriately, many anthropologists and archaeologists have also focused on food as a proxy of fitness, a currency of adaptation, and a major constraint/drive causing change (e.g. Winterhalder & Smith 1981; Harris & Ross 1987). The daily rituals of food creation, consumption, and disposal, and their inherent sociality, however, also make food an ideal subject for anthropological studies of cultural rules and their negotiation/transgression by individuals and groups (Lévi-Strauss 1969; 1978; Douglas 1972; Goody 1982). Food creates and constitutes social relationships; it is material culture.

Archaeological analyses of eating habits have varied throughout the twentieth century. There has been a tendency to use faunal and floral remains to understand the economy of a site, the subsistence activities, and the diet of inhabitants. Archaeology has thus been rather slow in following Anthropology's lead on the sociality of food, although the social dimensions of food in the past have attracted a good deal of attention in recent years (Hastorf 1991; Dietler 1996; Samuel 1996; Gummerman 1997; Gosden & Hather 1999). That said, we consider the pitting of the 'social' against the 'ecological' or 'biological' in archaeological discourse to be a sterile and futile practice when dealing with food. The evolutionary significance of subsistence practises and strategies lies in the manipulation and distribution of resources in social arenas, through sharing, cooking, communal consumption, and so on, rather than in the resources themselves. Furthermore, resources through their preparation and consumption are transformed into food, which like any item of material culture serves a variety of biological and economic functions, while at the same time carrying multiple symbolic meanings that may be purposively created, manipulated, and deployed by dynamic actors.

It was with these thoughts in mind that the conference 'Consuming Passions and Patterns of

Consumption' was held at the McDonald Institute for Archaeological Research and Department of Archaeology, University of Cambridge in September 1997. The current volume comprises some of the contributions presented at the conference as well as others solicited afterwards. Our title was inspired by Peter Farb's and George Armelagos' (1980) book *Consuming Passions: the Anthropology of Eating*. We use 'consumption' to focus on the social contexts and processes of food preparation, storage, eating, and disposal but our usage is rather looser than that of Gummerman (1997) and Gosden (1999) who define consumption in terms of recipes, meals, and eating paraphenalia. In contrast to Gummerman's (1997) focus on 'complex' societies, we have included archaeological and ethnographic case studies that span a wide range of societal forms and scales. Our interests in consumption are similar to Gosden & Hather's (1999) in food, and the animal focus of the current volume complements their emphasis on plant foods.

Given the ubiquity of food waste in the archaeological record, the relative lack of archaeological work on the cultural and social dimensions of food consumption is surprising. This lack of interest, which is happily a thing of the past, arose both from previous theoretical agendas and continuing methodological hurdles. From a theoretical standpoint, food, often coupled with demography, was frequently used as a causal variable or even 'prime mover' in explanations of changes in past cultural systems (e.g. Cohen 1977; Christenson 1980). Archaeologists have been increasingly unpacking normative characterizations of integrated sociocultural systems by examining variation within groups in terms of the different interests and goals of individuals based on gender, age, status, and so forth. With these theoretical developments there has been a new emphasis on fine-grained analyses of social relations. It has been within this theoretical space that archaeologists have started to approach food as 'good to think' as well as 'good to eat' (Harris 1985). Methodological limitations stem in part from looking at consumption as an act; from this perspective direct evidence of consumption is limited to past bodies (e.g. stomach contents, bone stable isotopes, etc.) and their waste (e.g. coprolites). If instead consumption is thought of a process, we can widen our investigation to include food preparation, presentation, distribution, storage, disposal, and so on. As studies in this volume amply show, a range of new approaches and methods is helping us address some of these issues.

A dominant theme at the conference was the question of whether social hierarchy and status could be detected from archaeological food residues. Food is very often linked to status and power, and consumption can be socially divisive, distinguishing the rich from the poor. For instance caste is marked by different food habits in India and rules prohibit eating with those of the lower class (Goody 1982). Likewise, in the Imperial age of Rome guests at banquets were not always given the same food and wine, the poor guests being made to feel the gulf between themselves and their hosts (Paoli 1963). Food and animals used for food often have a value or symbolism which can be indicative of status and this may be related to a number of factors including rarity of the food or religion and ideology. These factors and hence the value of the food may also change through time. Different relationships between food and the status of those consuming it may be explored using historical and ethnographical sources but actually detecting social and economic hierarchies from archaeological food waste can be far more challenging.

Using examples predominantly from southern Britain, Annie Grant uses historical and archaeological data to demonstrate how an archaeologist may recognize social and economic hierarchies by considering the species found on sites, the cuts of meat and the contextual evidence. Because a broad data set is used which covers a number of prehistoric and historic periods it is also demonstrated that the values of different animals as food do change through time in Britain. Although it may not always be obvious why perceptions of certain animals and the attributed values change, especially in prehistory, it appears possible to identify shifts in high-status animals demonstrating the advantages of focusing attention beyond the individual site.

Status and social hierarchy in food consumption will often go hand-in-hand with feasting events. The Collins dictionary defines a feast as a large and sumptuous meal, usually given as an entertainment for several people, but feasts can have many more meanings. Hayden (1990) sees a relationship between feasting and socioeconomic competition. Feasts may also serve a ritual purpose, they usually bring together a group of people, they can commemorate an event and they may also be used to reinforce status. Whatever the particular emphasis or number of meanings, generally speaking feasts are obviously social as much as nutritional events.

In the context of formalized communal feasting, Finbar McCormick explores social hierarchy in medieval Ireland. At this time there was a legal obligation of the provision of 'hospitality' meaning that the lord and his retinue had a right to be entertained. This also served the purpose of using all the meat from a kill before it spoiled, there being no means of refrigeration and salting being prohibitively expensive. From historical records, McCormick demonstrates how the carcass was hierarchical in quality and that different cuts were given to guests according to status. From an archaeological perspective, however, detecting this sort of feasting and the social hierarchy at these kind of consumption events can problematic: it may be difficult to distinguish whether food waste represents a large quantity of meat consumed in a short period or small portions over a long period. The context is critical and McCormick uses a case study to demonstrate how in some cases feasting and social hierarchy may be detected in the archaeological record.

Feasting is probably more likely to be detected from archaeological food waste in historical periods when the form of consumption may be described in writing. In this volume, however, two papers show that it may be possible to detect feasting from prehistoric evidence.

In their paper on the assessment of faunal remains from the Late Neolithic henge enclosure of Durrington Walls, Umberto Albarella and Dale Serjeantson describe the methodology employed for assessing feasting or communal eating. Henge enclosures such as this are often interpreted as being ceremonial centres although sometimes it is suggested that they also served domestic needs. Although the faunal remains and interpretations from this site have attracted much attention in the past Albarella and Serjeantson re-assessed the faunal remains, especially the cattle and pig bones, with the aims of investigating human activities in the Late Neolithic of Britain and detecting patterns of meat preparation and consumption, bone deposition and disposal. They show the value of doing this by revealing data that had previously gone unrecognized. Consequently, this work delivers important new insights into butchery and cooking practises of pig and cattle as well as the disposal of bones at the site and this in turn affects interpretations concerning feasting and domestic consumption. The results obtained are not only important for Durrington Walls but will have an impact on the interpretations made for other similar sites in the Late Neolithic.

In Neolithic studies the very nature of many of the sites such as stone circles, henge enclosures and so on has led to a focus on social and ritual interpretations of human practice and the landscape. Consequently faunal remains from these locations may be seen in a ritual or socio-economic context and therefore archaeologists may be more open to interpreting food waste as the result of events such as feasting. In Mesolithic studies, however, the nature of the evidence and the tradition of interpreting faunal remains in terms of economic practices and the natural environment has perhaps limited the consideration of the social and ritual aspects of consumption for this period.

The themes of feasting and cooking are examined in Preston Miracle's analysis of Mesolithic meals from the site of Pupićina Cave, Croatia. He suggests using the concept of the *chaîne opératoire* in the analysis of animal bones and develops other methods for elucidating the choices and actions of Mesolithic hunter-gatherers in food selection, preparation, consumption, and disposal. He also demonstrates how the diversity and amount of animal food brought to the site changed over time. These data, in conjunction with detailed analyses of butchery and cooking practices of red and roe deer suggest that feasting may have become important during the Mesolithic. While the meanings of these practices elude us, the social contexts of food consumption appear to have changed through time. This paper brings forward important methods for studying feasting at other Mesolithic and Palaeolithic sites.

Aspects of food storage may also be a means of understanding more about consumption in the past but as Hamish Forbes notes, evidence of storage in the past is often discussed in terms of the rise of social complexity and of élites, for example in the Late Bronze Age Aegean palaces. Instead Forbes broadens the issue of storage and consumption by focusing on the groups, such as peasants and the urban poor, which are sometimes ignored in archaeological discussions of past societies. Ethnographic data is used to demonstrate the complex decisions involved for modern Greek subsistence-based farmers when storing foodstuffs and this paper deconstructs our common assumptions that there is a close link between storage capacities and associated consumption on archaeological sites. Decisions about how much to store can be driven by production rather than the needs of the consuming group. Other aspects of storage such as the timing of removal of foodstuffs or the quantities removed or left in storage are shown to be highly strategic decisions influenced by a range of factors in the natural and social environments.

In a similar vein, marrow extraction from bone is more often associated with the poor, or societies under dietary stress who need to maximize the amount of nutrition which can be obtained from a carcass. In the paper by Albarella and Serjeantson it is noted that some of the pig bones at Durrington Walls had been abandoned or disposed of without being broken for marrow. This and other evidence is discussed in terms of communal eating or feasting on large quantities of meat. The paper by Alan Outram, however, considers the processes of marrow extraction in great detail in order to identify the intensity of bone fat exploitation, something which may not occur in feasting contexts but which may be present at many other types of sites. Although archaeozoologists often note fresh fractures on bone as indicative of marrow extraction it is shown that this is too simplistic an approach. The conditions of the bone before breaking, for example whether they are heated, boiled or frozen, affects the way in which they fracture. Outram conducted a series of experiments into how these variables affect breakage and demonstrated how to discern between fracture types consistent with marrow extraction and those which are not. This methodology is shown to be applicable to archaeological material through the analysis of faunal remains from a Mesolithic site in the Italian Dolomites and a medieval Norse settlement in Greenland.

Not only can consumption practices distinguish the rich from the poor, but food consumption is usually related to differences in the gender and age of the consumers. This is often brought out in discussions of food production, for instance the different roles that men, women and children play in hunting, fishing and gathering but identifying such differences from the archaeological record can be problematic if not sometimes impossible. Sandra Montón observes that food processing and cooking are some of the most fundamental activities in creating and maintaining social life, although they appear to have assumed a low profile in archaeological discourse. She sees this as a result of cooking being within the domain of the women and the domestic sphere, and an interest in this has only been introduced through gender archaeology. Montón also assesses how different aspects of cooking may be detected in the faunal record and examines how the evaluation of food producing as a social practice affects key discussion areas in zooarchaeology, calling for new subject areas to be developed.

Nicky Milner takes a slightly different approach to the previous papers and discusses a particular type of site, namely Danish shell middens, in relation to the consumption of shellfish. The large numbers of shells found on such sites are generally regarded as representing the debris that has accumulated from shellfish consumption in the past, but rarely are the human actions of gathering, processing and eating shellfish explored. There are many environmental and economic parameters which, to some extent, may govern which shellfish are eaten and when, but there are also many other reasons including gender relations, technology and cultural perceptions. Using ethnography it is shown that there are different methods which may have been employed for opening and cooking the shellfish and there is even the possibility that feasts or communal meals took place at these sites. Milner suggests some methods for identifying these different kinds of activities in the archaeological record and proposes that an awareness of these sorts of consumption practices is needed when attempting to understand changes that occur in shell midden composition through time.

An interesting aspect of consumption is the flip side of eating, that is food avoidance, prohibition and taboo. These aspects are often related to religion and ideology, the Jewish dietary tradition and laws being an obvious example with the clean and unclean food listed in the books of Leviticus and Deuteronomy. The Dharma-Sutra texts in Hinduism also present dietary prejudices and taboos and certain foodstuffs such as horse meat has been banned in the Christian church in the past. This is a subject that is rarely explored in archaeology, although Grant does discuss it in this volume. The paper by Gustavo Politis and Nicholas Saunders explores avoidance by examining the ideologies behind animal food taboos in patterns of faunal exploitation among the Amazonian Nukak hunter-gatherer/horticulturalists. They use this ethnographic study to document the archaeologically identifiable consequences of ideological behaviour.

In sum, a variety of theoretical approaches intersect in 'consumption'. Archaeology's recent flirtation with consumption parallels the renewed interest in consumption in Anthropology and other social sciences (Miller 1995). The subtlety and complexity of food symbolism and its manipulation in and contribution to social strategies makes these challenging topics for analysis in the present day, let alone in the past. We are not content, however, with just highlighting the social embeddedness of food in the past. We need to develop rigorous methods for addressing and evaluating socially-informed interpretations of food use and symbolism. Fortunately in the case of food waste, we have hard-won taphonomic information for looking at the consumption side of production and procurement. Thus, despite inherent difficulties, only through archaeological studies of food can we understand long-term patterns of stability and change in food choices.

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Chapter 2

Cooking in Zooarchaeology: Is This Issue Still Raw?

Sandra Montón Subías

Feeding practices, including food processing and cooking, are some of the most fundamental activities in creating and maintaining social life. Despite their crucial character, traditionally they have not been considered in archaeological studies. In this paper I will emphasize why it is necessary for archaeology in general, and for zooarchaeology in particular, to call attention to this sphere of practices.

Traditionally, Western thought has considered societies to be divided into two main spheres of production: the domestic sphere and the public sphere. Different analyses have already denounced the artificiality of this division and how the sphere of the domestic — associated with women and considered non-fundamental in the configuration of social processes — has been banished from most social studies (Oakley 1974; Yanagisako 1979; Rosaldo 1980; Cowan 1989; Wylie 1992; Hendon 1996). Indeed, the traditional study of social processes has emphasized change and therefore left unconsidered the activities belonging to the domestic sphere, since they have been thought to be natural, routine and unchangeable. If one desires to take an alternative approach, there are even epistemic difficulties in the naming of this sphere of practices. In fact, this lack of vocabulary in language is symptomatic of a more general problem: the lack of fit between women's experiences and the frameworks of thought available for understanding experience in general (De Vault 1991). We have chosen the term 'maintenance activities' (Picazo 1997) to refer to these set of practices, since it directly appeals to the importance of women's work in continually generating the social matrix of life.[1]

Feeding and cooking as a foreground to social dynamics

What needs to be stressed is how fundamental and central maintenance activities are putting in place most basic social relations, how the decisions taken in this sphere of practice can affect many other realms of activities, and how other practices can only be developed when sustained by maintenance activities. Feeding, and food processing and cooking as integral parts of it, is a good example. An event that occurred while on a trip through Senegal illustrates some of these aspects. When visiting some villages in the Southwest of Senegal, I was told that the divorce rate was increasing in some communities. For their daily subsistence, these communities rely on a well-known dish called cous-cous, which is prepared by women. A change in the economic conditions of the country had led many families to a lower acquisitive level. As a result, many husbands were not able to buy wheat to prepare this dish any longer. Instead, they would replace it with the traditional and also cheaper mill. The disadvantages of this new staple are huge, however, since it requires a tremendous investment of labour to process it. As a result, women were no longer able to allocate their time to many of their previous activities. Once this became clear to the women, many of them left their marital dwellings and returned to their family homes, producing a temporal readjustment in the communities' sets of social relations.

Despite their clear significance as a structuring principle of social life, food processing and cooking have been considered inconsequential in most academic discourses. Stemming from the Greek tradition, an important branch in philosophy has praised fasting. As Lupton (1996, 2) points out 'not only were everyday practices such as eating and food preparation regarded as being beneath philosophical study, they threatened pure thought by encouraging philosopher's bodily needs to disrupt and disturb their cogitations'. Fasting has been associated with the masculine and the rational, while cooking and its dimensions with the feminine and the emotional. Probably because of this, cooking and food have remained as important issues in domains such as painting, literature, cinema, even psychoanalysis, where emotions and sensations have not been 'obliterated' (see, for example, Esquivel 1998; Mahoney & Yngvesson 1992).

Food and raw resources, however, have also been central issues in some academic disciplines. Nutrition is probably the clearest example, although with a unique stress on the biological dimensions of food and some cooking practices (Blaxter & Waterlow 1985; Linder 1985; Stinson 1992). The social discourses around food have been mainly developed in Sociology and Anthropology, but even here food processing and specifically cooking practices have drawn less attention than other aspects in the world of food. Anthropological reports describe, many times in detail, cooking events performed in ritual festivals. There are fewer accounts, however, detailing everyday-life cooking practices (see also Lévi-Strauss 1965 on this point), and even fewer have considered the implications which food processing may have as a foreground to social dynamics (a clear exception is the attention given to cooking as a way to understanding social life and historical processes in the analysis undertaken by Weismantel 1994). Cooking has usually been seen as a dependent variable of other aspects: the ecological context (Harris 1985), what has been called 'food' production and food consumption. As Goody (1994, 43) states, cooking is 'the end point of that major activity of humankind (reproduction apart), that is, the production of food'. But cooking is many times more than a final process in a chain; as shown below, it can also be at the forefront of this chain, serving as an impetus to drive the very system of production.

Most approaches have analyzed food and cooking from the perspective of consumption. They have emphasized the importance of food as a way to express and construct social behaviour patterns, norms or religious prohibitions, cultural and symbolical meanings (Crawley 1902; Frazer 1907; Fortes & Fortes 1936; Firth 1966; Young 1971; Douglas 1971; 1975; Arnott 1975; Khare 1976; Sahlins 1976; Barthes 1979; Turner 1982; Bourdieu 1984; Mintz 1985; Visser 1986; Weismantel 1994). In recent years, and connected to the contemporary concern with the body and health, the sociology of food and eating have received renewed attention and the interaction between food, embodiment and subjectivity has been investigated (Fischler 1988; Curtin 1992; Falk 1994; Lupton 1996). The cultural and subjective values of food, which pass into the subject through its possession and consumption, have again been emphasized. Consumption is, once more, the aspect more emphatically considered, but the importance of cooking processes as a way to embodiment has also been acknowledged (see, for instance, Falk 1994).

From a structuralist perspective, cooking has also been seen as a fundamental social component. For Lévi-Strauss (1958; 1965) cooking systems express cosmologic and sociologic oppositions of human societies and are central to understanding them. The structures of a society can be found here, as it is possible to find them in the kinship system, in mythology, and in political ideology among others. However, because of his own theoretical framework, the relationships among the different systems expressing structures in society are not investigated. In fact, it was not until the emergence of Feminism in certain disciplines of the social sciences that the various activities associated with the 'domestic' began to receive the attention that they deserved. In the wake of feminism, different scholars in History, Economy, Sociology and Anthropology considered housework important, and food processing and cooking practices began to be analyzed (Oakley 1974; Cowan 1989; De Vault 1991).

Cooking as a maintenance activity in archaeology

Archaeology has remained quite ignorant of the contributions made by the aforementioned research, even when elements employed or resulting from food-processing are the most common ones (hearths, cooking pottery, grinding stones, animal bones). Only Gender Archaeology, in dealing with the spheres of women's experiences (Conkey & Gero 1991) and introducing the feminist interest on housework —mainly in household studies (Hendon 1996) — has begun to see cooking as a fundamental realm to be analyzed. Brumfiel (1991), for example, brought to light how cooking activities were central in the transition from pre-Aztec to Aztec society in Central Mexico. During this transition there was a fundamental change in cooking — from wet to dry food — that made feasible important changes in labour patterns demanded by Aztec domination. This is thus a good example of how social changes are supported by maintenance activities.

Feeding is a complex social phenomenon and implies different levels of action and relationships among food preparers/givers, and between food-preparers/givers and food-consumers/receivers. From a technical point of view, food-preparers are engaged in three main types of actions (see also Colomer & Montón 1997):

a) The first of these refers to food processing and involves all those activities related to the transformation of vegetal and animal resources into food, into edible products that will be used in the short- or long-term. These activities include cooking processes (boiling, frying, roasting, steaming, smoking, etc.) as well as other tasks that transform raw products without using heat (flour procurement, fermented and salted products, etc.). Literally, the term food has been defined as any substance that can be taken into the body of an animal or plant to maintain its life and growth. In the case of humans, this aim is mainly accomplished through the mediation of maintenance activities, through food processing. The term food has, therefore, a social meaning since these substances are only converted into food when they are filtered by the work of maintenance activities in a cultural process.

b) Essential requirements to the conversion of raw resources into food are the procurement of water and fuel, which therefore constitute an important aspect in the process of feeding. Though their properties are not always incorporated to food, they are usually essential to metamorphose raw products into food. The quantity and quality of water and fuel required influence the daily organization of maintenance activities.

c) Finally, it is also important to maintain the artefacts (pots, knives, grinding stones, ovens, etc.) and spaces (hearths, storage facilities, waste areas, etc.) needed for these activities. Although the time allocated to maintaining artefacts and spaces is variable and culturally patterned, cleaning activities are always crucial to a community's salubrity and have consequences in the spatial planning of settlements and houses.

Food processing and cooking, as feeding activities, constitute a form of labour that embraces specific kinds of relationships both because of the particular nature of the labour required and probably because of the agents performing these activities. Food processing and cooking have traditionally been a part of women's knowledge, which has been handed down by women to women. As with other occupations, they also have a period of apprenticeship. Learning relationships are fundamental in becoming a cook and to the successful development and continuity of the technological process. It is necessary to know some of the properties of the raw resources, how tools and facilities in use are to be employed, the different steps involved in each one of the cooking systems, the cooking time, the temperature conditions, fuel suitability, maintenance of the energy source, etc. Through cooking the nature of raw resources change improving their characteristics to human consumption: palatability and digestibility is improved, toxic and bacterial elements disappear and preservation is accomplished (Leopold & Ardrey 1972; Stahl 1984; Linder 1985; Wandsnider 1997). Cooking may change the nutrients of raw resources by increasing their nutritious value, or decreasing or losing it. It is therefore crucial to acquire a good knowledge of these processes. On the other hand, through cooking processes the desirability (social or personal) of food is also accomplished.

Despite its importance, food-processing technology has seldom been acknowledged as a social technological system to be analyzed (exceptions are, for example, Firth 1966; Bruneton 1975; Goody 1994; Colomer 1996). Academic attention has focused on the technology of the activities that procure raw resources such as hunting practises, agricultural methods, etc. (see Oswalt 1976 as an example of this). In a similar manner, technological changes experienced in food processing, while directly affecting the working time of an important part of the population, have been ignored (Cowan 1989). I myself had the opportunity to discover, in a recent conversation with a friend from Calcutta, how important the introduction of the stove was for Indian women living in rural areas. The overlooking of this issue is probably related to the fact that cooking is associated in most societies with women's work and therefore included in the economic sphere of the 'domestic'. Indeed, cooking (as a maintenance activity and a part-time job) is probably one of the activities most consistently performed by women. In practically all known societies (present and past), there is a strong identification between women and cooking. Although men assist in some cases and participate in the preparation of ritual meals, the responsibility of the process relies on women as is shown by countless examples (Brumfiel 1991; Moore 1986; Friedl 1975; Fruzzetti 1985; De Vault 1991; Warde & Hetherington 1994; Goody 1994; Lupton 1996, to name a few). I do not think it is a coincidence that precisely these ritual meals have drawn more attention in academic studies, as it is not a coincidence that the aspects emphasized by ethnoarchaeology and zooarchaeology in the analysis of food processing have been those related to butchery practices conducted or supposedly conducted by men (see below).

Cooking and zooarchaeology

Animal bones are among the most common remains in archaeological excavations. Most of them are the result of social practices carried out by humans and, basically, most are cooking remains discarded after consumption. But zooarchaeology has been affected by the same biases as other disciplines in the Social Sciences in relation to 'domestic' activities. Broadly speaking, academic discussion in zooarchaeology has been focused on three main sections: a) aspects related specifically with the identification and quantification of the animals present in the archaeological sample; b) with the procurement and management of these animals; and c) with the formation of the bone archaeological record. Cooking, as shown below, may affect the three of them, but its presence and consequences have rarely been estimated. During the last few years, however, and though the contributions are still scarce, some studies have drawn attention to the cooking domain as an important topic to be considered (Gifford-González 1989; 1993; Oliver 1993; Pearce & Luff 1994; Montón 1996). Indeed, there are some issues in zooarchaeology which are given a new twist when analyzed under a cooking perspective.

One of the most debated subjects in prehistory is when fire was first controlled by humans and when it was first applied to the transformation of raw resources (Gowlett *et al*. 1981; Isaac 1984; Clark & Harris 1985; James 1989). So, one of the most intriguing questions facing prehistorians is 'when did cooking first appear?'. The emergence of cooking must have had important consequences to humankind. Although controversial, the possibility that cooking influenced anatomical changes in hominid evolution during the Middle Pleistocene needs further research (James 1989; Wandsnider 1997). What does stand without a doubt is that the application of heat produced an enrichment of the diet by providing many more products that were not previously edible (Leopold & Ardrey 1972). In the case of animals, cooking (roasting first and boiling later on) allowed humans to take advantage of some animal parts that, otherwise, would have had less or no nutritional value. In addition to the dietetic improvements, the appearance of cooking practises would have probably opened a new field to express and construct new networks of social relations and values (as it is demonstrated by the manifold meanings and relations associated with food and cooking in present and past societies (Frazer 1907; Pullar 1970; Barthes 1979; Revel 1979; Bahlouol 1983; Visser 1986; Curtin 1992; Goody 1994; Weismantel 1994). The emergence of cooking, therefore, should be an important subject for archaeology and history. To zooarchaeologists, this question deserves special attention since the management of animal carcasses must have been deeply affected by the introduction of cooking. Present ethnographic observations have demonstrated how cooking is a key point in understanding patterns of transport and processing of hunted animals (Binford 1978; Gifford-González 1989; 1993; Oliver 1993):

> How an animal is disjointed and filleted depends on whether a butcher aims to produce joints of meat to roast on a fire, segments of bones and flesh to boil in a pot, boneless cuts to be sliced and dried as jerky, or manageable and quickly frozen segments for winter storage (Gifford-González 1993, 185).

and they have also led to suggestions on the evolution of animal carcasses management:

> the importance of cooking in structuring initial butchery and transport decisions suggests that prehistoric innovations in nutrient extraction technologies (e.g., fire, roasting, pits, stone boiling, and ceramic boiling vessels) may have driven the evolution of carcass transport and processing strategies. (Oliver 1993, 222)

So, it seems irrefutable that cooking produced important changes in human daily-life, but it is still unclear when cooking first emerged. A better understanding of how heat in cooking processes affects bones could help in the clarification of this problem. More experimentation on these aspects could contribute to the interpretation of the contexts where the presence of controlled fires is ambiguous. I wholeheartedly agree with the necessity of ethnoarchaeological observation (Gifford-González 1993; Oliver 1993) but archaeological experimentation also has to be encouraged in order to know how different systems of cooking affect bones.

Cooking indexes on bones

There are not many experiments conducted in archaeology that attempt to understand how cooking alters bones. As previously stated (Martínez 1995), the study of bone modifications by humans has a long tradition in zooarchaeology (Martin 1907–10). Recently, the interest in this taphonomic area has been renewed (e.g. Bonnichsen & Sorg 1989; Stiner 1991; Hudson 1993; Lyman 1994). By far the largest segment of research has focused on the processes of skinning, carcass disarticulation, defleshing, periostium and tendon removal and marrow extraction. These processes have seldom been connected with cooking practices and the alterations that bones suffer in the different cooking processes have not received, by any means, the same interest. Although there is an acknowledgement that different cooking methods affect bones in different ways (Colley 1990), taphonomic analyses have seldom considered cooking as an important taphonomic agent.

Different experiments have analyzed the effects that heat has on bones. With few exceptions (Pearce & Luff 1994), however, many of these experiments have been conducted with goals other than the evaluation of cooking activities (Herrmann 1977; Shipman *et al.* 1984; Von Endt & Ortner 1984; Buikstra & Swegle 1989), since the way heat affects bones is also of interest to other disciplines such as physical anthropology.

In the wake of these studies we know that heating usually changes the colour, surface texture, microscopic morphology, and crystalline structure of bones; that weight and size of bones may decrease and that breakage and deformation may be affected. Not all these changes, however, are important to cooking, since some of them only occur at temperatures higher than the ones bones reach at normal cooking temperatures. Bones begin to shrink at 750ºC; the main changes in crystalline structure are produced between 525 and 645ºC; changes in microscopic morphology, one of the most reliable indicators to reveal which temperatures the bones have been subjected to, begins at 185ºC (Shipman *et al.* 1984).

In other cases, changes experienced by bones in cooking are only context-specific and so, it is impossible to extract indexes that can always be applied. The experiment conducted by Pearce & Luff (1994) was aimed at seeing differences in fresh, boiled and roasted bones. They could see that, according to the methods used and, in the case of roasted bones, as a function of cooking temperatures and time length, the colour and texture of bones were different. It seems clear, as pointed out by Pearce & Luff (1994) and Shipman *et al.* (1984), that colour is not a good indicator for showing at what temperature the bones were affected. The changes in surface colour, however, specifically when combined with texture surface, should be examined more in relation to the cooking system used.

Although the effects of cooking methods in relation to bone fragmentation, breakage and deformation also need further investigation, current research shows some differences between fresh, boiled and roasted bones. Pearce & Luff (1994) saw that boiled bones tend to split longitudinally, the length of boiling time being an influential factor. On the other hand, roasted bones fragmented more and their friability increased with temperature. Some ethnographic observations seem to point in the same direction. While he was among the Hadza, Oliver (1993) noticed different patterns of bone breakage between fresh bones and roasted bones. Gifford-González (1993), considering other experiments (Bonar & Glimcher 1970; Richter 1986; Sedlin 1965), noticed that the loss of collagen in cooked bones can possibly produce different breakage patterns. But what seems clear is that, as previously mentioned, different cooking and processing methods (boiling, roasting, brining, smoking, etc.) influence the way animals are butchered. In a study of the Roman sites in Lincoln, Dobney *et al*. (1996) interpreted cattle scapulae with trimmed glenoid cavities and chopped spinae as trimmed and cold-smoked joints.

The experiments conducted up to now are promising. They themselves, though, demonstrate the necessity to conduct further research. Besides, it is necessary to bear in mind that it would be important to detect not only if the bones have been cooked or not but which method has been employed. At the present state of research it is almost impossible to interpret faunal samples from this perspective. Only few bones in archaeological samples show at first sight evidence of having been cooked (e.g. Coy 1975). Moreover, in many cases, post-depositional processes have affected bones in such a way that it is impossible to see human alterations on bone surfaces. It would be important, therefore, to discern how cooking processes change bone structure. New experimentation should also overcome some of the current problems. Experiments should be carried out with larger samples and with fleshed and defleshed bones from different species. We have to bear in mind that most of the cooking processes are done with fleshed bones, which can modify the effects of heat on the bones (Van Wijngaarden-Bakker 1985). It would also be important to determine whether other post-depositional factors may affect the bone in a similar way (Spennemann & Colley 1989; Lyman 1994).

Thus, experiments with the aim of identifying cooking processes are still needed as well as ethnoarchaeological observations which are sensitive to these issues. As Oliver points out, 'we do not know how different elements are cooked, which bones are broken prior to cooking, whether roasting or boiling of bone creates visible damages, how cooking- and consumption-related bone breakage varies by element, taxon, and cooking technique' (1993, 201).

Cooking as a taphonomic agent

As already mentioned, cooking has seldom been considered as an important taphonomic agent. The scarce information available at present, however, leads to the conclusion that ignorance of this aspect can seriously distort the evaluation of our faunal archaeological samples.

One of the primary concerns in zooarchaeology has been the quantification of faunal remains and different indexes have been aiming to achieve this goal. Among them, the weight of bone per taxon is still used by many zooarchaeologists in order to give meat weights and make comparisons among the species in the record (see Casteel 1978 and Vigne 1991 for a discussion on weight methods). Bearing in mind other existing criticisms, the effects that cooking has on bones may render this method problematic because bones lose weight while being cooked. Although more experimentation is needed, the results after Pearce & Luff (1994) indicate differences in the percentage of weight lost with roasting and boiling methods. Whilst boiled bones always lost the same proportion of weight, roasted bones lost more weight in relation to cooking temperature. Cooking methods also have to be considered when using other indexes such as the number of identified specimens. Since cooking methods affect both post-cooking fragmentation and pre-cooking butchery, archaeological representation may be biased against some animals.

Differential preservation is another important aspect in the evaluation of faunal samples. Cooking needs to be added to the other factors that influence bone preservation. According to the cooking method employed, bone characteristics are different, making it more favourable to preservation and more or less attractive to the action of other taphonomic agents such as dogs. It has been noted that roasted, smoked and burnt bones are better preserved than boiled bones (Pearce & Luff 1994; Van Wijngaarden-Bakker 1985). Buikstra & Swegle (1989), however, mention that this is not always the case and that the preservation of burnt bones depends on the characteristics of the sites.

In discussing taphonomic questions, we also cannot forget the problem of intrusive animals in the archaeological record. At some sites for example, it may be impossible to distinguish whether animals such as rabbits were consumed or not. Cutmarks may inform us on this aspect, but many times they are absent. Facing the impossibility of discerning whether these animals are contemporaneous with the rest of the record, they are often excluded from economic evaluations. More inspection of the marks left by cooking on bones could be useful to resolve such problems.

Discussion

In this paper I have stressed two important aspects in the evaluation of food-processing practices. On the one hand, food processing — as an integral part of maintenance activities — is fundamental in generating and sustaining social life. On the other hand, and as a social practice, the evaluation of food processing affects key discussion areas in zooarchaeology such as the quantification of bone remains, the management of animal resources and the very formation of the archaeological record.

We have briefly seen how important the development of cooking practices must have been to humankind and how cooking has sustained changes throughout historical periods. But the study of food processing and cooking is also important for the interpretation of daily life, since its practice permeates the whole social net and it is crucial to the entire community life. It is not only technological processes that make raw resources edible. Through the work of social agents, cooking transforms raw resources into food in a cultural process, that also confers cultural values to food and the people who consume it. Cooking, therefore, is not only a technological process to make raw resources edible but 'a moral process, transferring raw matter from "nature" to the state of "culture", and thereby taming and domesticating it' (Lupton 1996, 2). In this process, networks of personal relationships are created and social features expressed and constructed. The politics of cooking have already been noted, with special stress in the definition and creation of identity and difference (individual and collective). In this sense, cooking has generated and expressed ethnic and nationalistic feelings, gender, class, and so on. (Barthes 1979; Bahlouol 1983; Bourdieu 1984; 1985; Mintz 1985; Klopfer 1993; Weismantel 1994; Zubaida & Tapper 1994; Jansen 1997).

In spite of their evident pre-eminence, food-processing, and most clearly cooking, have assumed a low level of importance in archaeological discourse. Up to now, stress has been put on how resources are procured and how they are eaten. How they are prepared to be eaten is also of paramount importance. Cooking has spatial and material requirements that are involved in the organization of the settlements (from the selection of the very place to settle to the allocation of food-processing areas or the disposal of waste material). Cooking is also a key point in directing other practises among communities and in understanding changes that are produced in other spheres. The way food is prepared is culturally patterned and can have a cultural meaning when patterns are detected in the archaeological record. Thus, cooking and changes in the way food is cooked is socially and culturally informative.

Finally, I would like to stress the necessity of choosing new subject areas. Subject-areas that exhibit a focus on the interests and activities of women. It is not only that those activities, like food processing and cooking, traditionally considered part and parcel of women's domain have to be included; what is important is to demonstrate how central these activities are in any explanation of the past. In doing this, we shall begin to deal with new kind of relationships, such as the ones defining food processing and cooking and maintenance activities in general. It is well-known that only research generates more research, so it is important in this case to note these domains as relevant and link them with practises in other social spheres.

Note

1. The research on maintenance activities is being carried out in the context of a project in progress entitled *Creation and Maintenance Activities of Social Life and Gender* (IM 75/97). This project is being undertaken by a group of Spanish women scholars from different disciplines within the Social Sciences. The group of archaeologists is composed by Esther Hachuel, Laia Colomer, Marina Picazo, Paloma G. Marcén and Sandra Montón.

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Chapter 3

Food, Status and Social Hierarchy

Annie Grant

It's not just steak . . . It's status . . . It's not just pork, it's power.
Alan Bennett, *A Private Function*

Much of the research that begins with the identification and analysis of animal bone remains from archaeological sites has concerned itself with the reconstruction of husbandry practises and patterns of consumption at subsistence level. This is perhaps unsurprising as the development of archaeozoology as an important discipline of archaeology was very closely linked with the 'economic archaeology' of Grahame Clark and Eric Higgs (for example Clark 1952; Higgs 1972). We still talk of 'subsistence economies' when we wish to characterize pre-industrial and especially prehistoric societies, and yet we are now aware that for such societies there is plentiful evidence for the storage of surplus production and the trade and exchange of foodstuffs, as well as an extensive involvement of animals and animal products in ritual practices. For such societies, as for our own, food is much more than a simple means of providing the energy and nutrients necessary for metabolic functioning. This paper takes as its topic one aspect of food consumption 'beyond subsistence', the role of food consumption in defining status within social, and inevitably also economic, hierarchies; the majority of examples chosen as illustration come from southern Britain.

Eating is both a social experience and an activity that is socially divisive and socially indicative. Amongst the many socially determined aspects of consumption — what is eaten, how it is prepared, where, when and in what circumstances it is consumed, how it is served, and who shares in the meals — few may be expected to be visible in the archaeological record. However, as this paper attempts to demonstrate, in certain circumstances, signs of the social and economic hierarchies of past societies can be found within the animal bone remains that survive as evidence of meals eaten in the past.

An archaeozoological approach does, of course, restrict any discussion to the consumption of meat and fish. This, however, is less of a limitation than might be expected; in many societies, meat-eating tends to have a greater social significance than the consumption of vegetable foods. Dyer (1983) uses historical evidence to demonstrate the importance attached to meat-eating in the medieval period in England. His analysis of household rolls and expense accounts from the later Middle Ages shows that between a third and a half of the expenditure on food of the upper classes went on meat and fish, while documentary evidence for the diet of the lower social orders shows it to have been largely based on cereals and vegetables. For a much more recent period, Bennett's (1984) '*A Private Function*' from which the quote introducing this paper is taken, satirizes the social significance of meat-eating during the period of severe food shortages in Britain that followed the last war.

Without appropriate written evidence, detecting differences in the relative proportions of meat and vegetables consumed in the past and relating these to different social levels becomes very much more difficult, but, as this paper attempts to show, not impossible. The line of research that undoubtedly has the potential to provide the most precise indication is trace element analysis of human bone remains. Contrasting levels of trace elements in human remains suggest differences in the contribution of meat and/or dairy products, fish and vegetables in the diet (for example, Barabar & de la Rua 1997). For very many periods of the past, however, human remains are rare, and even when sufficiently large numbers of skeletons are found in cemeteries, the burial traditions do not necessary preserve the social status of the dead.

In contrast to human bones, animal bones are extremely common finds. While these latter can say nothing directly about the consumption of vegetable foodstuffs, it is argued here that they can yield clues that are suggestive of broad differences in the amount of meat available to different contemporary groups. The evidence comes from the remains of the most common domestic animals; cattle, sheep and pigs. Published analyses of animal bone assemblages show a considerable variety in the relative proportions of the bones of these species. There are changes and trends that can be observed to have taken place over time, but there are also differences that can be observed between contemporary settlements within the same area. Some of the differences in species proportions appear to reflect environmental factors. For example, in southern Britain during the Iron Age, the ratio of sheep to cattle bones is fairly consistently higher at sites on high ground than at those in the valley bottoms, and may be explained in terms of the contrasting environmental preferences of these two species (Grant 1984a). However, environmental factors can by no means explain all the variations observed, and economic and social factors may have at least as strong an influence.

Surveys of faunal remains from British sites from a wide time period suggest a correlation between relatively high proportions of pig remains and high-status occupation. This is most easily demonstrated for the medieval period; the refuse found associated with the buildings of the wealthy and influential — castles, palaces and religious houses — have, on average, significantly higher percentages of pig bones than rural or urban settlements (Grant 1988a, fig. 8.2; Albarella & Davis 1996).

There is also an increasing body of evidence to suggest that in the prehistoric and Roman periods, comparatively high proportions of pig bones are associated with archaeological indicators of high status or wealth such as imported luxury items or large and complex buildings. The correlation transcends environmental and temporal groupings; for the Iron Age, examples can be found from chalk downland as well as from lowland settlements, and from sites of different periods. Some of the highest proportions of pig bones for the late Iron Age period are found at settlements whose material remains suggest participation in extensive trading networks. For example, the wealth and importance of the oppida at Silchester (Hampshire) and at Skeleton Green (Essex) are clearly demonstrated by the range of imported material goods found; both sites have rather higher proportions of pig bones than are found at most other contemporary settlements within their regions (Grant 2000; Ashdown & Evans 1981) (see Table 3.1). The oppidum at Skeleton Green has a particularly high proportion of pig bones; they even outnumber cattle bones.

For the Roman period too there are many examples of wealthy or important sites with higher proportions of pig bones than at contemporary settlements of a more modest nature. These include the major villa constructed at Fishbourne in Sussex, whose bone assemblage is dominated by pig in both the pre-villa and main villa phases (Grant 1971). The Basilica areas of towns such as Exeter and Silchester (Maltby 1979; Grant 2000) also have high proportions of pig, contrasting with a number of other contemporary sites including an area outside the walls of the Roman town of Chichester (see Table 3.2). At Silchester, the high proportion of pig bones in the Basilica area of the town contrasts with the lower proportions found in the rubbish deposits of the town defences (Maltby 1984).

The role of the pig as an indicator of high status may come as some surprise, as it is often viewed as a rather humble peasant animal. The explanation may lie in the very different roles played by the three main domestic animals. During many periods of history and prehistory — and for many of the world's poor today — the bulk of the diet was almost certainly provided by vegetable foodstuffs. Food such as cereals and rice is, in most environmental conditions, much cheaper to produce than meat. Many animals are kept because their value lies not only in the meat that they provide once they are dead, but also in the many other useful 'secondary products' they provide while they are alive. Particularly important to early societies is the traction provided by cattle; manure, milk, and wool are also vital products. Cattle and sheep provide meat and a wide range of important secondary products but the only significant by-product of the live pig is manure. Viewed in this way, a pig becomes a 'luxury' animal endowing status on those who can afford to feed and eat it. As Gilbert in *A Private Function* remarks, 'It's not just pork, it's power' (Bennett 1984).

High proportions of pig bones are rather rarely found together with evidence to suggest that the primary focus of cattle and sheep management was also meat. Mortality profiles for both these latter species and cattle in particular, frequently imply that very many of the animals raised were only consumed after they had played their part in the production of a wide range of secondary products. For example, the majority of the cattle from the Silchester oppidum were killed at a fairly mature age and may have provided milk, traction and/or replacement animals for

Table 3.1. *Relative proportions of cattle, sheep and pig bones from selected sites with Late Iron Age occupation (numbers given for sheep and pigs are ratios to 100 cattle bones; calculations are based on fragment counts). (C = century; Number = number of identified fragments on which the ratio calculations are based.)*[1]

Site	Danebury	Ashville	Barton Ct	Odell	Silchester	Silchester	Silchester	Skeleton Green	Abingdon
Location	Hampshire	Oxfordshire	Oxfordshire	Bedfordshire	Hampshire	Hampshire	Hampshire	Hertfordshire	Oxfordshire
Type	Hillfort	Farm	Farm	Farm	Oppidum	Oppidum	Oppidum	Oppidum	Settlement
Approx. date	C1 BC/1 AD	C1 BC/AD	C1 AD	C1 AD	C1 BC/AD	C1 AD	C1 AD	C1 AD	C1 AD
Cattle	100	100	100	100	100	100	100	100	100
Sheep	174	115	93	95	43	59	81	56	191
Pigs	21	29	22	25	43	68	89	153	12
Number	1221	710	951	2590	428	2768	3201	2437	530

Table 3.2. *Relative proportions of cattle, sheep and pig bones from selected sites with first-/second-century Roman occupation (numbers given for sheep and pigs are ratios to every 100 cattle bones; calculations are based on fragment counts). (C = century; Number = number of identified fragments on which the ratio calculations are based.)*[1]

Site	Silchester	Silchester	Exeter	Exeter	Chichester	Abingdon	Odell	Winnall Down
Location	Hampshire	Hampshire	Devon	Devon	Sussex	Oxfordshire	Bedfordshire	Hampshire
Type	Timber basilica	Stone basilica	Residential/ pre-basilica	Town basilica	Town	Settlement	Farm	Farm
Date	AD 80–125/50	AD 125–150	AD 75–100	C2 AD	C1/2 AD	late C1/2 AD	C1/2 AD	C1/2 AD
Cattle	100	100	100	100	100	100	100	100
Sheep	66	90	118	134	42	252	70	100
Pigs	59	73	93	117	17	36	17	16
Number	1330	1091	786	443	2797	1871	1239	1791

several years before they were finally slaughtered and consumed (Fig. 3.1).

Animal mortality patterns may help to identify and distinguish between producers and consumers and thus economic if not also social hierarchies. For example, the restricted age profile of the cattle remains from the Silchester oppidum contrasts with the much wider range of ages present at contemporary farming settlements such as Barton Court Farm and Odell (Wilson 1986; Grant 2000) (Fig. 3.1). The Silchester profile suggests that the inhabitants of the oppidum were consuming animals that had been raised elsewhere; the mortality profiles from the two

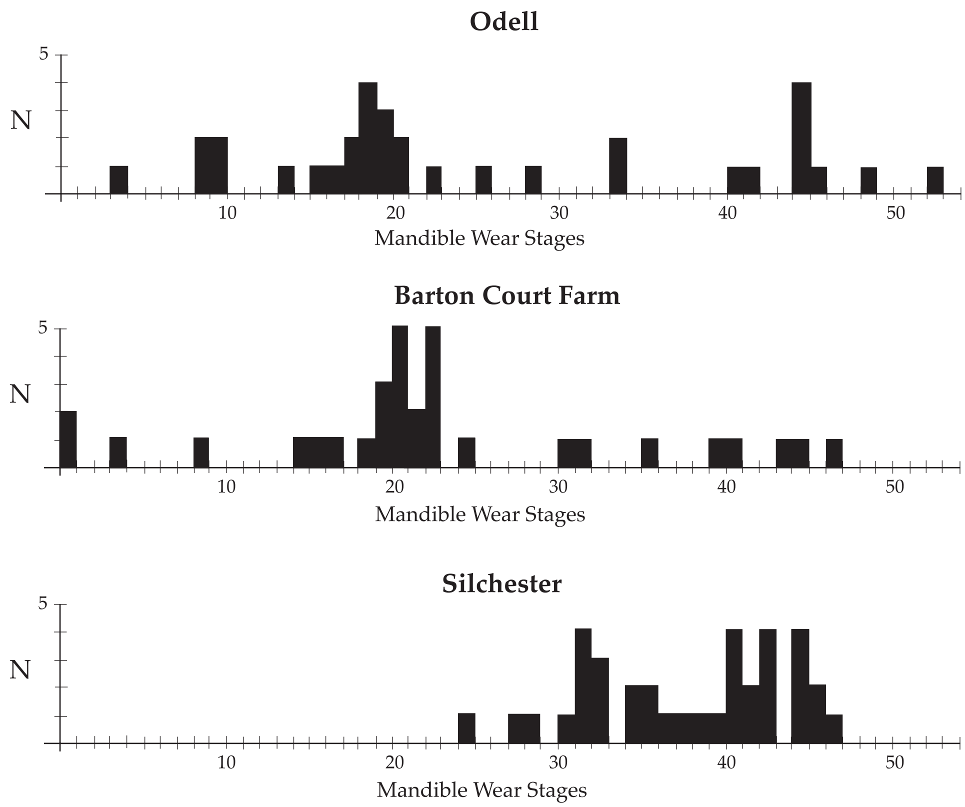

Figure 3.1. *Cattle mortality profiles from three Late Iron Age sites in central southern Britain. (Mandible Wear Stages - see Grant 1982.)*[1]

farm settlements, with animals of a wide range of ages including the very young, suggest involvement in the raising of cattle, perhaps not only for their own consumption but also for trade or exchange. The cattle mortality profiles from these latter sites include a relatively high proportion of juvenile animals, which could be interpreted as an indication of a husbandry with a focus on meat production. If these sites were indeed part of a complex trade and exchange network, however, we would expect a considerable proportion of the animals they raised to have been killed and consumed elsewhere.

At Silchester, the bone remains of the other domestic species further complicate the picture. The pig remains are also from a restricted age range, but the sheep bones are from animals of all ages, from neonatal to elderly, and, when compared with mortality profiles from a number of contemporary settlements, give little indication of any social and economic stratification. Unfortunately the archaeological evidence is rarely clear-cut, and ambiguities remain and alternative explanations are also plausible.

Another approach is to look for the remains of animals that, either because they are rare, or because they have been invested with particular significance or meaning, are eaten only by the rich and powerful. If we begin again by looking at the medieval period, we have clear documentary evidence to show that the consumption of some species was largely restricted to certain classes of society. For example, in the early medieval period, the deer of the very extensive areas defined as Royal Forests and parks were, respectively, the property of the king, and of those members of the aristocracy who had purchased licenses from the king to enclose areas of wood- and grassland; 'venison offences' were severely punished (Stagg 1979).

The documentary evidence for the high status of venison as a food is mirrored in the archaeozoological evidence for the medieval period: average percentages of deer bones are significantly higher in bone assemblages from castles and religious establishments than in those from towns and villages (Grant 1988b, fig. 2). Deer remains are occasionally found at rural settlements of the period. One example where there was a significant proportion of deer bones is the Northamptonshire rural settlement of Lyveden; here, an almost complete but butchered red deer skeleton was found in a disused well in the settlement (Grant 1975). This find suggests the consumption of venison by those who were not entitled to do so and who therefore needed to hide the evidence.

We cannot, however, assume that particular species will have the same symbolic roles at different times and in different places. In the late prehistoric and Roman period in England, the social value of deer seems to have been rather different. Deer remains are very much rarer in the archaeological record for these earlier periods and there is little evidence to suggest that venison was a high-status food. In fact, at a number of large Roman villa sites there are more deer remains in deposits relating to secondary or squatter occupation than in the deposits relating to the main occupation period (Grant 1981). During these earlier periods, deer do not seem to have been very important as a food resource for either rich or poor although they were exploited as a source of raw material: the majority of deer remains from very many sites of apparently very different status are of antler, much of it shed and not from slaughtered animals.

The two native species of deer, red (*Cervus elaphus*) and roe (*Capreolus capreolus*), were probably fairly common in Britain in the prehistoric and Roman periods, but by the medieval period, the expansion of arable cultivation may have significantly reduced the extent of their natural habitats and thus their numbers. From the late Saxon period onwards, significant resources were devoted to managing and controlling the deer population, to increasing their numbers, most significantly by the importation of a third deer species, the fallow deer (*Dama dama*) from the continent, and to ensuring that they were no longer available to the peasantry. Like the oyster, which is now a luxury item, but was once a cheap foodstuff for the relatively poor, the status value of venison seems to have been inversely related to its availability.

There is also archaeozoological evidence to suggest that the wealthy in the medieval period ate a greater variety of animal foodstuffs than the poor. Castles, palaces and religious sites have both higher percentages of bird bones, and a much wider range of species represented than contemporary urban and rural settlement sites (Grant 1988a,b). Again, this aspect of food consumption is a good indicator of social status for the medieval period in Britain, but has yet to be demonstrated for earlier periods. However, it may warrant further investigation; bird bones tend to be more common at the oppida of the late Iron Age than on rural sites of the period (Serjeantson 2000), and several high-status sites from the Roman period have a wide variety of bird species present.

Medieval documentary sources indicate the importance of some individual bird species. We know, for example, that the swan was a royal bird, but this is not clearly reflected in the archaeological record.

The remains of swans, although rather rare, have been found in both ordinary urban rubbish deposits and in those within castles and palaces. This is not necessarily an example of archaeology contradicting history; patterns of bone deposition reflect not only consumption but also refuse disposal. In towns in particular, rich and poor may have lived very separate lives, but they often lived fairly close together and some of their food waste may well have ended up in the same rubbish dumps. It does, however, alert us to some of the limitations of archaeological evidence; archaeological deposits may be created by a complex series of processes that results in an accumulation of artefacts and ecofacts that had very different origins.

A rather different, but also important aspect of food consumption that may also be socially indicative is food avoidance. Food prohibitions are common in many religions, and in some all meat is proscribed. Amongst the Hindus of India there is a clear relationship between food and caste, and in contrast to the aristocracy of medieval Britain, those in the highest castes are frequently vegetarian (Goody 1982). One example of food avoidance in Europe concerns the horse, which was proscribed as a food for Christians in 732 (Rau 1968) and still remains deeply unpopular, at least with the British. Butchered remains of horses are rare in archaeological contexts from the Roman period onwards, and those remains that have been found have, perhaps in the light of knowledge of the ban on the consumption of horse meat, sometimes been interpreted as the remains of horses that had been fed to dogs (Albarella & Davis 1996; Dobney *et al*. 1997). It is not, however, impossible that horses were eaten by those who were too poor and hungry to take much note of the Church's regulations, and the presence of horse bones in other food refuse may be suggestive of low social or economic status.

We might expect that analysis of the occurrence of different parts of the skeleton in food refuse would be even more informative of social differentiation than either species proportions or the presence or absence of the bones of unusual or rare species. After all, in much of Western Europe and North America today, there is a clear distinction between different parts of an animal carcass in terms of its market value. The cuts of meat from the rear of the animal, such as rump steak, tenderloin and leg, are much more expensive than the meat from the shoulder, the neck and the limb extremities. The different values attached to cuts of meat govern the modern craft of meat cutting taught to those entering the butcher's trade. These values, however, are very much culturally determined and modern notions of what constitutes 'high'-quality, and thus expensive, meat and 'low'-quality cheap meat may not be appropriate for other cultures, past or present (Grant 1987). It is also unwise to assume that the meat of young animals has a universal social cachet; a tough old sheep for some may be flavoursome mutton for others. For periods for which we have documentary evidence, we know that differences between the cooked food of the rich and the poor lie as much in the expensive imported spices which were used to flavour it, and the wine that was drunk with the meal as in the cut of meat or the age of the animal from which it was obtained (Dyer 1983; Hammond 1993).

Despite these caveats, analysis of body part representation can sometimes be very informative. Concentrations of cattle lower limb bones are not uncommon, particularly in the towns of the Roman period; they provide evidence for the separation of the parts of the carcass that carry little meat from the main meat-bearing bones (Maltby 1979; 1984). The areas of towns where these butchery waste deposits are found are perhaps unlikely to be those where the rich were living. Similarly, bone deposits that include a high proportion of cattle, sheep or goat horn cores may identify the areas where craftsmen lived (Armitage 1984). Such evidence may thus be useful in investigating social zoning, especially in urban contexts.

Rather clear signs of social status are often to be found in cemeteries where grave goods are a part of burial rituals. The rich and important may be marked out from the rest by the size of their graves and the quantity and quality of the jewellery and personal possessions buried with them. Sometimes, these grave goods also include food, usually interpreted as sustenance for the deceased on his or her journey to the afterlife. If patterns of consumption in life are reflected in patterns of consumption in death, such food offerings may provide clues as to the types of food that have high social or ritual value.

Burial traditions for the places and times from which I have taken earlier examples are not very informative, but a particularly interesting example comes from the necropolis of the third- to second-millennium BC town of Kerma in Northern Sudan (Bonnet 1990). Here, the high-status burials are marked out by the size of the tumulus and the rich and exotic grave goods buried with the dead. Food offerings of both grain and joints of meat were a common feature of the burial ritual. The joints of meat, which were almost always from sheep, had been butchered in a very consistent manner and were carefully placed to one side of the principal corpse. The animal remains found within the largest tombs also frequently included sacrificial animals, again mostly sheep, but occasionally goats or dogs; these animals were entire and unbutchered prior to burial. The food offerings found within the tombs never include beef, nor are any of the sacrificial animals cattle. From such evidence, we may be tempted to conclude that sheep meat was a high-status food and that beef was not. Cattle, however, do play a part of the burial ritual in other ways: the dead are often laid on a carefully prepared cattle hide and the tumuli of some of the most impressive graves were partly surrounded by a crescent of buchrania, the frontal bones and horn cores of many hundreds of cattle, as if a whole herd had been slaughtered (Bonnet 1990, fig. 74).

In contemporary deposits in the religious quarter of the town of Kerma, a few kilometres from the necropolis, both sheep bones and cattle bones are common in the urban refuse, although cattle horn cores are very rare finds. It is thus not implausible that the flesh of those cattle whose skulls marked out the important tombs in the necropolis may have been eaten in the town perhaps even at ritual or funerary feasts. Cattle may thus have been as important in defining status and position as the sheep meat offered as sustenance to the dead (Chaix 1990; Chaix & Grant 1992). The finds at this site seem to suggest that the symbolic importance of animals may have been context-specific. Both cattle and sheep meat seem to have been eaten in the town, but the cemetery evidence suggests that cattle, whose remains were placed on the edge of the tumuli, may have had a value as the visible symbols of power while sheep were chosen to accompany and feed the princely dead. The interrelationship here between animals, food, social status and ritual is difficult to unpick and fully understand, but animals and meat undoubtedly played an important role in defining the social and religious hierarchy.

Summary and conclusions

The many inadequacies of archaeozoological evidence are well rehearsed; taphonomic biases are almost inevitable and the methods of analysis that we have available to us have many weaknesses as well as strengths. However, the problems that are inherent in the study of animal bones should not discourage us from trying to push interpretations of archaeozoological data as far as they can reasonably go. This paper has briefly suggested some of the ways that an understanding of what was eaten might help us to recognize and define social hierarchies in the past. It has, of course, also pointed to some of the associated problems and pitfalls; the evidence is rarely completely unambiguous, and it is far too easy to assume that the values assigned to particular foodstuffs in the past were the same as they are today. Some of the approaches suggested need to be applied to larger bodies of data, from wider time scales and geographic areas. Such approaches require the focus of attention to move beyond the individual site, the unit of attention of so much archaeozoological study. In this way we can continue to develop the potential of archaeozoology to make a significant contribution to our understanding of human societies in the past.

Note

1. References for sites referred to in Tables 3.1 and 3.2 and Figure 3.1: Abingdon (Hawthorne & McKee in prep.); Ashville (Wilson 1978); Barton Court (Wilson 1986); Chichester (Levitan 1989); Danebury (Grant 1984b); Exeter (Maltby 1979); Odell (Grant 2000); Silchester (oppidum and basilica) (Grant 2000); Silchester (defences) (Maltby 1984); Skeleton Green (Ashdown & Evans 1981); Winnall Down (Maltby 1985).

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Chapter 4

The Distribution of Meat in a Hierarchical Society: the Irish Evidence

Finbar McCormick

When Sir William Petty wrote his economic appraisal of Ireland in 1672 it was at a time when the old Gaelic political and social structures, in which cattle were measured as the primary form of wealth, had all but disappeared. He noted in the context of the native Irish diet that 'as for flesh, they seldom eat it, notwithstanding the great plenty thereof, unless it be of the smaller animals, because it is inconvenient for one of the families to kill a beef, which they have no convenience to save. So 'tis easier for them to have a hen or a rabbet, than a piece of beef of equal substance' (Hull 1899, 191). It is clear that if one did not have a market economy, a social system for distributing meat, or a method of preserving meat, the carcass of a bovine was simply too large to serve as an immediate and efficient source of food.

This paper deals with the problem of distributing and consuming the carcass of a large beast in early societies. Even when we accept that early animals were generally smaller than most of their modern counterparts, the slaughter of a bovine, pig or sheep, still left a considerable amount of meat to be consumed. One can, for instance, accept Legge's (1981, 99) figures of 450 kg (992 lb) as the liveweight of a Bronze Age bovine. This is not an unrealistic figure as a mature Kerry cow, one of the smallest and most primitive modern breeds, is estimated to weigh about 454 kg (1000 lb) while a bull weighs 590 kg (1300 lb) (Anon. 1967). Gibson (1988, 165), in the context of early modern Scottish cattle estimates that lean meat and edible fat would account for about 39 per cent of the live weight of the animal, the remainder consisting of carcass bone (9 per cent), tallow fat (2 per cent) and head/hide/entrails (50 per cent). In the case of early cattle, therefore, a slaughtered animal would be expected to provide about 176 kg (388 lb) of edible meat. As a consequence of this, when a bovine was slaughtered in an early society, a large amount of perishable food became available for consumption. The same situation arose, but to a lesser degree, with the slaughter of other domesticates.

How, therefore, was the carcass distributed when an animal was killed so that the meat could be consumed before it began to putrefy? In examining this question in the context of a society in which the concept of the retail meat trade did not exist, as was the case in medieval Ireland, one must consider whether or not small amounts of meat were eaten on a regular basis, and more importantly, whether or not this was facilitated by the preservation of meat. If meat was preserved as a rule, with fresh meat only being eaten on rare occasions, this would overcome most of our problems. An animal would be killed, a small amount eaten in a fresh state, and the remainder of the carcass preserved and consumed as necessary.

Preserved meat

In early Irish literature there is ample evidence for the consumption of salted flesh but this is almost invariably bacon. There is little equivocal evidence for the salting of beef or mutton in a pre-Norman context (Kelly 1997, 336), and there is only a single reference to salted beef (*bósaill*) in the twelfth-century *Vision of MacConglinne* (Meyer 1892, 81), a source which contains a multitude of food references. The seventh-eighth century *Crith Gablach* refers to a 'sack of sea ash (salt) for the cutting up of joints of cattle' (de Paor & de Paor 1960, 78), implying that salt came either from salt pans or, perhaps, from the burning of seaweed. The latter method of producing salt for the preservation of meat is attested to in the Hebrides in the late seventeenth century (Martin 1703, 129, 135). As its production was restricted to coastal areas it is not unreasonable to assume that salt must have been a relatively expensive material. This assumption is supported by the fact that one eighth-century text mentions salt taxation (Kelly 1997, 342) while in the twelfth century it is recorded as being imported from England, again implying its expensive nature (Meyer 1892, 60).

The curing of meat necessitates the usage of a large quantity of salt. In twentieth-century Irish home curing, although admittedly using large improved pigs, 18 kg of salt was needed for wet curing a 100 kg pig carcass, and 25 kg needed for dry-curing (Anon. 1941). The cost of the salt necessary for the curing of a bovine carcass was probably prohibitive, and this would explain the virtual absence of salted beef from the early documentary sources.

In addition to the expense, there are other factors which limited the amount of meat that could be preserved by salting. In the absence of refrigeration, meat can only be salted successfully during cold weather. The recommended period for home curing in Ireland in fairly recent times was between the months of November and March (Anon. 1941). The consumption of salted meat seems also to have been of a seasonal nature. A gloss or commentary on a seventh-eighth century law on sick maintenance indicates that the main period for the consumption of salted meat was from 'New Year's Day to Shrovetide' (Binchy 1936, 37). Interestingly, early eighteenth-century Scottish evidence also shows that the consumption of salted meat was seasonal, but at a different time of the year. Some 82 per cent of the salted meat, in the form of bacon, ham and pickled pork, was consumed between June and September in the household of the the Laird of Ochtertyre (McCormick 1998). The same records show that pork was the only type of flesh that was salted in Scotland, again confirming the early Irish evidence. Furthermore, the kitchen records of the household demonstrate that such preserved meat represented only a small proportion of the flesh consumed during the year. On the basis of the above evidence one can safely reject the hypothesis that the salting of flesh offered a solution to our problem concerning the disposal of large quantities of meat when an animal is slaughtered. Finally, there is no reference to the smoking of meat in the early documentary sources.

Hospitality and communal consumption in medieval Ireland

If, as seems likely, the great majority of meat was eaten fresh, how did the early Irish deal with consuming the large amount of meat that became available when an animal was slaughtered? Formalized communal feasting goes a long way to solving this problem. In medieval Ireland much of this feasting fell within the legal obligation of the provision of 'hospitality', which meant that the lord, and his retinue, had a right to be entertained (i.e. fed) and billeted by his substantial vassals (Simms 1978, 68). This institution of legally enforced hospitality was known as *cóe.* The main season for this feasting (*aimser chue* or coshering season), was between New Year's Day and Shrovetide (Kelly 1997, 320). This is of special interest as this time of year, i.e. late winter and spring, coincided with the period when fodder shortage necessitated the slaughter of excess livestock. The institution of legally extracted hospitality was, in essence, organized around the life cycle of the livestock. Outside this period it seems to have only occurred on special occasions such as Easter and the feast of St Martin (Kelly 1997, 320).

The period of legally ordained entertainment generally consisted of two days and two nights and there are incidences of extra meat having to be bought in for the occasion (Simms 1978, 80). A vassal might be called upon to entertain his lord twice, or even four times a year and as Simms (1978, 80) notes, the retinue of a greater noble might be as many as forty or sixty persons. It seems likely that the vassal providing the hospitality would also have been part of the nobleman's retinue and when the group went on to receive, or exact, the same treatment at the home of another vassel, he would then have been at the receiving end of their hospitality.

At these feasts large quantities of fresh meat were undoubtedly consumed in a very short period of time. The early medieval laws do not provide details of how exactely this *cóe* operated. A good example of the mechanics and scale of this institution can, however, be seen in a description of a visit of Archbishop John Colton with his retinue in an area of County Tyrone in 1397 while conducting his metropolitan visitations in the diocese of Derry. In this instance, the archbishop had the role of the noble and the parishes he was visiting, the role of the vassal. He arrived at the ecclesiastical settlement of Cappagh and found it had 'not houses enough to receive and lodge the said Lord Primate and his retinue with their travelling furniture' (Porter 1853, 186). He moved instead to the nearby, and bigger, settlement at Ardstraw. The Lord Primate, however, ordered the reeve (steward) of Cappagh to bring 'beef for the kitchen', for himself and his retinue at Ardstraw. This transpired to be 'one fat ox', the 'expense' of which was the responsibility of the parish of Cappagh. In addition to this, the record states that the parish of Ardstraw had to contribute 'bread, butter, milk and flesh-meat; halters, straw and corn for the horses, for each house where men and horses of the said Archbishop was lodged' (Porter 1853, 187). It is stressed that all these facilities were supplied '*gratis*', and without any cost to be paid by the said Primate but at the common expense of the priests and inhabitants of the parish. Next morning the populace lent seven pack-horses to transport the company's luggage on to their next stopping place, where they received similar '*gratis*' facilities and entertainment (Porter 1853, 188).

Dividing the carcass

The carcass of a large animal such as a bovine, is hierarchical in the quality of the meat from its different parts. Since people of different status were present at these feasts, it was necessary that the carcass parts were distributed in a formalized fashion with specific cuts of meat being given to persons of different rank. In an eighth-century tale known as 'The story of MacDatho's pig', the leading men of Ulster and Connaught argue over who had the right to carve the pig at a banquet (Thurneysen 1935). The reason for the argument was that the person who carved was in turn the one who distributed each joint and therefore had ultimate discretion of defining the status of each guest relative to the others.

The most detailed illustrations of the process of equating different meat joints with persons of specific rank are in the twelfth-century *Book of Leinster* and in the fourteenth-century *Yellow Book of Lecan*, which describes a banquet held by the king of Tara. The substance of these descriptions, however, reflect a much earlier tradition (Sayers 1990, 90). An amalgamation of this information compiled by Lincoln (1992, 76) and Sayers (1990, 90) is shown in Figure 4.1.

In this instance, the feast was being held in the residence of the king rather than that of the vassal, but the food would have been provided by the latter in the form of food rent. At the Tara feast the king gets the best part of the beast, i.e. the tenderloin and fillet, with the poorest parts, i.e. the lower shanks, going to the plasterers, carpenters, artisans and braziers. In between these there is a whole range of people of different status all receiving cuts of meat that are deemed appropriate to their rank. It should be noted that the head in this case was given to the carvers, butlers and stewards, a tradition that continued into relatively recent times in Scotland as a kitchen record of the household highland laird in 1738 records that the head was given to the servants (Colville 1907, 65).

The idea that the carcass was divided and distributed on this basis continued in Gaelic Ireland until Tudor times although the later evidence suggests that the animal, after being butchered, may have been simply distributed amongst the retinue and servants of the lord to be consumed elsewhere. The formality of distribution, however, still remains. Hamner, a late sixteenth-century English observer, recorded of the distribution of the carcass of a cow and a sheep in a Gaelic lord's household as follows

> Cow:-The head, tong and feet to the smith. Neck to the butcher. 2 small ribs, that goe with the hind quarters, to the Taylor. Kidneys, to the physician. Marybones [marrow bones?] to the doney-lader[1], the strongest man in the hous. Udder to the harper. Liver to the carpenter. A peece to the garran-keeper [horse keeper]. Next bone, from the knee to the shoulder, to the horse boy. Choice piece of beef to the Shott. The hart, to the cow-heard. Next choise pece to the housewif of the house. The third choic to the nurse. Tallow for candles. Hide, for wyne and aquavitae. Black poodings for the ploughman. Bigge poodings for the weaver. Kylantony [?], the a-e pooding to the porter. Dowleagh, a brode long pece, lying upon the gutts, to the calf-keeper. Sweetbred, to hor that is with child. Rump, to him that cutts the beast [lord or master of the house?], Tripe to the keter[2]. The drawer of the water hath the great big pooding'
>
> Mutton: Head to the horse boy. Neck to the garran-keeper. Liver, the carpenter. Shoulder to the astronomer. Bag pooding, for the man that brings water. The hart and the feet for the shepherd, Skyne, for the cook (Anon. 1855, 119–20).

The same practice, i.e. the differential division of the carcass amongst people of different status, was also practised in Scotland at an even later date. Martin (1703, 171), while writing of the Outer Hebrides *c.* 1695, notes that 'Before money became current, the chieftains in the isles bestowed the cow's head, feet and all the entrails upon their dependants; such as the physician, orator, poet, bard, musician, etc., and the same was divided such, the smith had the head, the piper had the etc.' Unfortunately, Martin does not complete his list.

Elsewhere, Martin (1703, 167) records that 'every chieftain had a bold armour-bearer, whose business was always to attend the business of his master day and night, to prevent any surprise, and this man was called galloglach; he had likewise a double portion of meat assigned him at every meal'. It is interesting that this person, who was essentially the chieftain's

To horsemen a *cuinn*	To carvers a head	To butlers a head	To stewards a head	To charioteers *cuinn*
To harpists a tenderloin	To pipers a shank		To chessplayers a shank	To champions a pig's shoulder
To judges a tenderloin	To scholars a rump steak		To cupbearers a rump steak	To *aire forgill* 1st rank nobles a tenderloin
To literati a tenderloin 2nd rank literati a rump steak	To artisans a lower shank		To braziers a lower shank	To the king a tenderloin To the queen a rump steak
To *ollam filed* 1st rank poets a haunch Anroth 2nd rank poets a knee	To smiths a front shoulder		To physicians a knee	To *Aire ard* 2nd rank nobles a haunch To *Clí* 3rd rank poets a knee
To hostelers a haunch	To armourers a belly piece		To pilots a belly piece	To *Aire túise* 3rd rank nobles and historians a haunch
To expert a *roichnech* To 2nd rank craftsmen a knee	To chariot makers a knee		To pirates a knee	To *Aire échta* 4th rank nobles a *roichnech* To *Cano* 4th rank poets a knee
To diviners, sorcerers and *Commlid* a shank	To jugglers a shank		To buffoons a shank	To *Aire déso* 5th rank noble and *Doss* 5th rank poets a shank
To plasterers and carpenters a lower shank	To satirists the thick part of the shoulder		To clowns the thick part of the shoulder	To *Mac fuirmid* 6th rank poets and *Fochloc* 7th rank poets a lower shank
To trumpeters and hornplayers an outpouring of mead To engravers and ringmakers a belly piece				To cooks an outpouring of mead To fort builders and *oblaire* a belly piece
To shoemakers and turners the thick part of the shoulder	To the Royal doorkeepers the coccyx	Entrance	To the royal jesters the ribs	To wallmakers and ditchdiggers the thick part of the shoulder

Figure 4.1. *The layout of the banquet at Tara from the* Book of Leinster *and* Yellow Book of Lacan. *(After Lincoln 1992 & Sayers 1990.)*

private bodyguard, received an extra special portion. In Ireland the 'shot', who presumably held the same position in the lord's household, received a 'choice piece of beef', according to Hamner. The giving of the head to the smith, in Hamner's description, is also paralleled in later Scottish evidence. Samuel Johnston (1775, 114) noted on his travels in Skye that in the MacDonald chieftain's household the smith also was given the head. Presumably the smith received the head as payment for pole-axing the animal as only he would have owned a hammer heavy enough for this purpose. It is also the first part of the carcass that is removed in the butchering process after the animal has been killed. McCormick (1993, 97) suggested that the unusually low incidence of cranial parts in the Benedictine midden at Iona may have been a result of this practice. It has also been suggested that many urban meat markets were called Smithfield because the paddock for the cattle market would have been located near the forge (Anon. 1855, 119). Johnston too notes that other joints were distributed amongst 'officers' and 'workmen' and as in the case of Ireland, the udder was given to the musician, although in this case it was the piper rather than the harper (Anon. 1855).

The faunal evidence

The above descriptions of dividing the carcass in the context of communal feasting and formal distribution of different grades of meat amongst people of differing status provides a solution to the problem posed at the beginning of this paper, i.e. how does one deal with the large quantities of perishable meat generated by the slaughter of large animals in a society where a retail monetary market for meat does not exist? Indeed, the sudden glut of meat precipitated by the slaughter of a bovine necessitated the existence of such social occasions and processes. Because of the hierarchical quality of the meat from different parts of the carcass it was imperative that these feasts were not confined to people of a single status but were instead communal occasions for a cross-section of society.

Finding faunal evidence that can be used as unequivocal evidence for identifying the type of feasting and formal division of the carcass discussed above is extremely difficult. In general, the assemblages from early medieval Irish habitation sites do little more than provide data that does not contradict this type of feasting as a model for meat consumption at this time. The main problem with archaeological faunal assemblages is that unless there are pit deposits, an extremely rare occurrence on Irish sites of this period, it is usually impossible to establish if an individual assemblage represents a large quantity of meat consumed in a short period of time, or instead, if it represents small portions of meat consumed over a long period. Whenever early medieval Irish sites have provided samples of animal bone adequate for analysis all parts of the carcass are almost invariably represented (McCormick 1987). While it could be argued that this could reflect the occurrence of this form of feasting, it must also be noted that a similar range of faunal remains is also usually present in medieval urban contexts where retail markets were known to have been in existence. Even on rural sites in a non-market context, high-status sites will usually have servants in residence so the food debris will reflect the diets of different levels of society.

To support the hypothesis presented in this paper one needs to find contexts where there is evidence for a wide range of animal parts, i.e. representing those joints which would be consumed by people of different status, within a high-status context where only a limited range of high-quality carcass parts might be expected to be present. The early medieval Irish crannog provides at least the potential for this. These are artificial islands which, on the basis of the artefacts they produce, can be assumed to be of noble status. On the basis of the documentary evidence some, such as Lagore, Co. Meath (Hencken 1950), are known to have been royal centres. Recently a crannog, not recorded in surviving historical sources, has been excavated at Moynagh, Co. Meath. The finds include fine bronze-working debris, gold and imported glass, all of which clearly identify it as being a high status site (Bourke 1994; Bradley 1991). Unfortunately, the surface had been mechanically disturbed prior to excavations and the complete arrangement of buildings on the site cannot be determined. The surviving remains were, however, much more extensive than on previous crannog excavations. The structures on the eighth-century levels consist of two round-houses, one of 11 m diameter and the other of about 5 m (Bradley 1991, 13–18). The large house was presumably that of the royal or noble site owner and his immediate family, and it produced a suite of finds appropriate to the status of the inhabitants (Bradley 1991). The smaller house which produced few finds was probably that of servants. There is no evidence that a large retinue also lived on the island. As the island was a considerable distance from the lake shore, it could be expected that animals would have been slaughtered on the shore and then a restricted range of high-quality meat joints, with lesser quantities of

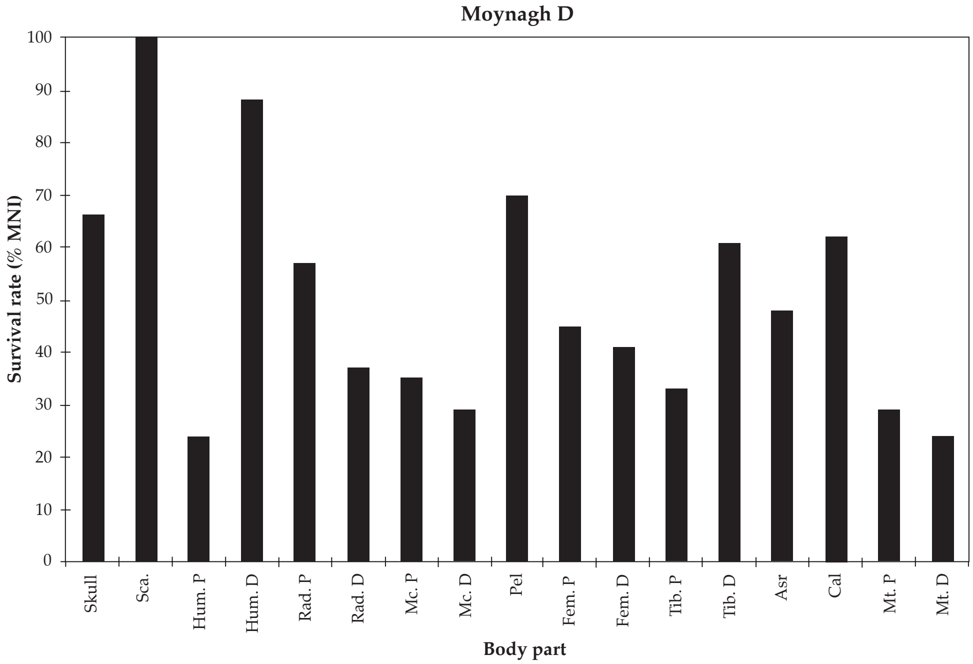

Figure 4.2. *Distribution of cattle carcass parts from Moynagh crannog sample D (McCormick 1987). The survival rate is calculated by giving the part on which the minimum number of individuals (MNI) was based, a value of 100 per cent and expressing the MNI values for the other parts accordingly.*

poor carcass parts, would be ferried to the crannog. There is no reason why complete bovine carcasses should have been carried over to the island as the inhabitants of the two houses would have been incapable of consuming the entire large animal before it began to perish.

Figure 4.2 shows the range of cattle bones found at Moynagh crannog. It is clear that all parts of the carcass were present, including the poorest joints such as the head and the feet, indicating indeed that complete carcasses were brought to the crannog. This would not have been necessary if the meat was only for an average high-status family and their servants. Such a small group of people could not physically have consumed a complete carcass of a bovine before it spoiled and if the meat was coming to the crannog in small units, one would have expected more specialization in the joints of meat present. Such a carcass distribution can, however, make sense in the context of feasting, when a large number of people of differing rank came specifically to the island to consume food thus necessitating the transportation of such a heterogeneous range of carcass parts to the island. The consumption of meals by the owner's family and a restricted number of guests and servants cannot convincingly account for the range of faunal parts present. As in the case of the royal meal at Tara the direct result of slaughtering a large animal at Moynagh was the bringing together of a large number of people of differing rank and status in order to consume it.

The acceptance of the hypothesis that formalized feasting provided the principal context for the consumption of meat raises many questions. Is it really to be believed that high-status households could only have consumed meat when such a feast was organized? This seems unlikely. It seems more likely that some of the foodstuffs given to the lord as part of the *cóe* obligations were outside this system. The flitch of bacon was an important part of this food rent provided by clients (Kelly 1997, 336) and because this was preserved meat it could be consumed over a long period of time. The early texts also note that domesticated geese and chickens were kept and these could be consumed as required. Accidental deaths of farm animals might also have made fresh meat available at unexpected times but it should be remembered that animals that died accidentially, but did not bleed at time of death were regarded as unclean and the consumption of their meat was specifically forbidden by early church law (Bieler 1975, 177).

Conclusions

The slaughter of a large animal in nearly all early non-market societies must have created a situation where much more meat suddenly became available than could be eaten by a small unit of consumption, such as a family unit. In hunter-gatherer egalitarian cultures meat can be distributed on a kinship basis. In the case of the African !Kung bushmen 'meat moves from the hunters . . . upwards through the kinship network to parents and in-laws, and then outward and downward again' (Yellen 1977, 289). Specific joints were given to specific relations of the hunter ensuring that individuals at different times would receive both high-status and low-status meat joints, depending on the closeness of their kinship relationship with the hunter of each animal killed. In a hierarchical society such a scheme of distribution would not suffice as persons of high status would expect to consume predominately high-status meat joints. Alternative systems of distribution have to be devised which recognize the inherent hierarchy of meat parts within the carcass of large animals, taking into consideration the necessity to consume the meat in a relatively short period of time. Different societies adapted to this challenge in different ways. The large temple administrations in early Egypt facilitated the regular slaughter and consumption of cattle in the context of sacrifice and offerings to the dead (Darby *et al.* 1977, 133–50; Lehner 1997, 233–5). In prehistoric Britain, communal feasts at ritual sites may have served the same purpose (Albarella & Serjeantson this volume). In medieval Ireland, feasting held within a legal institution of enforced hospitality (*cóe*) provided a mechanism that allowed such large-scale meat consumption.

Notes

1. An Anglicization of *duine laidir* which literally means strong person.
2. Anon (1855, 126) provides an interesting footnote to this term which states that 'Cater is derived from the French *acheter*, to purchase. Sir John Davis wrote that the beef eaten in the houses of the Monaghan chieftains was for the most part stolen out of the English Pale and for this purpose 'every one of them keepeth a cunning thief whom he calleth his caterer'.

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Chapter 5

A Passion for Pork: Meat Consumption at the British Late Neolithic Site of Durrington Walls

Umberto Albarella & Dale Serjeantson

Bring in our best pig for a stranger's dinner.
A feast will do our hearts good.
Homer, *Odyssey* XIV, 416–17

. . . they drove in a tall boar, prime and fat,
planting him square before the fire. . .
Homer, *Odyssey* XIV, 421–2

Archaeologists interested in the animal economy and food consumption of earlier prehistoric Britain are often frustrated by the dearth of sites with large assemblages of the material that can provide the most direct information on this subject: animal bone. It is therefore not surprising that the few existing large assemblages from British prehistoric sites have been intensively studied and their results frequently used and quoted. Best known among these is probably the Mesolithic site of Star Carr, whose bone assemblage has been studied twice (Fraser & King 1954; Legge & Rowley-Conwy 1988), and discussed in many other publications. Durrington Walls has equal importance for the amount of debate that it has generated for the Late Neolithic. It is commonplace that the published prehistoric sites and bone assemblages do not reflect equally the wide range of activities of prehistoric people; this is particularly true for the British Late Neolithic which is much better known from its ceremonial sites than from its elusive domestic settlements. Many researchers have turned their attention to the formidable body of data available from the bone assemblage of Durrington Walls. We too realized that the assemblage had great potential that had not yet been explored.

The site and its excavation

Durrington Walls, in Wiltshire, is one of the well-known Late Neolithic henge enclosures, of which most are distributed in southern Britain. It consists of a nearly circular enclosure, *c.* 470–480 m across, surrounded by a ditch with an external bank breached by entrances in the east and west (Wainwright & Longworth 1971). The main pottery type at the site is Grooved Ware. It was constructed around the middle of the second millennium BC with dates which calibrate to approximately 2800–2400 BC (Darvill 1989). A little evidence of earlier (Middle Neolithic) and later (Iron Age) occupation was also found, but this produced only a few animal bones and pottery sherds. Some sherds of Beaker pottery were also found in at least one area of the site.

The henge enclosures have generally been interpreted as ceremonial, or partly ceremonial, sites. While discussing the function of the timber structures found within these monuments Wainwright wonders 'whether they be temples or communal buildings serving a more secular purpose or, most probably, a combination of the religious and the secular' (Wainwright & Longworth 1971). Darvill (1989) among others has suggested that 'it may be appropriate to see the henge-enclosures as residential foci that include provisions for the ceremonial need of the community as well as their domestic needs'. The possibility that some of the bones represent domestic refuse as well as material discarded following ceremonies involving food consumption must therefore be considered.

Durrington Walls was described for the first time in the archaeological literature at the beginning of the nineteenth century (Hoare 1812). Early excavations were carried out in 1951–52 (Stone *et al.* 1954), but the main excavation occurred in 1966–67 (Wainwright & Longworth 1971). This latter excavation produced a long trench in the southern part of the enclosure which revealed the presence of timber structures — the Southern and Northern Circles —

and also allowed the investigation of the morphology and contents of ditch and bank. Abundant bone remains were found in the Southern Circle, in the ditch, and also in an area referred to as the 'midden', an elongated oval hollow located just outside the Southern Circle. A later excavation in the northern part of the site, outside the enclosure, revealed the presence of more Neolithic structures and also of Iron Age and Roman settlement (Wainwright 1971). Animal bones were also recovered from this later excavation and gave results similar to those from the main excavation (Westley 1971).

The animal bones from the 1951–52 excavations were discussed briefly in the original report (Stone *et al.* 1954). Those from the 1966–67 excavations were studied by Harcourt (1971a), who also took into account the data from the excavations of Stone. The assemblage has since been used as evidence that there was a switch from a cattle-dominated husbandry in the Early and Middle Neolithic to one dominated by pigs in the Late Neolithic (Grigson 1982). It has also been the subject of a study of enamel hypoplasia in pig teeth (Dobney & Ervynck 1998) and has provided a metric baseline for pigs which can be used as a comparison for specimens from other sites and periods (Albarella & Payne 1993). In 1984 Richards & Thomas published a reconsideration of the assemblage, a study which has been cited frequently since that time.

History of the project

In 1991 we originally approached the investigation of the Durrington Walls' bones with independent and different aims: one of us (UA) wanted to use the pig bones to analyze problems of biometric variability in different ages, sexes and populations and the other (DS) was interested in the implications of some unusual features of the animal bones which had been reported both by Harcourt (1971a) and also by Richards & Thomas (1984, 206). Both reported that many of the bones were complete; further, according to Richards & Thomas, there was a 'total absence of dog gnawing'. Both these features were quite contrary to the findings from other prehistoric and later assemblages studied by the authors. In particular, the findings were unlike those from Runnymede, another site with high numbers of pig bones in both occupation phases, the Middle Neolithic and the Late Bronze Age (Serjeantson 1991; 1996).

As soon as we began to examine the material, other research questions arose which were more specifically connected with the interpretation of Durrington Walls, and these are discussed in this paper. We realized that the assemblage was not only a useful source of data for comparison and interpretation of other sites, but also a valuable and still unexplored source for the interpretation of human activities in the Late Neolithic of Britain. We modified our original aims and set out to detect patterns of meat preparation and consumption, bone deposition and disposal that had not been identified by previous work. We aimed to use this information to determine, if possible, whether the origin of the assemblage did indeed lie in ceremonial feasting or domestic activity, and, if in the former, what was the nature of the feast. We proposed to do this by comparing certain aspects of the bones of the two main species, pigs and cattle. Had they been treated in the same way, and if not, why not?

We also hoped to reconsider the spatial distribution of the bones. In the original account of the material Harcourt (1971a) and Wainwright & Longworth (1971, 188–91) stated that there were no differences in the bones between different areas of the site and that no differences were apparent in the percentage of species from each of the various localities. Richards & Thomas, however, in the light of ethnographic studies of the deposition of bones and other objects, reopened the question of whether different classes of material might be expected in different parts of the site. They wrote (1984, 206) that 'the complete restudy of the faunal assemblage has been necessary in order to realise the potential of the site' and reported that they had detected spatial patterning in the deposition of both pottery and bones. Since their conclusions on the differential distribution of species and elements have now been repeated many times we were interested to see how a more detailed study might bear these out.

One point immediately caught our attention and made it clear that much more information might be gathered from this assemblage: up to the time of our study in 1991 the bones had not been washed. Until that was done, it would not be possible to see essential details of the taphonomy of the bones or to be confident that the age and size of the bones were accurately recorded. First, therefore, with help of the curators of the Salisbury and South Wiltshire Museum, we arranged for all the bones to be washed.

Methods

We did not attempt a re-analysis of the entire assemblage, but concentrated on the research questions outlined above. We recorded some data in greater detail than had previously been done, but only on a selection — if rather large — of the assemblage. The study was carried out mainly on the two principal species, pig (*Sus domesticus/scrofa*) and cattle (*Bos taurus/primigenius*), which represent the bulk of the assemblage: 90 per cent of the specimens according to the Minimum Numbers of Individuals (MNI) provided by Harcourt (1971a). We also rapidly scanned the bones of other species to ensure that we were not missing any important information about the assemblage.

The following elements were recorded for both pigs and cattle: humerus, radius, ulna, femur, tibia, astragalus and calcaneum. In addition, for the pigs only, the maxillae, mandibles, loose teeth, atlas, scapula, pelvis and medial metapodials were recorded. As was normal practice at the time on excavations in England, bulk sieving was not carried out, and also shaft fragments were discarded before Harcourt was given the material for examination (Wainwright pers. comm.), so virtually all the extant material has an articular end.

Since the analysis of the data was mainly aimed at gaining information on the distribution of the body parts and on taphonomic and human effects on the bones, we recorded the following data for each of the main long bones: the part of the bone present (using the 'zone' method described in Serjeantson 1996), fusion of the epiphyses, preservation of the bone surface, modern fractures, gnawing marks, butchery marks and burning marks. Some but not all of this information was also noted on the other elements. Eruption and wear stages were recorded for all pig teeth according to Grant (1982) and to a modified version of the system described in Bull & Payne (1982). The measurements taken on the pig bones have been used as a basis for a metric data base which is currently the largest for pigs for prehistoric Britain (Albarella & Payne 1993).

Although the relative frequency of the two taxa, the age at death, and their size, was not central in our study, these data are essential to complement the other results and are therefore rapidly summarized in the next section.

The bone assemblage

Frequency of species

As stated, cattle and pig are by far the most common species at Durrington Walls, with pig much more abundant than cattle. This is common for Late Neolithic sites in southern Britain (see Grigson 1982). A recent view of Neolithic bone assemblages from southern Britain (Serjeantson 1998) has shown that on Early and Middle Neolithic sites pig are rarely more than 30 per cent of the three major domestic animals; Runnymede is an exception with pig over 40 per cent in two areas of the settlement. In the Late Neolithic, pig remains are more than 40 per cent of bones of the three major domestic animals at all Late Neolithic sites with Grooved Ware associations and at most other Late Neolithic sites. The types of sites with a high proportion of pig bones include groups of pits and the West Kennet palisade enclosures (Edwards & Horne 1997) as well as henges. Pig bones were also common in the fills of the Late Neolithic pits outside the Durrington Walls enclosure (Westley 1971). Of the other large henges, Mount Pleasant, Dorset (Harcourt 1979) has more pig than cattle while at Marden, Wiltshire the two species are equally represented (Harcourt 1971b). It is not the aim of this paper to discuss the nature of the pig predominance in the Late Neolithic, but it is worth mentioning here that a debate exists about its interpretation. The abundance of pig has been argued to be a genuine feature of the Late Neolithic economy, possibly owing to the changed environmental conditions (as suggested by Grigson 1982); alternatively it is due to the fact that most Neolithic sites have a ceremonial function and therefore the finds need not reflect the real relative importance of the animals at the time (Richards & Thomas 1984; Legge 1991; Maltby 1990). Pigs, having large litters and being fast growing, are ideal animals to be used for the production of meat for feasts; large quantities can be produced in a relatively shorter time than from cattle or sheep.

The proportion of sheep is very low, a characteristic of many Late Neolithic sites. Wild mammals and birds are also very sparse at Durrington Walls: Harcourt recorded that about 14 red deer and fewer than a dozen other wild animals were present, remarkably few compared to the numbers of domestic pigs and cattle.

Kill-off patterns

Pig: The age at death suggested by the mandibles (Fig. 5.1) points to a peak of killing of pigs while still immature (*sensu* O'Connor 1988). This probably indicates mortality between approximately one and two years. A few specimens were also killed in the third and perhaps fourth year (sub-adult and adult), whereas very juvenile and elderly animals are much rarer. The maxillary evidence is rather different. There are fewer maxillae from immature animals and many more in the sub-adult and adult categories which would indicate a higher number of animals killed in

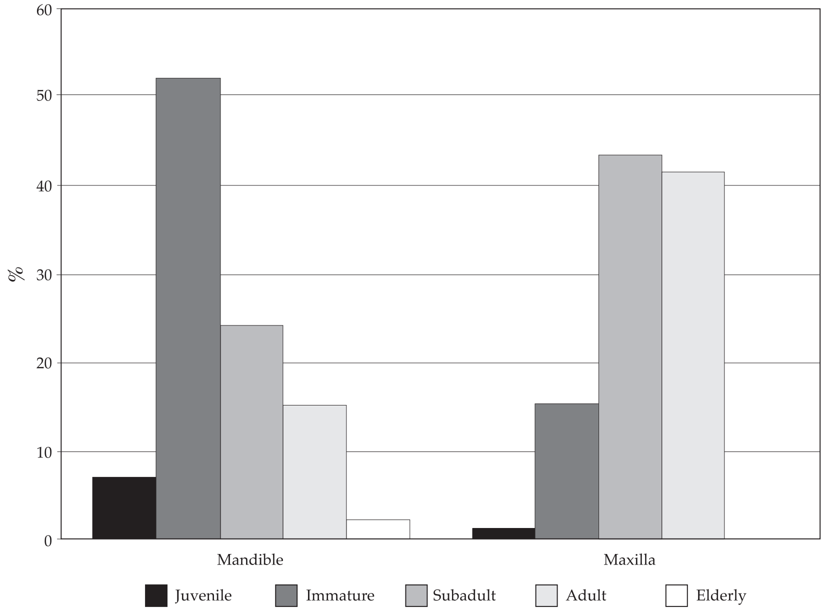

Figure 5.1. *Durrington Walls. Age of pig mandibles and maxillae according to the stages defined by O'Connor (1988). Only dental rows that include M1 have been included. n mandibles = 112, n maxillae = 74.*

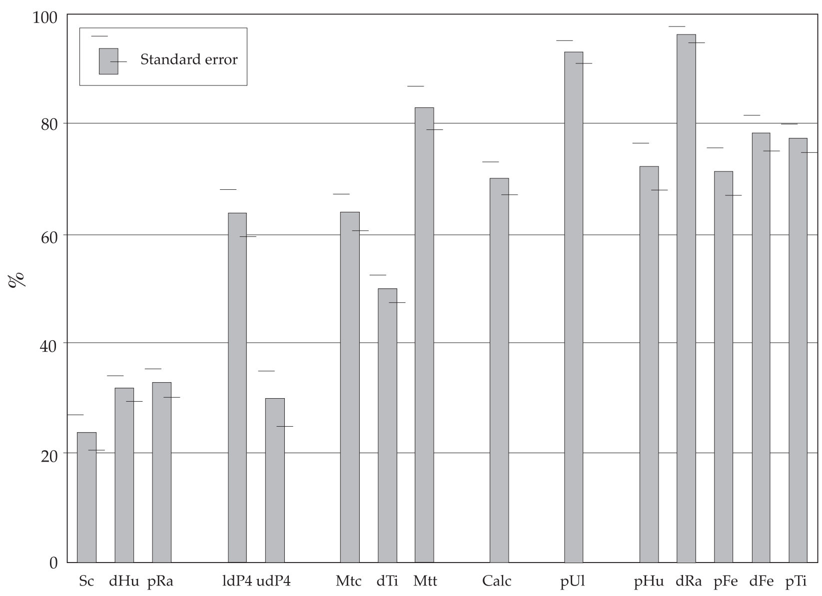

Figure 5.2. *Durrington Walls. Percentages of unfused diaphyses and deciduous 4th premolars (dP4) of pig. Unfused diaphyses only were counted. The percentage of dP4s is calculated as 100 × n dP4 / (n dP4 + n P4). The elements are ordered in the sequence of fusion and tooth eruption suggested by Habermehl (1975). Key: p proximal, d distal, l lower, u upper, Sc scapula, Hu humerus, Ra radius, Mtc metacarpal, Ti tibia, Mtt metatarsal, Calc calcaneum, Ul ulna, Fe femur.*

the third and fourth year than in the second as suggested by the mandible. It is most likely that this is accounted for by the fact that maxillae — especially young ones — are more fragile, and break up readily and that few loose teeth were recovered and retained. We therefore believe that the evidence of age at death from the lower jaw is more reliable.

The fusion evidence is shown in Table 5.1 and Figure 5.2. The figure also includes upper and lower dP4s expressed as a percentage of all fourth premolars which allows the percentage to be compared with the bones. The fusion evidence suggests that 25 to 30 per cent of the animals were killed before the early fusing epiphyses fused, that is before about one year of age, *c.* 50 per cent before the middle fusing epiphyses fused, before about two years, and that 70–90 per cent were killed before the late fusing epiphyses fused, at about three years. The metapodials do not fit the pattern, as they suggest that a higher proportion of pigs were slaughtered before the end of the second year (Table 5.1). There is therefore an inconsistency between the tooth eruption and wear data and the fusion data, with the teeth suggesting younger ages than the bones. The only post-cranial elements to provide similar results to the teeth are the metatarsals and, possibly, the metacarpals. In other words, it seems that some of the skulls and metapodials of older animals are missing, which may be consistent with what is suggested by the distribution of the body parts (see below). Despite the inconsistencies, it is probably safe to suggest that most of the Durrington Walls' pigs were slaughtered when they were between one and three years old. This is the age when the animals have grown enough to produce a substantial amount of meat, but at the same time are still young enough to produce good-quality meat.

Cattle: The fusion of the main limb bones of the cattle is consistent with Harcourt's suggestion that most

Table 5.1. *Durrington Walls. Frequencies of unfused, fusing and fused bones of pig. Fusion ages from Habermehl (1975). Unfused diaphyses but not epiphyses, are counted.*

	Fused	Fusing	Unfused	% Unfused	Fusion age
Scapula	121	3	40	24	1 yr
Humerus prox	13	18	78	72	$3^1/_2$ yrs
dist	125	79	94	32	1 yr
Radius prox	198	19	107	33	1 yr
dist	6	1	167	96	$3^1/_2$ yrs
Ulna prox	5	5	142	93	3 yrs
Metacarpal	68	9	138	64	2 yrs
Femur prox	19	12	76	71	$3^1/_2$ yrs
dist	20	15	121	78	$3^1/_2$ yrs
Tibia prox	24	36	198	77	$3^1/_2$ yrs
dist	125	69	197	50	2 yrs
Calcaneum	58	8	157	70	2–$2^1/_2$ yrs
Metatarsal	13	3	77	83	2 yrs

Table 5.2. *Durrington Walls. Number of maxillary and mandibular teeth of pig. A tooth row includes two or more teeth.*

	Loose teeth		Teeth in row		Total	
	Max	Mand	Max	Mand	Max	Mand
dP3	3	6	11	43	14	49
dP4	3	14	21	64	24	78
M1	22	22	77	125	99	147
M2	30	25	55	99	85	124
M3	36	30	12	29	48	59
Total	**94**	**97**	**176**	**360**	**270**	**457**

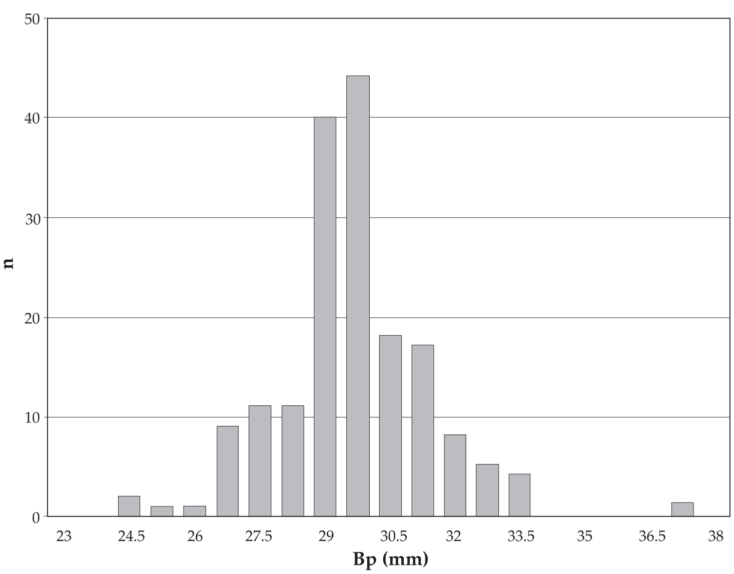

Figure 5.3. *Durrington Walls. Pig: breadth of proximal radius (Bp). The measurement is defined in von den Driesch (1976) and was taken as recommended by Payne & Bull (1988). Fully fused specimens only included.*

bones belonged to mature animals (Harcourt 1971a). A few calf bones, however, were found in the bags in which the pig bones had been stored, which suggests that juvenile cattle may be slightly underestimated in Harcourt's counts.

Size

What is relevant to this paper is that this biometric work is in full agreement with Harcourt's statement that the pig population was entirely or almost entirely domestic (Harcourt 1971a). Unimodal curves were obtained for most measurements, and only one bone — the radius — provided one very large outlier which may belong to a wild boar (Fig. 5.3). Cattle bones were not measured but we noted a few very large specimens as aurochs (*Bos primigenius*), a similar number to that suggested by Harcourt.

Body parts

The relative numbers of the cattle limb bones can largely be explained by a bias towards preservation of the denser elements. For instance, the femur and ulna, which are more fragile and late fusing, are found in lower numbers than the humerus, radius and tibia, which have denser articular ends. More surprising is a scarcity of astragalus and calcaneum. This may suggest that relatively fewer limb extremities were imported to the site (Fig. 5.4) and it could mirror the scarcity of skulls which was noted by Harcourt. We also observed that cattle teeth were not as abundant as bones.

The distribution of pig body parts was analyzed in more detail. It too can partly be explained by different rates of preservation between different elements, but, since pigs are smaller, recovery bias has also played a role. A number of anomalies were found (Fig. 5.5) and these can be summarized as follows:

- there are more lower than upper teeth;
- there are more bones than teeth, when the expected number in the skeleton is taken into account;

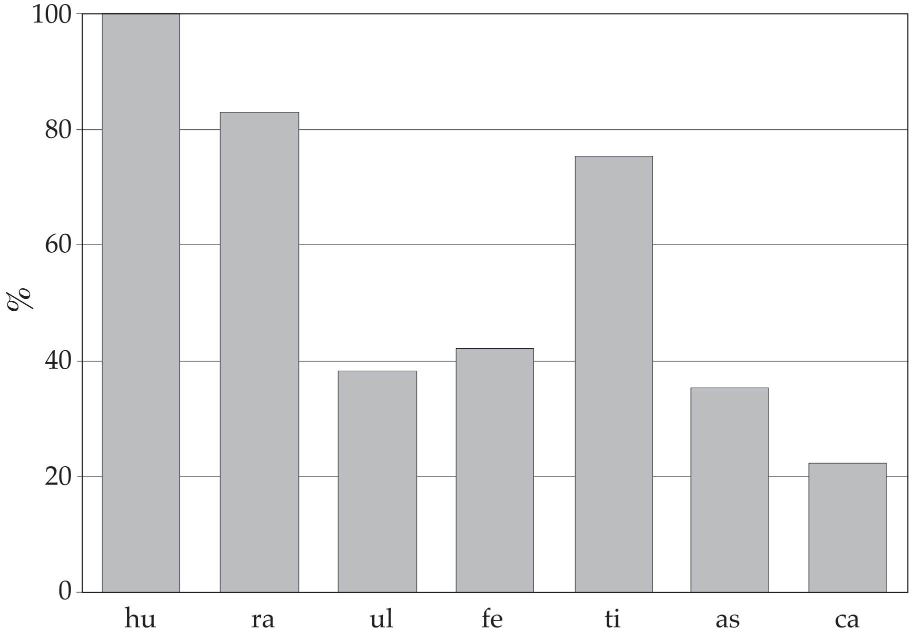

Figure 5.4. *Durrington Walls: cattle: distribution of major limb bones. Elements are calculated as a percentage of the most common bone, the humerus (*n = *65). Key: hu humerus, ra radius, ul ulna, fe femur, ti tibia, as astragalus, ca calcaneum.*

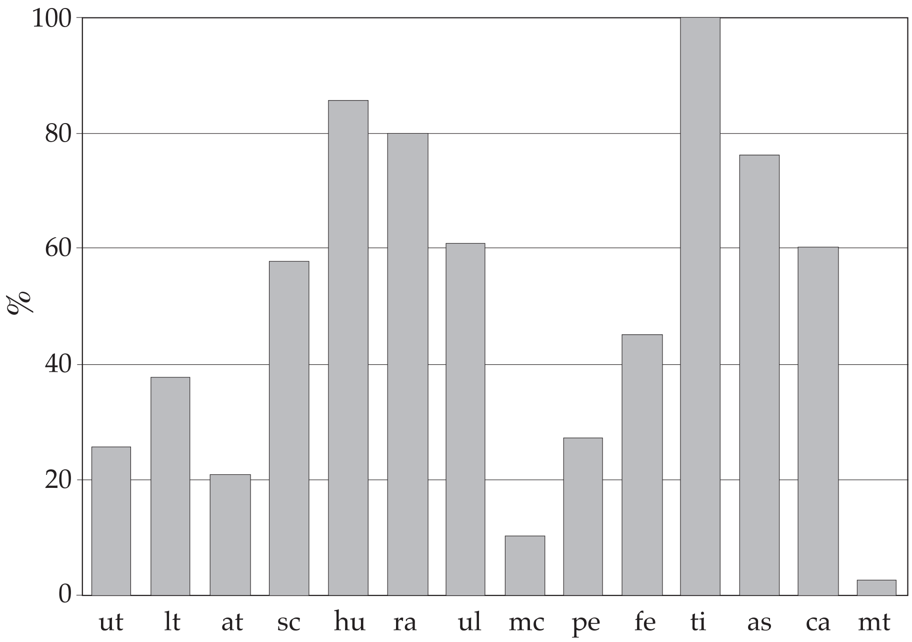

Figure 5.5. *Durrington Walls: pig: distribution of body parts. Key: See Figure 5.4. ut upper teeth, lt lower teeth, at atlas, mc metacarpal, pe pelvis, mt metatarsal.*

- there is a high number of tibiae;
- there are few metapodials;
- there are fewer metatarsals than metacarpals.

Of these, the inconsistency between the number of maxillary and mandibular teeth can probably be entirely explained on the basis of survival and recovery. As can be seen in Table 5.2, a much higher proportion of mandibular than maxillary teeth were found in dental rows. As discussed, maxillae are more fragile and the teeth — particularly the young ones — which ended up loose because of the breakage of the jaw, may have been overlooked during the excavation.

The lower number of teeth than bones, taking into account the expected number, cannot be explained as a taphonomic phenomenon. The opposite is the case in most archaeological assemblages: jaws and teeth are more common than other elements. Pig teeth especially are relatively more common than the bones, due to the destruction of the porous — generally young — post-cranial bones. The very good preservation of the Durrington Walls assemblage (see below) could perhaps explain equal numbers of teeth and bones but not the much higher frequency of post-cranial elements. We must therefore assume that this difference was in fact genuine at the time of the original formation of the assemblage. If we analyze this finding in combination with the ageing data (above) we can suggest that, whereas the body parts of the younger animals are more or less equally represented, many skulls of the older specimens are missing. These may have never been imported to the site — which would mean that some animals arrived at the henge as dressed carcasses. It is equally possibly, however, that some skulls were discarded in areas of the site not touched by the excavation — perhaps where the primary butchery was carried out. It is also possible that the skulls were used for display, as can still be seen among some peoples today (Hodder 1982, 155), or perhaps were placed on posts or trees, as suggested by Davis & Payne (1993) for the cattle skulls at the Bronze Age barrow of Irthlingborough, Northamptonshire.

The low frequency of cranial elements was also noted by Harcourt (1971a), who suggested that skulls might have been disposed of elsewhere on the site. Richards & Thomas (1984, 206) observed that 'teeth appear in large numbers', but offered no details. As shown, the reality lies somewhere between these two statements. Teeth are by no means absent, but are fewer than would be expected. The key to butchery and consumption at the site is to be found in the numbers of mandibles relative to the numbers of post-cranial bones. Before trying to find an explanation for the other discrepancies in the distribution of pig body parts it is necessary to consider questions not tackled so far: the effects of natural and human agents on the bones.

Taphonomy

Most of the animal bones are in an excellent state of preservation, though a few are eroded. The good preservation is mainly due to three important factors:

- the soil in which the bones were buried was chalky, which, due to its alkaline pH, normally provides a good environment for bone preservation;
- many bones were subject to prompt burial. This was suggested by the presence of some bones still in articulation, several unfused diaphyses and epiphyses found together, and by the low incidence of gnawing marks;
- many were buried below the maximum depth of rootlet activity and regular water percolation.

As mentioned, one aspect of bone modification that alerted us to the potentially unusual character of the assemblage was the low incidence of gnawing reported. We had become accustomed to seeing a good deal of gnawing on bones from prehistoric settlements of all types and have shown (Serjeantson 1991) that traces of gnawing are actually more frequent (because more clearly recognized) on well-preserved, unfragmented bones. If we compare the incidence of gnawing marks at Durrington Walls with that at the Middle Neolithic assemblage from Runnymede, it becomes obvious that scavenger activity at Durrington Walls was minimal (Fig. 5.6). It is interesting to note, however, that gnawing marks are more frequent on

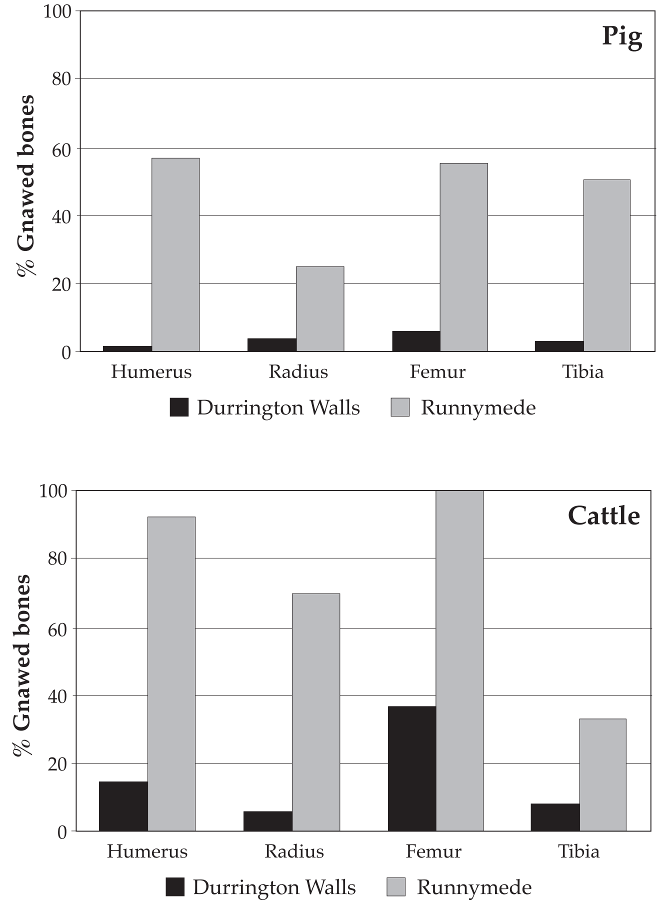

Figure 5.6. *Percentage of gnawed bones out of the minimum number of elements of the four main long bones of pig and cattle: Durrington Walls and Runnymede compared.*

cattle than pig bones and this may suggest the existence of different ways of disposing of the bones of the two species. Richards & Thomas (1984) are incorrect in claiming a 'total absence of dog gnawing' but the incidence, as we have seen, is slight. Although the majority of the Durrington Walls bones must have been rapidly buried, it would be wrong to think that the assemblage is totally homogeneous. If the assemblage has provided some of the best-preserved bones we have ever seen, some others have a surface which is completely corroded (Fig. 5.7), which suggests that some bones were disposed of in different ways or lay closer to the ground surface.

The human agent

Butchery

Owing to the very good preservation of the Durrington Walls bones, butchery marks were generally

Figure 5.7. *Durrington Walls. Examples of bones with very well-preserved (L) and badly damaged (R) surfaces.*

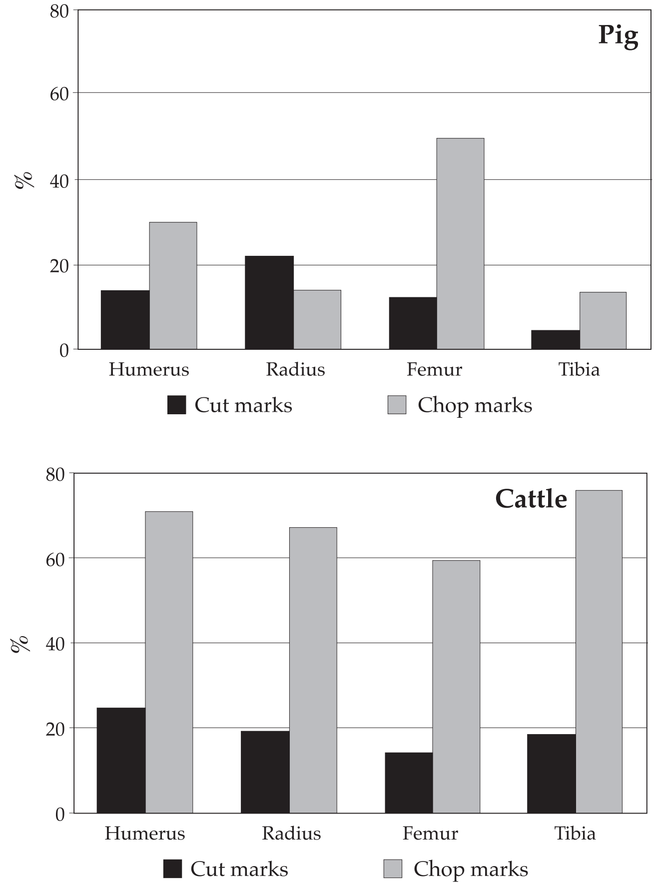

Figure 5.8. *Percentage of butchered bones of pig and cattle at Durrington Walls. Pig: humerus = 404; radius = 385; femur = 239; tibia = 503. Cattle: humerus = 76; radius = 83; femur = 69; tibia = 72.*

Table 5.3. *Durrington Walls. Rate of fragmentation of pig long bones. Proximal and distal ends include fusing/fused epiphyses and unfused diaphyses, but not unfused epiphyses. Key: 1 = both epiphyses fused or fusing; 2 = one epiphyses is fused/fusing and the other is unfused; 3 = both ends of the diaphysis unfused*

	Prox. end only		Distal end only		Complete bone 1		Complete bone 2		Complete bone 3	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Humerus	49	14	238	69	8	2	33	10	19	5
Radius	152	52	42	11	1	<1	66	18	65	18
Femur	69	31	118	52	3	1	–	–	35	16
Tibia	72	16	205	44	33	7	58	13	95	21

more easily detected than in most other archaeological assemblages. Chopping marks and cut marks on bones of both species were common (Fig. 5.8). Both were more frequent on cattle than on pig bones, and chopping marks much more so. Richards & Thomas (1984) referred to a 'relative scarcity of butchery evidence'; they were probably misled into this observation by the unusually large number of complete pig bones and it is less surprising that they failed to notice that some bones bore cut marks, as the bones were unwashed.

It is true, however, that pig carcasses were less intensively butchered than usual. Considering that in most archaeological assemblages pig bones are heavily broken, the high frequency of complete long bones at Durrington Walls (Table 5.3) is remarkable. At Runnymede — which has a typical pattern of fragmentation — only 2 out of 100 pig long bones were complete; here the percentage is as much as 20 per cent for some elements. Although this low rate of fragmentation on the surviving bones from Durrington Walls is partly due to the fact that shaft splinters were not collected and retained, there is no doubt that it also reflects a non-intensive use of the flesh. The carcasses of the pigs were not subdivided

Figure 5.9. *Durrington Walls. Cattle radius burned and chopped mid shaft.*

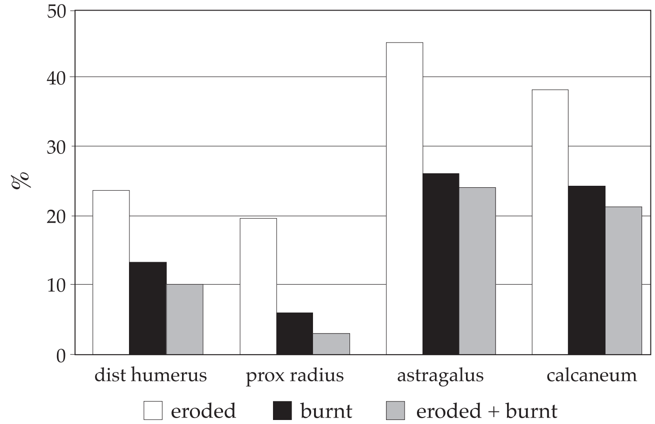

Figure 5.10. *Durrington Walls: percentage of eroded, burnt and eroded+burnt pig bones. Humerus = 404; radius = 385; astragalus = 290; calcaneum = 229.*

Figure 5.11. *Durrington Walls. Pig humerus with rib stuck in its internal cavity.*

in small cuts, but were rather cooked and consumed in large chunks. Further, the marrow was not as systematically extracted from the bones as it is on most settlements, although there is spectacular evidence that this did happen on a fair proportion of the bones. A large number of cattle bones (Fig. 5.9) and a few pig bones are at the same time burnt on the mid shaft and chopped, a technique used for the extraction of the marrow (Binford 1981). It is seen on the cattle bones from Stonehenge (Serjeantson 1995), Neolithic Runnymede (Serjeantson 1996) and other sites. Most of the chop-mark evidence provides indirect information for marrow extraction, but one pig humerus has a rib tightly stuck in its internal cavity (Fig. 5.11). The rib has obviously been used to poke out the marrow: a rare example of an archaeological specimen which directly reflects a human action from the past. Other pig bones had similar holes but no ribs were found inserted into them.

Burning

On cattle bones the most common case of burning was that on the mid-shaft, as described above. More interesting, because unexpected, was a regular pattern of burning on some pig elements: distal humerus, astragalus (Fig. 5.12), calcaneum and, to a lesser extent, the proximal radius (Fig. 5.10). This was not noted on any other bones with the exception of the cuboid (a tarsal), few of which were recovered

Figure 5.12. *Durrington Walls. Pig astragali with burn marks and erosion of distal end.*

and which we did not routinely record. The burnt bones were generally brown, sometimes black, but never white or calcined, as are bones exposed to very high temperatures (Gilchrist & Mytum 1986). The burning was usually associated with a pattern of erosion, presumably caused by the increased fragility of the bone following its exposure to heat. Some bones bore this distinctive pattern of erosion but had no clear signs of the colour changes associated with burning (Fig. 5.10). The general association of these two conditions, however, leads us to suggest that these eroded bones had also been in contact with a source of heat, probably a fire. The erosion and/or the burning never extends to the whole bone, but is limited to a well-defined area. The intensity of the erosion and burning is variable, but it never extends to the shaft of the long bones or to more than half of the astragalus and calcaneum. One or two cattle bones only also show this pattern of burning and erosion.

The regularity of this burning is striking and clearly indicates that the bones were not burnt because of accidental contact with fire. It more probably associated with the cooking technique that was used. It appears that the pig carcass was regularly butchered at the humerus-radius joint of the fore limb and at the tarsal joint on the hind limb. The limbs or the carcass were then roasted on a fire either above the flames or within the embers. Bone extremities become exposed — or partly exposed — as a joint is roasted, and these must have been in direct contact with the fire, while the rest of the bone was protected by the flesh and perhaps the skin. Depending on the intensity of the heat, the bone was either left untouched, became slightly singed and eroded or was burnt. This particular pattern of burning has not been observed by the authors at any other site. Maltby refers to the fact that many of the pig and cattle bones were charred at the contemporary henge on Coneybury Hill, Wiltshire (Maltby 1990), and at the barrow at Barford Farm, Pamphill, Dorset (Maltby 1989), and he suggests that roast meat was eaten at Coneybury Henge, so it likely that he observed the same traces as are present on the bones from Durrington Walls on the rather smaller samples from those sites. Otherwise, similar burning marks on the bone extremities have only been recorded on smaller animals such as the birds from the Upper Palaeolithic cave site of Grotta Romanelli, Italy (Cassoli & Tagliacozzo 1997).

Discussion of differential use of body parts

Having discussed the butchery and burning evidence, we can return to our discussion of the body parts of the pigs to explain the other anomalies in the assemblage. As can be seen in Figure 5.8 the tibia is the least frequently butchered of the pig bones. This may correlate with the fact that this bone was most commonly found complete (Table 5.3). Of the bones that are no longer whole, there are more distal ends of the humerus than of the tibia (Table 5.3). One reason why the tibia is apparently so frequent may be that it was more frequently intact so was more frequently collected. Broken ends of humerus and radius may have occasionally been overlooked. Moreover the pattern of erosion and burning on the ends of the humerus and radius may, in some cases, have led to the destruction of the articular ends of these bones. The femur is least frequent, but this is known to be a more fragile bone (Brain 1967). The relatively few astragali and calcanea can be accounted for by the fact that these are smaller bones are sometimes overlooked. Some of these also may have been destroyed by heat.

The scarcity of metapodials is less explicable. If, however, we take into account all the evidence discussed before, an explanation can be suggested. The cranial elements are also under-represented and both these and the metapodials suggest a younger age than the other post-cranial bones. It is therefore tempting to propose that some of the carcasses of the older animals were dressed off-site or in another area of the enclosure and the heads and metapodials were removed. We have seen that the hind limb was cut near the tarsal joint, so the metatarsals would have become separated from the other long bones and may have been discarded elsewhere or scattered and destroyed, while the fore limb was cut at the

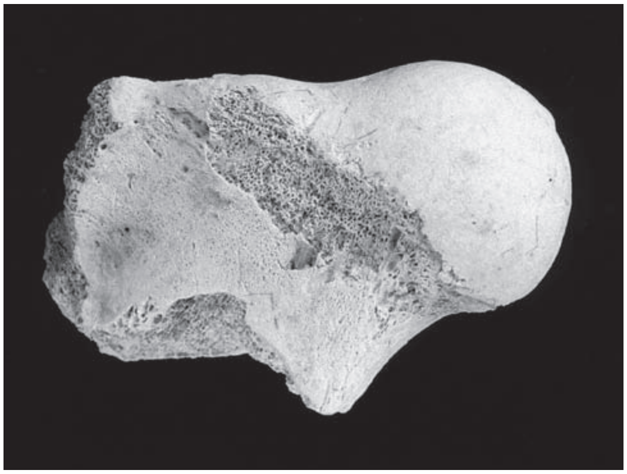

Figure 5.13. *Durrington Walls. Cattle femur with embedded flint.*

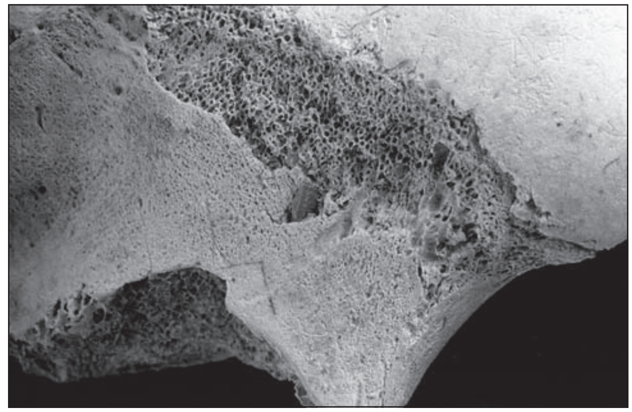

Figure 5.14. *Durrington Walls. Cattle femur with embedded flint (detail).*

humerus-radius joint so the metacarpals would end up in the same cut as the radius. Although this piece of carcass would have had only a small amount of meat it was at least occasionally cooked, as shown by the erosion and burning on some of the proximal ends of the radius. If this can explain why there are more metacarpals than metatarsals, the fact that there are not more equal number of metacarpals and radii probably lies in the fact that the smaller metacarpals survived less well or were overlooked during the excavation. It is obvious that many variables are involved and that different sets of factors may have caused similar effects. We did not record phalanges, but these were, like metapodials, very few. Phalanges are small, however, and their scarcity may also be due to a recovery bias.

The relative numbers of the main bones of the axial skeleton and upper limbs can therefore be accounted for by a combination of the effects of butchery and cooking and the natural density of the bones. There is no apparent selection of parts of the body. This is in contrast to findings at the palisade enclosures at West Kennet (Edwards & Horne 1997, figs. 73 & 74), where the femur is the most frequent bone, a finding which is contrary to what would be expected. It does suggest that there selected parts of the carcass were consumed and disposed of in and around the enclosures. There was no discrepancy between numbers of left and right hand bones at Durrington Walls; again the only contemporary British sites from which numbers from left and right have been recorded as very different are the West Kennet palisade enclosures, where the right hind leg joint was more numerous than the left.

Figure 5.15. *Durrington Walls. Pig humerus with embedded arrow tip.*

Embedded flints

The discussion of the human effect on the bones cannot be concluded without a mention of one of the most surprising findings. There are small fragments of stone embedded in four bones: a cattle femur, a pig humerus, a pig femur and a pig calcaneum (Figs. 5.13–5.17). Three fragments are definitely

Figure 5.16. *Durrington Walls. Pig femur with embedded flint.*

Figure 5.17. *Durrington Walls. Pig calcaneum with embedded stone.*

flint, whereas the nature of the small piece of stone embedded in the pig calcaneum is uncertain. The most interesting of these is in the pig humerus: the piece of flint embedded in the lateral side of its distal end is the tip of an arrow-head (identified by Andrew David). The type of tool from which the other fragments of stone have come is not clear in the remaining examples. All the stone fragments are implanted in the lateral areas of the bones, which is consistent with the possibility that they derive from projected objects. The lateral position on the distal humerus is particularly interesting as cut marks resulting from butchery on this bone are generally found on the medial side. This consideration, together with the shape of the flint, leads to the suggestion that it is unlikely that the stone derives from a cutting tool, such as a knife. The most remarkable aspect of these specimens is that, despite the fact that the bones belong to domestic animals, they resemble hunting damage. The cattle femur is in the size range of domestic cattle and much smaller than that of an aurochs and the three pig bones are all approximately in the middle of the size range of the pig population, which has been interpreted as entirely domestic (see above).

It is hard to imagine why people should shoot arrows at domestic pigs. One possibility is that the cattle and pig herds (or parts of them) were maintained in a semi-feral state and spears or arrows were used to immobilize them for the kill. An alternative explanation might be that they were kept under close control but their slaughter was used as a hunting exercise, though there is otherwise little evidence for hunting by those who congregated at Durrington Walls. It is even possible that there was ritualized hunting within the enclosure. Whatever its nature, the significance of this activity cannot be detected in the absence of other evidence.

Spatial distribution

As mentioned, this question is the most problematic. This is not because the lateral distribution of bones is of no interest for the interpretation of the site. The main problem is that there is now uncertainty about the information about the contexts from which the bones have come. The bones were not marked, and there are inconsistencies between the information written on the bags and that written on the boxes in which the bones are stored. Many of the bones are now stored in bags by species and anatomical element, rather than by context. It is impossible to try to reconstruct exactly how this happened. The Museum has not made any changes in how the bones were bagged and boxed since they were received in the 1970s (Deathe pers. comm.), so this may be the condition in which they were received by the Museum. The bones have also been handled by many people over time. Whatever the case, we felt that any remaining spatial information had to be treated with extreme caution as it is now unreliable. It was indeed as a consequence of concluding that the surviving context data is unreliable that the decision was taken to treat the assemblage as a single unit for the purposes of this study.

A brief discussion of the problem is necessary, however, not only because differences might be expected between the different areas of the site, but also because this was the question which most concerned Richards & Thomas. These authors detected differences in the distribution of bones between different areas, both as concerns the relative frequency of the two main species and the distribution of body parts. Bearing in mind that Harcourt and Wainwright in the original report noted that there were no differences between different parts of the site, the possibility that the differences detected by the latter authors were an artifice of the bone storage has to be considered. That variation may have occurred between different areas of the site would not be surprising: cattle and pig carcasses were obviously treated in different ways and their bones may have, as a consequence, been disposed of accordingly. Whether the differences detected are genuine or not, our findings do not confirm the conclusions that 'a set of rules governed the deposition of appropriate elements in different parts of the site' (Richards & Thomas 1984, 207).

The second claim by Richards & Thomas is that the bones of wild animals were treated in different ways to those of the domestic animals. They reported that 'many "exotic" species like horse, red deer, roe deer, beaver, fox and dog are found in the south Circle at Durrington (and in some cases nowhere else on the site) and the bones of wild pig and wild ox are only found in the outer ditch'. This conclusion is questionable. As discussed, bones of wild animals are very scarce on the site as a whole. Our analysis of pig biometry showed that only one or two of several thousand pig bones belonged to wild animals, and the apparent context of these — so far as it can be relied on — is the Southern Circle; similarly at least one of the bones of aurochs is from the Southern Circle. Insofar as the present labels can be relied on, the bones of these and other wild animals were not restricted to certain areas of the sites. Thomas, in recent years, has returned to his work on Durrington Walls and applied his results to a more general interpretation of the Neolithic (e.g. Thomas 1991) and the exclusion of the wild animals from the henge is also claimed again. The distinction between bones of domestic and wild animals at Durrington Walls is also recalled by Pollard (1995) in a recent reinterpretation of the material from Woodhenge, the smaller henge located just outside the Durrington Walls enclosure excavated in the late 1930s by Cunnington (1929). Pollard goes on to suggest that the deposition of bones of wild cattle and pig in the Woodhenge ditch signify 'the skills of the hunt and the appropriation of Nature'. He uses the Durrington Walls evidence to suggest that this may be a general character of henge sites: our study suggests this rests on shaky foundations.

Discussion

Our analysis of the animal bones from Durrington Walls has revealed some of the activities carried out at the site which were previously unrecognized or described on the basis of little detailed evidence. Perhaps more importantly, it has provided firm evidence for some of the activities that have been discussed, but not up to now examined in depth.

The butchery and burning point to the fact that pork was cooked using a fairly standard method: large pieces of meat, possibly even complete carcasses, were roasted on the bone. This might be expected to have been a method of cooking which was quite common in prehistory but, judging from the scarcity of the distinctive traces of burning on bones from other sites in prehistoric Britain, the roasting of whole animals and whole joints must have been rare.

The body part analysis, which took into account natural as well as cultural damage to the bones, suggests that whole carcasses of younger pigs were cooked and eaten in the area investigated, while skulls and feet of the slightly older animals were removed elsewhere. Cattle and pigs were butchered, consumed and disposed of in different ways at the site. Variations in the butchery, cooking and survival of the animal bones suggest that diverse activities took place at the site. Some of the pig bones were abandoned or disposed of without being broken open for marrow, something also rare in other assemblages. This and the relatively slight butchery and burning confirm the fact that the meat of some of the pigs was not intensively used, confirming what was suggested by Richards & Thomas (1984).

These considerations together indicate that large amounts of meat were produced in a short time, presumably to feed large gatherings of people. In other words, 'feasting' continues to be an appropriate description of the episodes of meat consumption at Durrington Walls. Indeed, feasting is more clearly suggested by the animal bones from this site than from any other earlier or later site in Britain. Though pigs, and especially young pigs, were the main feasting animals, beef was also cooked and consumed but sheep and wild animals almost entirely ignored.

Fire must have been an important element at Durrington Walls. It is tempting to envisage groups of people, whether a restricted group within the population or the whole community, gathering around fires lighted within the enclosure, while pigs were roasted on spits or in the embers. When most of the meat had been consumed, some were still using the heat and flames of the lighted fires to help in breaking open bones for marrow extraction. The capture and slaughter of the pigs, testified by the flints embedded in some of the bones, may have been part of the ceremony, but the evidence is still too slight for this to be confirmed.

Following the feasts, some at least of the apparently large quantity of bones which were generated were deposited in the ditch and in other features within the henge. The organization of bone deposition may well have had symbolic significance as proposed by Richards & Thomas, but whether or not certain species and elements were deposited in certain features or certain areas of the site cannot now be re-examined owing to the loss of context information.

It is clear that, once deposited, some of the bones were quickly covered and protected from the destruction by dogs, the trampling and the weathering which is the normal fate of bones on early settlements. The very scarcity of dog gnawing, in contrast to its relative abundance in most prehistoric assemblages, suggests either that dogs were excluded from the site or that bones were withheld from the dogs. This too tends to confirm that some special activity other than normal domestic food consumption was taking place at Durrington Walls, even if this was only consumption of out of the ordinary quantities of meat.

The rapid disposal of some of the bones may reflect no more than a concern to leave the area clear of rubbish. Feasts must have been held only occasionally; so, if some people lived at the site all year round, bones may have been removed because it was not seen as appropriate to live among the debris. The fact that not all bones were promptly buried, and that not all were butchered and cooked in the same fashion may confirm that the site had a domestic as well as a ceremonial function, as has been suggested. The complete carcasses of young pigs may have been more specifically associated with the feasting while the butchered carcasses of the older pigs and the cattle were associated with food consumption on a smaller scale at more regular intervals.

Conclusion

Overall, our analysis has reinforced the original interpretation that the site was used for ceremonies and feasting, probably on a large scale. Whether the term 'ritual' is appropriate for describing the activities that were carried out at Durrington Walls depends on the definition of the term preferred. It is certainly appropriate to describe the activities as 'ceremonial', since this term describes a formalized public event. The term 'ritual' implies an activity with symbolic or even religious significance; this may or may not be implied in the communal feasting which took place. As in modern societies, gathering and eating together are important aspects of community life, essential to reinforce social bonds. These are certainly evident here, whether restricted to an élite or engaged in by the whole community. The fact that feasts were held on site does not necessarily imply that symbolic significance was attached to the use of different animals or to different depositional events, but of course it may have done.

Durrington Walls is so far unique for the period in having provided such a large and well-preserved animal bone assemblage. None of the other henges or contemporary sites has an assemblage large enough to give results of the same significance as Durrington Walls. It will be interesting to see if the patterns of element representation and the bone modification which could be clearly observed in the large assemblage from Durrington Walls are also present in smaller contemporary assemblages. Thomas' reconsideration of Mount Pleasant (Thomas 1996), though it contains little detail of the bones, led him to suggest that pigs heads were not disposed of within the palisade enclosure. The element representation at the West Kennet palisade enclosures suggests the same thing. But do other henges such as Coneybury in fact have evidence for pig roasts? And were these confined to henges or to sites with Grooved Ware use? Or were they also carried out at other Neolithic sites?

The assemblage has retained the potential to answer questions about life in the Late Neolithic, but it is from a relatively old excavation and unfortunately some of its potential is now irremediably lost in the uncertainties about the original contexts of the bones and which bones were collected and retained. We must await new excavations on henges on which bones are well-preserved before further studies of the role of animals in these monuments can be understood. Any future excavation at Durrington Walls or a site of similar scale and significance would employ modern methods of recovery (including bulk sieving) and recording, and this would allow the conclusions reached here to be re-examined. Further excavation would also allow the question of structured deposition to be tested. Ethnographic studies have suggested that we might expect pattern in the division of the carcass and also in the deposition and dispersal of the bones, and that this may have had symbolic content. Our past studies of animal bones from sites of all periods have, however, made us acutely aware that most of the bones found on archaeological sites have been subject to so much natural destruction and reworking by dogs, trampling and other activities that no interpretation of bone deposition is justified which fails to take into account site-formation processes and the taphonomic history of the bones and that consequently any such pattern will always remain elusive.

The current desire to consider significance in the deposition of bones on early sites has not been matched up to now by the necessary attention to details of ageing, and to the effects of human and natural bone modifications on the parts of the carcase, including recovery techniques. The natural processes which govern survival of organic materials including bones and teeth are immensely more complex than those which govern survival of pottery. Deposition and survival on sites with a long history of use is a complex topic which can only be tackled when the excavation team and the bone analyst work closely together and are aware of the potential and limitations of each others' data.

The richness of this assemblage has allowed us to reinterpret the activities on site in spite of the limitations of the collection as it exists today. It has shown that there may be a value in reinterpreting assemblages from earlier excavations, but for these especially the analysis has to take into account fully the history of bone recovery and retention and address the various factors which governed the deposition and survival of bones. We hope nevertheless that this paper will inspire other researchers with the confidence that a fresh look at the evidence of the animal bones can provide new and invaluable insights into prehistoric life.

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Chapter 6

Bone Fracture and Within-bone Nutrients: an Experimentally Based Method for Investigating Levels of Marrow Extraction

Alan K. Outram

Animal fat plays a very important role in the diet of most hunter-gatherer peoples and primitive pastoralists or farmers, whether past or present. Fats have a much higher calorific value than either protein or carbohydrates, by a ratio of 9:4 (Erasmus 1986; Mead *et al.* 1986). As such, in any community where there is dietary stress, the heavy exploitation of fat resources may be the only means of survival. This will particularly be the case where a given people are very dependent upon animal products and have little access to sources of carbohydrate. The Inuit would be a good example of such a group. The exclusive consumption of lean meat can lead to severe dietary problems (Speth 1987). One of the most obvious and reliable of sources of fat is the bones. Even when an animal is, itself, suffering from dietary stress and is very lean, there will still be plenty of fat within its medullary cavities. The marrow is the last resource of fat to be exhausted in the fat-mobilization sequence of a starving animal (Peterson *et al.* 1982; Brookes *et al.* 1977; Davis *et al.* 1987).

Faunal analysts have, for a very long time, noted the breaking of bones for the extraction of marrow. Their criterion has always been the presence of a fresh fracture type. These 'helical' fractures, produced when a fresh bone is dynamically fractured, are usually taken as being indicative of the deliberate breaking of bones and this is, quite reasonably, associated with marrow extraction. Such a methodology, for identifying individual instances of marrow extraction, is all well and good. However, if one wishes to assess levels of within-bone fat exploitation throughout whole assemblages, matters become somewhat more complex.

Medullary cavities are not the only sources of bone fat. In many ethnographic examples, grease is extracted by boiling comminuted cancellous bone from appendicular epiphyses and axial elements. The fat is then skimmed from the surface of the water once it has been cooled by the addition of cold water or snow (Binford 1978; Leechman 1951; 1954; Davis & Fisher 1990). This will lead to a great deal of fragmentation in the assemblage. Post-depositional taphonomic agents will then take their toll, increasing fragmentation still further and confusing the fracture patterns. In order to assess levels of bone fat exploitation in an assemblage, many variables must be considered. Levels of fragmentation must be assessed for different types of bone (i.e. diaphysis, epiphysis, axial etc.). Levels of dog gnawing, burning, modern damage and other forms of attrition must be considered. Most importantly, there must be a method for indexing the extent to which diaphysis fragments bear the signs of having been fractured 'fresh'. Examining a shaft cylinder for fresh fracture type poses few problems but where fragmentation is heavy, and only shaft splinters remain, things become more difficult. What is required is a fracture freshness index based upon criteria that do not require a whole bone circumference, and that can be calculated quickly, for a large number of specimens. The establishment of such an indexing method for fracture freshness is the subject of this paper.

This matter is, however, further complicated by the fact that, in many ethnographic examples, bones are not entirely fresh when they are fractured for marrow. There are instances of bones being frozen, being warmed near a fire or heated in water by Nunamiut Eskimo (Binford 1978), to take just one ethnographic example. The reason for heating bones prior to fracture is rarely given in ethnographic accounts. The Kutse bushmen of the Kalahari warm bones (but do not char them) before fracture and then suck out the marrow (Kent 1993, 338). In this instance, it is likely that the warming is intended to melt the outside of the marrow, hence making it possible to suck it out. The !Kung San warm bones by boiling them. This, apparently, gives the marrow a 'desirable consistency' whilst roasting makes it 'too thin' (Yellen 1991, 13).

Johnson (1985) describes the nature of fresh fractures in detail and also indicates that fresh fracture type is easily affected by anything that alters water content or creates micro-cracks. It is, therefore, of paramount importance to establish whether ethnographic examples of pre-marrow extraction bone treatments affect fracture type, thereby inhibiting the identification of marrow extraction. Below, a series of fracture experiments, which emulate ethnographic examples, are described. A method of indexing freshness of fracture is outlined and then tested against the laboratory generated fracture specimens to see whether, firstly, the index is sensitive to changes in fracture type and, secondly, whether pre-marrow extraction treatments of bone will so affect fracture freshness as to make it difficult to separate those bones from ones fractured, after loss of freshness, through some other taphonomic mechanism.

Experimental methods

All the bones in the experiments outlined below were fractured using the same method. Before fracturing took place the bones were cleaned of meat, connective tissues and as much of the periosteum as possible. They were laid upon a stone anvil and struck, mid-diaphysis, with a sharp blow with a water-rounded flint pebble. Further blows to the same spot were used, if necessary, to fracture the entire circumference of the bone, so that it could be parted in two.

After fracturing, the marrow was extracted using a variety of long, metal implements. As many as possible of the fragments resulting from the fracture were collected. For the purposes of preservation, the two halves of the bone and all accompanying fragments were boiled for two hours in a fine net bag and then any remaining soft tissue was removed. The specimens were then degreased by immersion for a short period of time in boiling sodium hydroxide solution, rinsed and allowed to dry.

All the bones used were cattle bones collected in a fresh state (no more than a day old). Many specimens were from fairly young animals with epiphyses not fully fused but with diaphyses of adult size. The exact number of bones and the elements used for specific experiments were largely governed by the fresh supply available at the time of the experiment. The experiments are outlined below.

Fresh specimens

The sample of fresh bones (no more than a day old) consisted of seven specimens; two humeri, one radius, one metacarpus, one femur and two tibia.

Frozen specimens

Four experiments were carried out on frozen bones. Six bones (one humerus, one radius, one metacarpus, one femur, one tibia, one metatarsus) were frozen for two weeks at –20°C and then thawed before fracture. The freezer temperature was maintained by the regular checking of a thermometer. Four bones (one humerus, one radius, one femur, one tibia) were frozen at the same temperature for four weeks and then defrosted. Six specimens (one humerus, one radius, one metacarpus, one femur, one tibia, one metatarsus) were treated to a much longer period of freezing, 20 weeks, before thawing. The fourth experiment was carried out on only two bones (one humerus, one radius) which were frozen at –20°C for 10 weeks but fractured in their frozen state.

Oven-heated specimens

Three experiments were conducted where the specimens were heated in an incubation oven. Four bones (one humerus, one radius, one femur, one tibia) were heated for one hour at between 80 and 100°C. The bones were then fractured fresh from the oven and the maximum temperature of the marrow measured with the use of a digital thermometer. The second experiment followed the same procedures but the four specimens (one humerus, one radius, one femur, one tibia) were heated for five hours. The third experiment, intended to provoke more extreme results, involved heating three bones (one humerus, one radius, one tibia) to between 100 and 120°C for a total of 43 hours. These specimens were also fractured fresh from the oven. The oven temperatures are quoted as ranges because of the oven's slowness in regaining its intended temperature after insertion of the specimens. The temperature of the oven was monitored by the use of a probe attached to a digital thermometer outside the oven.

Boiled specimens

Two boiling experiments were conducted. The first involved boiling three bones (one tibia, two radii) for 10 minutes before fracturing them immediately after withdrawal from the water. The maximum temperature of the marrow was recorded after fracture.

Figure 6.1. *The right-hand fracture on this femur shaft is an archetypal spiral fracture, exhibiting a helical outline and a smooth fracture surface which is at an obtuse or acute angle to the cortical surface.*

Four bones (one humerus, one radius, one femur, one tibia) were boiled for one hour and treated as above.

Specimens subjected to radiant heat

This experiment was designed to replicate the heating of bones placed immediately adjacent to a wood fire. This was achieved by recording the temperature reached by a mercury oven thermometer, placed approximately 15 cm from a domestic-sized wood fire, and reproducing the same effect, in the laboratory, with the use of an electric bar fire positioned to make the thermometer read the same temperature. Obviously the temperature of fires will vary tremendously and different distances from the fire would also cause considerable variation. The purpose of these measurements, however, was simply to produce conditions which are in the correct general range of magnitude. The temperature reached by the thermometer was in the range between 200 and 250°C. This, however, cannot be taken to represent the temperature reached by bones in the experiments below, since the thermometer and the bone will differ in their specific heat capacity and radiative and reflective properties. These figures must be taken as representing nothing more than an indication of the general order of magnitude in the heating.

The first experiment conducted with radiant heat was carried out on three specimens (one tibia, two radii). These specimens were subjected to the above specified radiant heat for six minutes on one side of the bone only. The bones were fractured (by striking heated side) immediately after heating and the maximum temperature of the marrow was recorded after fracture. The second experiment involved subjecting four bones (two tibiæ, two radii) to radiant heat for four minutes. In this case the heat was applied evenly round the bone shafts (the bones were slowly rotated). Fracture took place immediately after heating and the marrow temperature was once again taken.

Radiantly-heated frozen specimens

Four specimens (one humerus, one radius, one femur, one tibia) were frozen for ten weeks at –20°C and, whilst still frozen, were subjected to radiant heat (as above) for ten minutes on one side. The bones were fractured immediately after heating and the temperature of the marrow taken on both the heated and unheated sides of the shaft.

Analytical methods

Each fracture created in the above experiments was analyzed for a series of criteria. These criteria largely follow those outlined by Morlan (1984), Johnson (1985) and Villa & Mahieu (1991), and they are described below. After subjective analysis according to these criteria, the fractures were all assigned 'fracture freshness index' (FFI) values according to the method outlined below.

Fracture outline

The fracture outline is a description of the fracture's basic shape. Fresh bones are generally expected to fracture with a helical fracture. This is a curved fracture that spirals its way round the diaphysis (see Figs. 6.1 & 6.2a). Other outlines tend to be straight breaks, whether they are diagonal, transverse or longitudinal (Fig. 6.2b, c & d). It is important not to confuse a helical outline (Fig. 6.2a) with a diagonal fracture (Fig. 6.2d). A combination of outline types may co-exist in a single fracture. In this analysis the outline types to be found on both the proximal and distal ends of the fractured specimen are described. If no separate fragments were broken away, the two ends will have the mirror image of each other's fractures, but when large fragments are dislodged their outline can be very different.

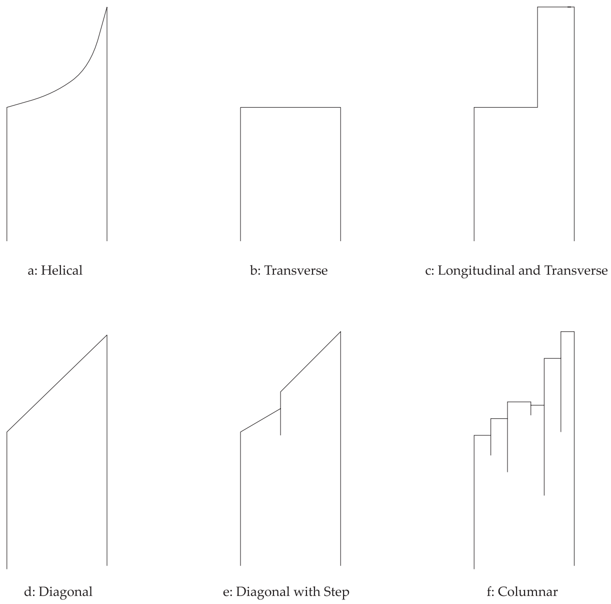

Figure 6.2. *A figure showing the shape of some possible bone fracture outlines: a) helical; b) transverse; c) longitudinal and transverse; d) diagonal; e) diagonal with a step; f) columnar.*

Fracture edge texture

The broken surface of a fresh fracture is usually smooth in nature, whilst on less fresh specimens it may be of rough appearance. In carrying out this aspect of the analysis, it is important to disregard roughness or jaggedness on small areas caused by stress relief features (as described by Johnson 1985), where the fracture line has rippled. Roughness resulting from lack of freshness is relatively easily discerned. The fracture surface appears granular, rather like the edge of a sherd of coarse earthenware or a broken biscuit (see Fig. 6.3). The edge of fresh fractured bone, however, looks more like broken plastic (see Fig. 6.4).

Fracture angle

On a fresh fracture, the angle of the fracture surface to the bone's cortical surface is usually acute or obtuse. Right angles are more common on unfresh specimens. Figure 6.5 illustrates acute, obtuse and right-angle fractures. For this study, an estimate of the approximate percentage of fracture surface that was at right angles was made for both the proximal and distal ends of the bone.

Steps and columns

On unfresh specimens, the fracture outline can become interrupted by micro-cracks already present in the bone. These micro-cracks, which are usually

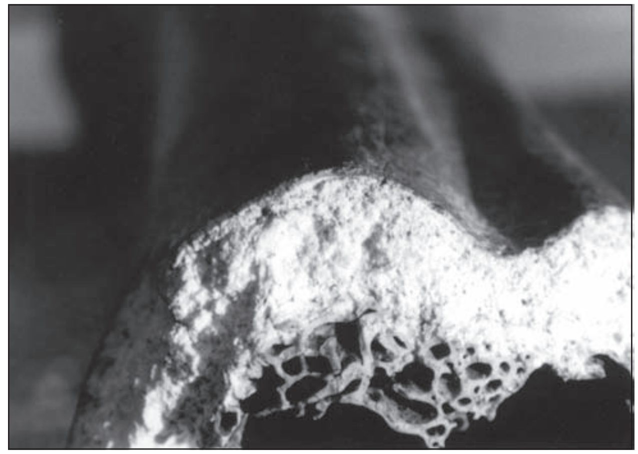

Figure 6.3. *A very granular and rough fracture surface on a metapodial, broken after most of its organic content had been lost.*

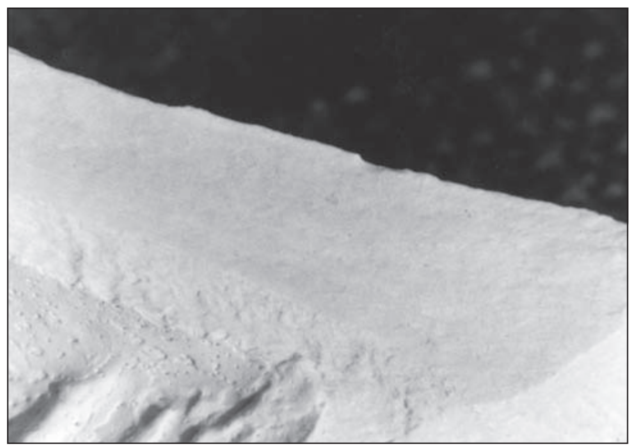

Figure 6.4. *The very smooth fracture surface on a humerus broken whilst fresh.*

caused by loss of water content in the bone (Johnson 1985), tend to be followed by a fracture line, for a distance, creating a step in the fracture outline (see Fig. 6.2e). When this effect becomes very serious the fracture outline may largely consist of small stepped columns (see Figs. 6.2f & 6.6). The presence or absence of such features was noted.

Other features

On fresh fractures, an impact point is often clearly distinguishable and the fracture fronts run out radially from this point (Fig. 6.7). An impact scar is left at the point of impact and, if the bone was struck whilst on a hard surface such as an anvil, there will also be a rebound scar on the other side of the shaft, as a result of equal and opposite forces (Fig. 6.8). Fresh fractures tend to terminate before the articulation

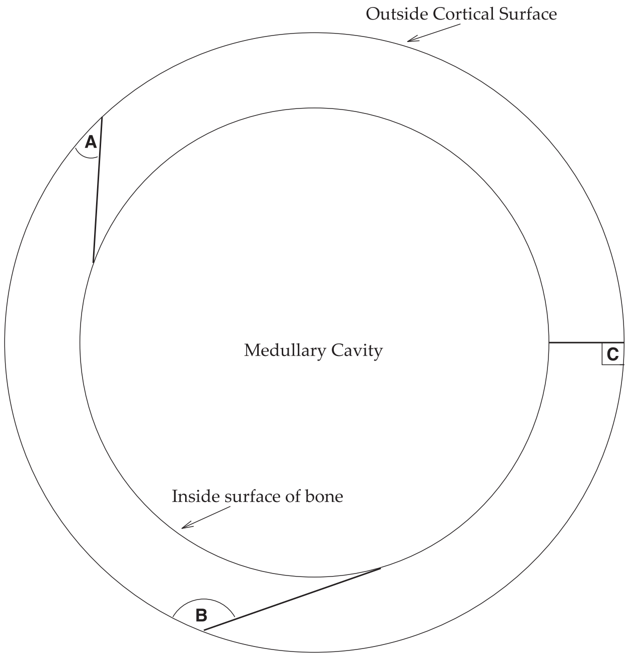

Figure 6.5. *A figure looking longways down the medullary cavity of a longbone showing three possible angles of fracture to the bone's cortical surface: A) acute; B) obtuse; C) at right angles.*

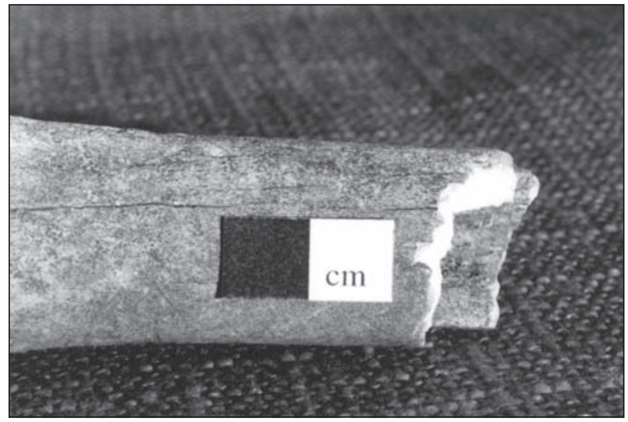

Figure 6.6. *The fracture on this bone exhibits a columnar fracture outline which is symptomatic of the bone having been fractured in an unfresh state after many micro-cracks had formed.*

Figure 6.7. *Spiral fracture lines radiate out from a central impact point on this fresh-fractured humerus.*

Figure 6.8. *This archaeological example of a fresh-fractured shaft splinter exhibits both impact and rebound scars. This suggests that the bone was fractured on an anvil.*

but, on unfresh bones, the fracture might continue and cut across the articulation (Johnson 1985). Information regarding these points was noted.

The Fracture Freshness Index (FFI)

The three principal criteria of fracture angle (criterion A), outline (B) and edge texture (C) were used in the creation of the fracture freshness index. These criteria are being used because they can be applied to all fragments (i.e. impact points, steps etc. cannot be expected to be present on all fragments) irrelevant of whether the whole diaphysis circumference survives or not. For each criterion, a score of zero, one or two was given to each fragment. Zero was scored if the fragment was entirely consistent with fresh fracture according to that criterion. One was scored if some 'unfresh' features were present and two was scored if 'unfresh' features dominated.

Therefore, if a fragment had no fracture surface at 90° to the cortical surface it would score zero for that criterion. If, for instance, 40 per cent of the fracture were at 90° then it would score one. If 50 per cent or more were at 90° then it would score two. For fracture outline, the presence of only a helical fracture means a score of zero, a mixture of fracture type means a score of one and a complete absence of

Table 6.1. *Summary of fracture experiment results.*

Experiment **Element**	**% at 90°**	**Outline**	**Texture**
Fresh			
Humerus	15	H	S
Radius	0	H	S
M'carpal	5	HL	S
Femur	0	H	S
Tibia	0	H	S
Humerus	0	H	S
Tibia	0	H	S
2 wk Frozen			
Humerus	40	H	SR
Radius	30	H	SR
M'carpal	5	HL	S
Femur	0	H	S
Tibia	0	H	S
M'tarsal	20	HL	S
4 wk Frozen			
Humerus	0	H	S
Radius	10	H	SR
Femur	0	H	S
Tibia	20	H	S
20 wk Frozen			
Humerus	10	H	S
Radius	20	H	S
M'carpal	25	H	SR
Femur	15	HD	SR
Tibia	35	HL	SR
M'tarsal	0	HL	S
10 wk Frozen (not thawed)			
Humerus	10	H	S
Radius	10	H	S
1 hr in Oven			
Humerus	30	H	SR
Radius	15	TLD	SR
Femur	5	HL	SR
Tibia	20	H	S
5 hr in Oven			
Humerus	35	TH	RS
Radius	0	LD	R
Femur	15	DLH	SR
Tibia	30	DL	SR
43 hr in Oven			
Humerus	45	TLD	R
Radius	50	TLD	R
Tibia	0	TLD	RS
10 min. Boiled			
Tibia	10	HL	SR
Radius	50	HT	SR
Radius	0	H	SR
1 hr Boiled			
Humerus	50	TLD	R
Radius	†	LD	R
Femur	0	HD	SR
Tibia	60	HL	R
Radiant Heat: 6 min., 1 side			
Tibia	0	H	SR
Radius	10	HD	SR
Radius	7.5	LDTH	RS
Radiant Heat: 4 min., even			
Tibia	0	H	S
Tibia	20	HT	SR
Radius	10	H	S
Radius	30	HLD	SR
Frozen 10 wk, Radiant Heat 10 min., 1 side			
Humerus	0	H	SR
Radius	70	TLD	R
Femur	27.5	HT	SR
Tibia	17.5	HL	SR

Key:
H = Helical, L = Longitudinal, T = Transverse, D = Diagonal.
Combinations of letters mean more than one outline type is present.
R = Rough, S = Smooth, SR = more smooth than rough, RS = more rough than smooth.
† = This specimen was far too jagged to be assessed for angle criterion.

helical fracture means a score of two. For fracture texture, zero means an absence of roughness (apart from aforementioned stress-relief features), one means some roughness but mainly smooth and two means largely rough.

To create the index value for a given fragment, the scores for the three criteria are summed up. This gives an index ranging from zero to six. Zero indicates a specimen entirely consistent with fresh fracture and six indicates a specimen that has lost almost all fresh fracture features. To create an average index value for each of the experiments, the mean of scores for each criterion was calculated for all specimens in that experiment and then those means were summed.

It is important to note that this scoring system is deliberately rough and ready. It is based on criteria that can be assessed very quickly by estimation. Fracture angles are not measured, nor should they be. Whether or not rough fracture surface dominates is estimated, detailed percentages are not arrived at through measurement. Some authors, for example Biddick & Tommenchuck (1975), have attempted detailed recording systems for fracture outline, but such methods are very time-consuming (and descriptive

Table 6.2. *Mean criteria scores and fracture freshness index by experiment.*

Experiment	A	B	C	Index
Fresh	0.29	0.14	0.00	0.43
2 Weeks Frozen	0.67	0.33	0.33	1.33
4 Weeks Frozen	0.50	0.00	0.25	0.75
20 Weeks Frozen	1.00	0.50	0.50	2.00
10 Weeks Frozen (not thawed)	1.00	0.00	0.00	1.00
1 Hour in Oven	1.00	0.75	0.75	2.50
5 Hours in Oven	0.75	1.50	1.50	3.75
43 Hours in Oven	1.00	2.00	2.00	5.00
10 Minutes Boiled	1.00	0.67	1.00	2.67
1 Hour Boiled	1.33	1.50	1.75	4.58
Radiant Heat (6 min., 1 side)	0.67	0.67	1.33	2.67
Radiant Heat (4 min., even)	0.75	0.75	0.75	2.25
10 wks Frozen, 10 min. Radiant Heat	1.00	1.00	1.25	3.25

rather than interpretative) and unlikely to be applicable to the analysis of large assemblages. In using a quick scoring system, like the one suggested here, there is likely to be some error on individual specimens. The aim of this study is not to interpret individual specimens, however, but large assemblages, where errors are likely to average out.

Results and observations

Table 6.1 gives a summary of the results obtained from each experiment. The original recording was in far greater detail. Table 6.2 gives the mean scores for each experiment and the FFI value (angle is A, outline is B and texture is C). Below, observations on each of the experiments are made.

Fresh

All the fresh specimens fractured according to expectations. The outlines of the fractures were helical and the edges were smooth. The metacarpus, however, had a slight area of longitudinal fracture, but this was almost certainly a result of the natural division down the centre of the metapodials of artiodactyls. The fracture angle was rarely at right angles. Most of the specimens displayed clear impact points and some also showed rebound points. The point of rebound is like a second impact point, on the underside of the bone, where the bone rebounded off the anvil (Johnson 1985). The fracture of fresh bones required, on the whole, just a single sharp blow. The average FFI value was 0.43.

Two weeks frozen (thawed)

Once again, the fractures were largely smooth and helical with some longitudinal fracturing on the metapodials. Both the humerus and radius, however, had a certain amount of right angle fracturing. Impact points were often present. The ease of fracture was the same as for fresh specimens. The average FFI value was 1.33.

Four weeks frozen (thawed)

Fractures were again helical and largely smooth with very little fracture at right angles. Impact points were present in all but one specimen. One blow was normally required for fracture. The average FFI value was 0.75.

Twenty weeks frozen (thawed)

Fracture was still largely helical after twenty weeks frozen. However, there was some diagonal fracture on a femur, some longitudinal fracture on a tibia and the expected longitudinal fracture on metapodials. The outlines were slightly more jagged and less uniform than those found on experiments described above. The fracture surfaces were generally smooth. Some right-angle fracture was encountered on every specimen, although in small amounts. Impact points were generally still present and fracture was still achievable with a single sharp blow. The average FFI value was 2.00.

Ten weeks frozen (not thawed)

The two specimens broken whilst frozen created smooth, helical fractures with very small amounts of right angle fracture. Impact points were present and fracture was easily carried out. The average FFI value was 1.00.

One hour in oven

Fracture of these specimens produced largely helical fractures. The femur produced some longitudinal fractures but the radius was the major exception creating a combination of diagonal, longitudinal and transverse fractures, with very little helical fracture present. Some roughness on edges was encountered on three of the four specimens. Some right angle fracture was present on all specimens. Impact points, as such, were generally absent. Instead, an area of crushing was often present. Some of the specimens were distinctly harder to break than fresh or frozen specimens. After breaking it was observed that the marrow in the cavities was loose, because a fair portion of it was molten. The temperature of the molten marrow was *c.* 45°C at the time of breaking. The average FFI value was 2.50.

Five hours in oven

Some helical fractures were present, but most fractures consisted of a mix of outline types. The radius was particularly jagged. There was a degree of roughness on all fracture surfaces. Right-angle fracture was present in significant quantities on the humerus and tibia and also present on the femur. The radius was free from any right angles owing to its jaggedness. No impact points were present. These specimens were not difficult to break. Much of the marrow fat was liquid in the cavity. This fat was *c.* 75°C at the time of breaking. The average FFI value was 3.75.

Forty-three hours in oven
No helical fracture was present. Instead there was a combination of other outline types. The edges were rough or largely rough. No impact points were present and the articulations were crosscut on both the humerus and radius. Two of the three specimens had large proportions of right-angle fracture. Upon impact the specimens shattered creating many small fragments. The marrow cavities were completely dried out. The average FFI value was 5.00.

Boiled for ten minutes
The fractures on these specimens were largely helical and smooth. One radius, however, had some rough, transverse fracture. This specimen also had a large degree of right-angle fracture. The other two specimens had little or no right-angle fracture. Impact points were not present and the bones were more difficult to break than fresh ones. Upon fracture the marrow was partly molten and at a temperature ranging between 57°C and 67°C for the different specimens. The average FFI value was 2.67.

Boiled for one hour
On the humerus and radius, helical fracture was entirely absent and on the tibia there was a mixture of helical and longitudinal fracture. The femur was anomalous in having mainly smooth, helical fracture without right angles. The humerus and tibia featured much rough, right-angle fracture. Because the radius was jagged and saw-tooth in its fracture outline it was impossible to assess proportions of right-angle fracture. These bones were incredibly difficult to break and upon fracture the marrow cavities were almost entirely devoid of marrow. The marrow had presumably all melted and made its way out of the bone through the foramen. The average FFI value was 4.58.

Six minutes radiant heat, one side
This experiment resulted in a degree of helical fracture on all specimens, mixed with other fracture types. Similarly there was a mixture of rough and smooth fracture on each specimen. Right-angle fractures were present in only small quantities. An impact point was present on one specimen. The heated side of the bone had not been browned or charred in any way as a result of its treatment. The marrow was, however, quite hot and molten on the heated side. The maximum marrow temperature ranged be-tween 60°C and 74°C on the different specimens. The specimens were slightly harder to break than fresh bones. The average FFI value was 2.67.

Four minutes radiant heat, even
Most of the fractures were largely helical and smooth. Right-angle fractures were present on three of the four specimens, but in fairly low proportions. Impact points were present on two examples and one rebound point was present. The bones were not particularly difficult to break and the marrow was part molten round the edges with maximum temperatures ranging from 31°C to 52°C. The average FFI value was 2.25.

Ten weeks frozen, ten minutes radiant heat, one side
The humerus was the only specimen to produce a largely helical, smooth fracture. The femur and tibia produced a combination of helical and other fracture types and had both rough and smooth fracture surfaces. The radius produced mainly rough fractures with transverse, longitudinal and diagonal outlines. The radius also produced this series of experiments' only clear steps caused by cracks present prior to fracture. Two large, right-angled steps were present on the heated side of the bone. Two cracks, probably resulting from differential expansion caused by sudden heating of the frozen bone (heat shock), had clearly interrupted the fracture path. All but the humerus had proportions of right-angle fracture. The radius had very high proportions. An impact point was only present on the humerus. The bone had begun to char on the heated side as a result of the treatment. Upon examination of the marrow cavity it was found that the marrow was molten on one side and still very cold on the other. At its most extreme, on the radius, the temperature of the marrow on the heated side was 70°C and on the unheated side was still below freezing point. The average FFI value was 3.25.

General observations
Several general observations should be made at this point. Firstly, it seems that the experiments largely lived up to theoretical expectations. Fresh bones pro-

duced helical, smooth fractures with sharp angles and, on the whole, the harsher the treatment the bones were subjected to, the less this was the case. However, there were frequent exceptions. Some of these exceptions are probably due to the different level of effect various treatments had on different elements. They could also be due to variation in the author's fracturing technique. It certainly seems that the use of criteria, listed above, will not guarantee a correct diagnosis of degree of freshness at time of fracture for every individual specimen. In fact, some of the criteria can be at odds with each other. For instance, in the 'Two Weeks Frozen' experiment, the humerus had entirely helical fractures but a sizeable proportion, *c.* 40 per cent, of right-angle fracture. Conversely, the radius in the 'Five Hours in Oven' experiment had no right-angle fracture but no helical fracture either! There are other, similar, examples. It seems, how-ever, that the average result for each experiment was in line with expectations. It should be stressed that this methodology has not been devised for the study of individual fractures. It is an average result that would be important in assemblage analysis.

Secondly, it was surprising to find that the heated bones, particularly the boiled ones, were, in general, far more difficult to fracture than fresh specimens. Bonfield & Li (1966) demonstrated that bones '. . . exhibit a pronounced maximum in strength at 0°C'. Their experiments included elastic and plastic deformation as well as impact testing at a range of temperatures from –196 to 900°C. So why were the heated specimens in this set of experiments so difficult to fracture? One explanation might lie with the fact that Bonfield & Li (1966) carried out their experiments on thin, rectangular cut strips of bone rather than whole bones, as in this series of experiments. With a whole bone, a fracture line clearly has to travel round the whole circumference of the diaphysis before the marrow cavity can be properly accessed. The boiled and oven heated bones (apart from the 43-hour oven specimen which was incredibly brittle) seemed harder to break, not because they were not fracturing, but because the fractures were not meeting up to allow the shaft to break in two. When the shaft finally became broken fully around its circumference, it was because many fractures, often travelling in different directions, had met. This accounts for the jaggedness of some specimens. Helical fracture, in fresh bone, travels around the circumference of the diaphysis naturally, making access to the marrow cavity much easier.

Thirdly, some of the treatments used were clearly too harsh to ever be successfully employed before marrow extraction. Boiling for one hour resulted in marrow loss, whilst boiling for ten minutes resulted in melting the outside of the marrow, which might aid marrow extraction or improve consistency (see above). Heating the bone for one hour in the oven melted some of the marrow, whilst heating it for five hours resulted in most of it being liquid. Heating for 43 hours resulted in drying the marrow out completely. The application of radiant heat for a short time melted some of the marrow which, again, might ease marrow extraction. It was the author's own experience that it was easier to extract marrow if the outside part was molten.

Optimizing the Index

It can be seen from Table 6.2 that the Fracture Freshness Index, as calculated, has broadly classified the experiments according to expectations. The FFI value is, in general, higher the more severe the pre-fracture treatment is. The only real exception is the 'four weeks frozen' experiment, which has a lower value than the 'two weeks frozen experiment'. It may, however, be possible to improve the index. The way each of the criteria was scored may not lead to optimal results. Calculating the level of statistical correlation between each of the criteria and between the criteria and the average index will indicate if the criteria are in agreement. It will also indicate if one of the criteria is weak and in need of adjustment.

Pearson's coefficients of correlation have, therefore, been calculated. The correlation between criteria B (outline) and C (texture) is very high (0.9450, p = 0.000) and significant. A (angle), although having positive correlations with B and C (0.5223, p = 0.067 and 0.5290, p = 0.063 respectively), does not have particularly high levels of correlation. Both B and C correlate very well with the overall index (0.9706, p = 0.000 and 0.9741 p = 0.000 respectively), whilst A does not correlate quite so well (0.6663, p = 0.013). It seems, therefore, that criterion A, as it stands, might be a weak link in the index. The way it is scored might be improved.

In reviewing the way angle was scored, it was noted that fairly classic helical fractures could produce small amounts of right-angle fracture. As such, the scoring system for angle was altered to allow up to an estimated 10 per cent right angle fracture before a score of one was awarded. The result of this adjustment can be seen in Table 6.3 (the adjusted criterion A is denoted A_1 and the new index, $Index_1$). This resulted in very much improved levels of correlation. A_1 has a correlation of 0.7782 (p = 0.002) with

B and 0.6993 (p = 0.008) with C. The correlations between A_1, B and C and $Index_1$ were all both high and significant (0.8514 p = 0.000, 0.9808 p = 0.000 and 0.9622 p = 0.000 respectively). Further slight improvements were made possible by altering the scoring percentages for angle more still. However, very little advantage was gained and those scoring systems were ignored on the basis of being too difficult to assess through estimation. Dismissing the first 10 per cent of right-angle fracture, though, is easily achievable in analysis. It is concluded, therefore, that $Index_1$, due to its high level of internal agreement and ease of application, is the best index to use.

Discussion

Table 6.4 puts all the experiments in decreasing order of fracture freshness according to $Index_1$. They have been split into three groups. In the first group are the fresh and frozen experiments. It appears that freezing had little effect upon fracture type. All of these experiments have low index scores. As pointed out earlier, the 'four weeks frozen' experiment appears to be out of place. One would naturally expect the longer treatments to get the higher, less fresh scores. There is no explanation that can be offered for this, other than random error. Also, with $Index_1$, the '10 weeks frozen (not thawed)' experiment comes out as completely fresh. This may be more easily explained. Firstly, only two bones were used in this experiment, opening it up to more random error and, secondly, these bones were not defrosted before fracture like the other freezing experiments. The process of defrosting is likely to cause micro-cracks resulting in a higher FFI score.

The second group of experiments consists of experiments that replicate pre-marrow extraction likely to be encountered in ethnographic examples. All the treatments were found to melt some of the outer marrow, which would make it easier to extract. These treatments, which all involved mild heating, resulted in less fresh fracture features being present than was the case with the frozen experiments.

The final group consists of pre-fracture treatments unlikely to be used prior to marrow extraction. The 'one hour boiled' and the '43 hours in oven' experiments both resulted in complete loss of marrow. The 'five hours in oven' experiment resulted in some marrow loss and its complete liquefaction. This is not a desired effect for the extraction of marrow as encountered through the study of ethnographic examples. The heating of a bone next to a fire whilst it is still frozen might be a conceivable practice, but would be unlikely to be carried out in this way. In this experiment the marrow was molten on the outside but still frozen elsewhere. All these unlikely treatments produced much higher, more 'unfresh' FFI scores.

It seems that all sensible pre-marrow extraction treatments resulted in scores under three on the index. It appears that the FFI is very sensitive in picking up changes in fracture type caused by pre-fracture treatments, and there are few clear anomalies. The FFI can distinguish between fresh bones, those suffering mild treatments and those suffering more extreme treatments. The index, therefore, appears to be a useful tool in assemblage analy-

Table 6.3. *Mean criteria scores with adjusted criterion (A_1) and adjusted fracture freshness index by experiment.*

Experiment	A_1	B	C	$Index_1$
Fresh	0.14	0.14	0.00	0.28
2 Weeks Frozen	0.50	0.33	0.33	1.16
4 Weeks Frozen	0.25	0.00	0.25	0.5
20 Weeks Frozen	0.67	0.50	0.50	1.67
10 Weeks Frozen (not thawed)	0.00	0.00	0.00	0.00
1 Hour in Oven	0.75	0.75	0.75	2.25
5 Hours in Oven	0.75	1.50	1.50	3.75
43 Hours in Oven	1.00	2.00	2.00	5.00
10 Minutes Boiled	0.67	0.67	1.00	2.34
1 Hour Boiled	1.33	1.50	1.75	4.58
Radiant Heat (6 min., 1 side)	0.00	0.67	1.33	2.00
Radiant Heat (4 min., even)	0.50	0.75	0.75	2.00
10 wks Frozen, 10 min. Radiant Heat	1.00	1.00	1.25	3.25

Table 6.4. *Experiments in order of freshness of fracture according to adjusted Fracture Freshness $Index_1$.*

10 Weeks Frozen (not thawed) (0.00)
Fresh (0.28)
4 Weeks Frozen (0.50)
2 Weeks Frozen (1.16)
20 Weeks Frozen (1.67)

Treatments having a limited effect upon fresh fracture type. Fresh features dominate.

****

Radiant Heat, 4 min., even (2.00)
Radiant Heat, 6 min., 1 side (2.00)
1 Hour in Oven (2.25)
10 Minutes Boiled (2.34)

Treatments having some effect on fracture type, but there is still a majority of fresh features.

****

10 wk Frozen, 10 min. Radiant Heat, 1 side (3.25)
5 Hours in Oven (3.75)
1 Hour Boiled (4.58)
43 Hours in Oven (5.00)

Treatments having more severe effect. There is a majority of unfresh features.

sis that will be able to ascertain whether fracture type is consistent with marrow extraction techniques (a score under three) or not.

The goal of the experimental part of this study was to assess the validity of an index of fracture freshness in distinguishing between fractures consistent with marrow extraction and those that are not. This goal appears to have been successfully met. It should be stressed that, in statistical terms, the experimental sample sizes were quite small (although in practical terms they were quite large). As such, this study should only be seen as a pilot study into fracture types resulting from different marrow extraction techniques, which was intended to answer a specific question. This study would therefore be insufficient to support the identification of specific treatments, for instance. More detailed experimental work in the future, with the use of larger sample sizes, a more systematic study of the different levels of treatment and testing by a number of different analysts, would hopefully strengthen the methodology presented here and might allow for greater resolution of interpretation.

Example applications

Below, are two summarized examples of the application of the Fracture Freshness Index. The first is an examination of a high-altitude, Mesolithic site in the Italian Dolomites, the second is an analysis of a medieval Norse settlement site in Greenland. In both these cases not only bone-marrow exploitation, but also bone-grease exploitation, was being studied. In order to study rendering for bone grease one must assess the extent and nature of fragmentation as well as fracture type. The Fracture Freshness Index was principally designed to identify marrow extraction from bone shafts. The same criteria cannot be used to assess fracture types on cancellous bone comminuted during grease rendering. However, the FFI, as well as helping to identify marrow extraction (which commonly occurs before grease rendering), also tells one much about post-depositional taphonomy. Hence, if most shaft fracture is fresh then it strengthens the argument that high levels of fragmentation associated with grease rendering were the result of that practice rather than post-depositional attrition, which would have resulted in more dry and mineralized fractures of shaft fragments. The FFI is thus used below in arguments relating to both marrow extraction and grease rendering.

Mondeval de Sora is situated above the tree line, at 2100 m above sea level, in the Italian Dolomites. It is a cave site with occupation dating from the Sauvetarrian culture (seventh mil. BP) (Alciati *et al*. 1992), continuing through the Castelnovian (sixth mil. BP) and, after a hiatus, being re-used in the Copper Age. Its animal bone assemblage, which consists largely of ibex and red deer (Rowley-Conwy pers. comm.), is extremely fragmented. Almost all cancellous bone on this site has been reduced to small fragments and virtually no elements survive unfragmented (Outram 1998). Most of the larger fragments are shaft fragments. This fragmentation pattern is consistent with the fracturing of the bones for marrow, followed by the comminution of cancellous bone for the purpose of grease rendering. In order to corroborate this theory, it is essential to ascertain whether this fragmentation pattern was created whilst the bones were fresh. It is conceivable that it could be the result of density mediated, post-depositional attrition. Application of the fresh fracture index should provide the answer.

Figure 6.9 shows a break-down of the number of fragments attaining each of the FFI scores for one of the Sauveterrian contexts. Scores of three dominate but scores of zero, one and two are well-represented (particularly zero). Representation tails off through four, five and six. The mean FFI score for the sample is 2.52 (N = 300). Certainly not all of the assemblage was fractured fresh; there must have been some damage occurring after the bones were dried. However, the average is under three and there is a very strong representation of specimens scoring zero. This suggests that most of the fragmentation was due to fresh, or near-fresh, fracture and, as such, it seems very likely that the fragmentation pattern encountered is due to marrow extraction and bone-grease rendering.

Moving to the second example, the farmstead of Sandnes is the largest in the medieval Norse Western Settlement of Greenland. The occupation of the

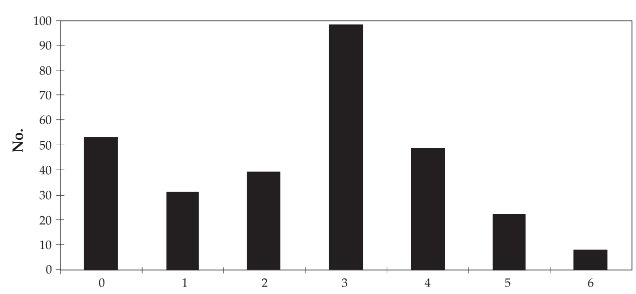

Figure 6.9. *A histogram showing the frequencies of FFI scores for a sample from the Sauveterrian layers of Mondeval de Sora, northern Italy.*

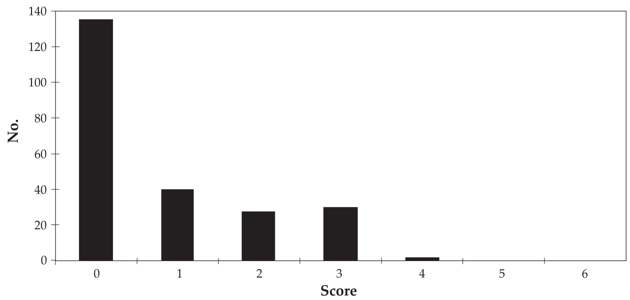

Figure 6.10. *A histogram showing the frequencies of FFI scores for a sample from the midden at Sandnes, Western Greenland.*

site started around AD 985 and ended by the close of the fifteenth century (Buckland *et al*. 1996). The inhabitants relied principally upon milk and meat from their domestic livestock, cattle, sheep, and goats, for their subsistence. This diet was subsidized by land-based hunting of seal, birds and caribou (McGovern 1985; Buckland et al. 1996). The climate was very harsh making this subsistence very marginal, and the Norse did not adopt Inuit subsistence methods and did not fish or hunt marine mammals by boat (Buckland et al. 1996). No fat-loving diptera (true flies) larvae were found in their middens. This led Buckland et al. (1996) to the conclusion that the subsistence stressed Norse had rendered all their bone waste for its valuable fat content.

The bone assemblage is indeed very fragmented (though not as extreme as Mondeval) and it is once again shaft fragments that dominate the larger size classes of fragments, with almost all cancellous bone, apart from the ribs, having been comminuted (Outram 1998; 1999; 2001). On this site the analysis of fracture freshness gave very clear results. Figure 6.10 shows the breakdown of index scores for the Sandnes midden sample. Scores of zero dominate by far and very few scores over three were recorded (and none over four). The mean Fracture Freshness Index value is 0.83 (N = 235). This leaves very little doubt that almost all fracture occurred on fresh bones. This, coupled with the entomological evidence and the fragmentation pattern strongly support the theory that the bones were being rendered for grease after marrow was extracted.

Conclusion

It has been experimentally demonstrated that a simple-to-apply index, based upon fracture outline, angle and texture, can discern between fracture types consistent with marrow extraction and those which are not. As well as working in theory, this method appears to work in practice. Its application has much strengthened the evidence for bone-fat rendering and marrow extraction at the above two sites. Furthermore, at the Greenlandic site, the conclusion suggested by interpretation of the bone fracture and fragmentation is corroborated by other forms of environmental evidence. The Fracture Freshness Index can also be used to examine other aspects of taphonomy, such as post-depositional attrition. If more detailed fracture experiments are carried out in the future, it is possible that more detailed interpretations might be ventured on the basis of fracture analysis.

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Chapter 7

Mesolithic Meals from Mesolithic Middens

Preston Miracle

The goal of this paper is to take topics like 'Mesolithic diet' and 'subsistence strategies of late glacial–early postglacial foragers' and explore ways in which food may have been 'good to think' as well as 'good to eat', to turn around Harris' (1985) phrase. Contrary to the spirit of Lévi-Strauss' initial dictum, this approach need not deny the evolutionary underpinnings of many aspects of human food behaviour, including choice (Harris & Ross 1987; Kaplan & Hill 1992), taste (Speth 1990), time allocation (Hames 1992), sharing (Hawkes 1993), and so forth. As people do not live by calories alone, consideration of the social contexts and cultural meanings associated with food and its consumption can enrich our understandings of hunter-gatherers of the past and present. Instead of contributing yet another polemic to the rather stale debate between 'evolutionary explanation' versus 'cultural interpretation', I use a late glacial–early postglacial archaeological case study from Istria, Croatia, to develop methods for inferring contexts of consumption from food waste.

Food is material culture. It cannot be understood divorced from the social and cultural context in which it is produced and consumed. Food plays an 'active' role in the creation of socio-cultural contexts and the negotiations of power enacted therein. Food creation and consumption have often been studied anthropologically in terms of cuisine and feasts (e.g. Appadurai 1981; Douglas 1972; 1984; Goody 1982; Lévi-Strauss 1969; 1978; Wiessner & Schiefenhövel 1996). 'Cuisine' refers to the manner of preparing food, the style of cooking, and the prepared food itself. Feasts are 'public ritual events . . . [that] provide an arena for the highly condensed symbolic representation of social relations' (Dietler 1996, 89). Archaeological interest in food, cuisine, and feasting has been relatively scant until recently (e.g. Dietler 1996; Gosden & Hather 1999; Gummerman 1997; Hayden 1996; Samuel 1996), particularly among prehistorians.

Focusing our gaze on earlier periods, we find fewer and fewer studies of cuisine and feasting as we move back in time. Why is this so? One reason is certainly the progressive scarcity and impoverishment of the archaeological record with greater time depth (Dietler 1996). Also, containers are key to food preparation and presentation (Goody 1982; Dietler 1996). They have a profound effect on how food is processed, cooked, and combined in consumption. The relative lack of containers during the Mesolithic and Palaeolithic, whether the true situation or owing to a preservational bias, has certainly curtailed discussions of cuisine during those periods. In the absence of containers cuisines are assumed to be either extremely simple (Goody 1982) or unknowable (Dietler 1996). These assumptions are not warranted, however, given widespread ethnographic accounts of foragers using stone boiling in pits and pitch-lined baskets (Binford 1978; Murphy & Murphy 1986, 293, 295), as well as direct boiling in soapstone and other non-ceramic containers (Boas [1888] 1964, 137). In the Great Basin of North America, the thoracic cavity of an eviscerated antelope or deer carcass was sometimes used as a container for cooking other foods (Fowler 1986, 82). In central Australia seed flour dough was baked in hearth coals (Spencer & Gillen [1899] 1968, 22). The development of boiling and grinding technologies certainly mark a very significant watershed in food preparation and cooking; both have their roots in the Late Pleistocene (Hayden 1981; Speth 1991).

Of equal or greater importance are the sources of interpretative models. Working from the premise that the present is the key to the past, Mesolithic (and Palaeolithic) archaeologists frequently turn to the literature on recent foraging peoples (e.g. Lee & DeVore 1968; Kelly 1995). The cuisines of recent foragers, however, have received little systematic attention. Although there are synthetic discussions of food procurement technologies and tactics (e.g.

Bicchieri 1972; Kelly 1995), as well as dietary choices (e.g. Winterhalder & Smith 1981; Kaplan & Hill 1992), there are not any general overviews of food preparation and cooking techniques. The latter topics are often discussed in regard to food sharing (e.g. Hawkes 1993; Wiessner 1996) and the sexual division of labour (e.g. Kelly 1995). Animals and plants do figure prominently in discussions of totems and taboos, which have important implications for food choice (mostly as avoidance, e.g. Hayden *et al.* 1986; Spielmann 1989; Speth 1990). Although these products, practices, and ideologies are clearly components of cuisines, researchers have rarely discussed them as such. The avoidance of 'cuisine' in studies of human foragers reflects long-standing, tenacious, and partially hidden assumptions that these people are closer to nature and the 'pure' human condition (see Kelly 1995); their cuisines do not warrant discussion as they 'naturally' follow from the species hunted and the plants gathered. Finally, the 'invisibility' of forager's cuisines also has gender dimensions since cooking and food preparation are often women's work and such work has often been undervalued by men, whether ethnographers or foragers.

While great strides have been made in understanding forager's diets and subsistence strategies through the use of approaches such as optimal foraging theory borrowed from animal ecology (e.g. Bettinger 1991; Kaplan & Hill 1992; Kelly 1995), we know much less about the social contexts and meanings associated with and created by food consumption. Given the lack of interest in the cuisines of human foragers, it is not too surprising that there has been little discussion of the topic among Palaeolithic and Mesolithic archaeologists. In sum, we know little about foragers' cuisines, whether of the recent or more distant past. These cuisines may be complex, variable, and revealing about the constitution and context of consumption.

There is a fair amount of ethnographic evidence of feasting among human foragers, and Hayden (1996) has suggested that there are three basic types of feast: celebratory, mutual aid, and commensal. The first two types are thought to serve functions of social bonding and risk buffering, and are widely known among hunter-gatherers, whether 'simple' (immediate-return) or 'complex' (delayed-return). These feasts are often treated as by-products of seasonal aggregations of mobile and dispersed populations; the primary functions of these population aggregations are thought to be exchanges of people (marriages), items (raw materials and artefacts), and information (rituals, resource availability). From an ethnographic standpoint, most of the interest has been in the associated exchanges rather than in the feasts themselves, although the labour and food requirements were often substantial. Aggregation sites would have been places of increased social activity and fluidity, where a range of social relationships would have been in a state of flux and up for negotiation (Conkey 1991).

Commensal feasts share the basic characteristics of diacritical display, control over labour, and economic gain (Hayden 1996). Food and the social contexts of its consumption are central to commensal feasts, and the ethnographic accounts of the Kwakiutl 'potlatch' and other American Northwest Coast cultures (e.g. Boas 1966; Codere 1950) figure prominently in the definition of commensal feasts. The exploitation of kin and non-kin labour was key to preparations, including the short-term accumulation of food and goods to be consumed, exchanged, given, and/or destroyed at competitive feasts. Competitive feasts were thus manipulated by so-called 'Triple A' personalities (aggrandizers, accumulators, acquisators) for personal gain. These competitive feasts thus helped to create and maintain social inequalities, and much of the interest in competitive feasting has been in looking at it as a mechanism for the emergence of social inequality (Arnold 1993; Hayden 1996).

The archaeology of food, cuisines, and feasts

While 'cuisine' in the abstract may be a useful concept, can it be operationalized in archaeological practice? Goody (1982) presents a useful framework for thinking about cuisines. He suggests five distinct phases through which food passes from procurement to disposal (Table 7.1). These phases are associated with different processes (activities), may vary in location and performance, and may be strongly conditioned by and indicative of particular cultural factors. Identification of 'dominant cultural factors' is somewhat problematic, as for example belief systems will define what is/is not food (procurement), structure sharing (distribution), and influence cooking (preparation). Nevertheless, this scheme is heuristically useful since it highlights ways in which different dimensions of food are embedded in cultural practices. Furthermore, many aspects of these different phases of food provision will leave material traces (Samuel 1996). While the complexity and multidimensionality of food and cuisines makes the existence of one-to-one correspondences between material remains and specific practices unlikely, nonetheless, the phases through which food is

Table 7.1. *Phases of food provision. (After Goody 1982; Samuel 1996.)*

Processes	Phases	Locus	Dominant cultural factors
collecting/hunting	Procurement	region	economics, what is/is not food
sharing/storing	Distribution	site	politics, division of labour
cooking	Preparation	hearth	division, stratification of labour
eating	Consumption	eating area	belief systems, taboos
clearing up	Disposal	midden	cultural definitions of waste

created and transformed should be quite visible archaeologically.

One potential shortcoming of Goody's (1982) scheme is that it directs attention to the identification of phases and their content instead of on the links between phases and the ways in which food is transformed through the cycle of procurement to disposal. The scheme presented in Table 7.1 is static. Focus on the temporally contingent nature of the food cycle will give us a more dynamic understanding of the interrelationships among the different phases. Timing and sequence are also critical to how cuisines are defined. By shifting attention from the phases themselves to their interrelationships in a cycle also brings our definition of food closer into line with the intent of the *chaîne opératoire.*

This scheme of food provisioning phases bears many similarities to Leroi-Gourhan's (1993) concept of a *chaîne opératoire* or operational sequence as

> an ordered train of actions, gestures, instruments or even agents leading the transformation of a given material towards the manufacture of a product, through major steps that are more or less predictable (Karlin & Julien 1994, 164).

The *chaîne opératoire* has been widely applied in studies of lithic technology (e.g. Karlin *et al.* 1991) and to a lesser extent pottery production (e.g. van der Leeuw 1993). While applications of the *chaîne opératoire* to lithic reduction sequences has productively focused attention on the dynamic processes of selection, manufacture, use, recycling, and discard, less use has been made of Leroi-Gourhan's observation that technical choices are made within social and cultural contexts (Lemmonier 1993a). My thesis is that the study of food would also profit from use of the *chaîne opératoire* since food is material culture created by technical and social acts. Karlin & Julien (1994, 153) have made a similar point, although they note that 'other technical systems, such as hunting and the gathering of plant foods or the activities associated with fire, remain difficult to understand, since the reconstruction of the operative processes is still too fragmentary'. An animal carcass and its constituent organs and bones are in many ways analogous to an unmodified nodule of flint. A butcher or cook progressively removes, modifies, and/or destroys animal parts, often leaving traces of past actions on the bones.

Can we move beyond these by-products of food processing and consumption to the meanings attached to past cuisines and the intents of prehistoric cooks and consumers? I have doubts that we can ever 'get into the mind of the maker' in prehistory. Nonetheless, as pointed out by Renfrew (1994), we can look at how past minds acted on the world around them, and by looking at the choices made, the paths followed versus those ignored, we can begin to grasp intent. The productive and consumptive activities of an individual actor are a series of decisions, each historically contingent (to some extent dependent on prior decisions or existing constraints), but always selected from a range of alternatives. As pointed out by Lemmonier (1993a) with reference to technology, these 'technical choices' are always social acts pursued for social reasons, but social acts that have material consequences — they directly interact with the individual's environment. To return to the bones, transport decisions made at a kill or field butchery site are not made in a social vacuum. In addition to considering carcass weight, condition, and travel distance, our carrier will also consider the size and state of consumers, existing stores, and the probable actions of other members of the group (e.g. Binford 1978; Metcalfe & Barlow 1992).

Few zooarchaeologists have continued down the analytical path set out in Binford's (1978) pioneering ethnoarchaeological work among the Nunamiut. His study remains the most detailed, although implicit, description and analysis of operational sequences in food procurement, processing, storage, consumption, and discard. Zooarchaeologists have made wide use of Binford's utility indices, and his characterizations of different types of site have been ubiquitously applied (critically and otherwise) in interpretations of subsistence-settlement systems from the European Upper Palaeolithic and Mesolithic and beyond. While there is much latent zooarchaeological interest in inferring the sequence of past events from animal remains, Gifford-González's (1993) task- and product-focused approach is one of the few explicit examples of a *châine opératoire* applied to zooarchaeology. Gifford-González (1993, 190) 'envisions each element in a faunal assemblage as an end product of a chain of events through which it has passed'. All phases from acquisition to final refuse disposal are monitored, with emphasis placed on the impacts of processing (products) and the costs and benefits of processing tactics (tasks) at all stages. Transport decisions are also very important in this scheme, as acquisition sites are often spatially separate from consumption sites. Gifford-González (1993, 191–3) illustrates her scheme with the kinds of sites, processing activities, and material traces expected from faunal assemblages/elements monitored at different stages of the processing chain. The different stages in her processing chain, although specific to animal remains, bear many similarities to Goody's (1982) scheme. Gifford-Gonzalez's scheme, however, also encourages one to consider the lifehistory of any given bone or carcass part in addition to the taphonomic history of an assemblage.

The large and high-resolution data sets from the open-air Magdalenian sites of Pincevent and Verberrie are ideal grounds for testing these ideas about operational sequences of food preparation, distribution, and discard (e.g. Audouze & Enloe 1991; Enloe & David 1989). It may be very difficult or even misleading, however, to try to reconstruct the lifehistory of a fossil. Simply put, in most cases it is impossible to infer more than 2–3 processing stages between the inevitable acts of acquisition (bones must have come from an animal once alive) and discard (otherwise the bone would not be there to become part of our sample). Given the unfinished state of analyses and the limitations of chronological resolution in the case study that follows, I have not focused on the gestures of butchery or tried to reconstruct long and detailed sequences of carcass manipulation from procurement to discard. Still, it is useful to consider ways in which cuisines might have varied during the Mesolithic.

First of all, we can consider ingredients. The basic 'laundry list' of animals present in an assemblage gives a first approximation, although one clearly needs to consider the effects of different taphonomic agents as well as the influence of sample size on assemblage diversity. The source of food and the distances it would have been transported may be very important factors. Can some foods be identified as 'exotic'? The contrast between terrestrial and marine resources has been frequently stressed in discussions of Mesolithic subsistence. Given the significant symbolic loading of these different spheres of resources, and the common cultural elaboration of rules for keeping these spheres distinct, it seems likely that the marine/terrestrial dichotomy may have also been an important structuring principle during the Mesolithic.

Secondly, we should also examine methods of preparing and cooking food. During the Mesolithic these practices might range from minimal preparation of raw food, to various techniques of preparation (thawing, disarticulation, filleting, pounding, etc.) and cooking (roasting, drying, smoking, steaming, boiling). Characteristics of the resources will constrain choices, although the possibility of a choice will always remain. Some of these preparation and cooking techniques may be amenable to identification and analysis from faunal remains, for example patterns of burning, cut marks, and fragmentation (e.g. Binford 1978; Kent 1993; Oliver 1993; Speth 2000).

Thirdly, we should consider which foods were combined at various stages of preparation and consumption, as well as treated differentially in discard. Choices of food combination and separation are frequent material for cultural analyses of cuisines (e.g. Douglas 1972). The ethnographic literature of recent hunter-gatherers is filled with descriptions of gender and age differences not only in what people procure, but also in what they eat on the move (e.g. hunting/gathering expeditions) as opposed to at residential camps. As discussed above, attention has focused on gendered differences in resource procurement (e.g. discussions of a gendered division of labour) and distribution (e.g. food sharing) among recent hunter-gatherers, with little discussion of the social contexts of food consumption and cuisines (see however Codere 1950; Hayden *et al.* 1986; Speth 1990; Spielmann 1989). From an archaeological perspective it is next to impossible to compare foods 'eaten on the go' to those eaten at a camp, since the latter context dominates (or is assumed to dominate) the archaeological record, not to mention the difficulties of comparing the effects of gender and/or age beyond the coarse resolution of dietary history preserved in the stable isotopes of human bones. Still, archaeologists have started to take note of the significance of foods consumed sequentially, whether in space or time, as opposed to those consumed together (e.g. Jones 1996). In closed and discrete depositional contexts like some burials and other 'structured depositions', we can reasonably assume the deliberate association of different foods. Along with stomach contents, these associations probably provide the most direct evidence of past 'meals', although decipherment of attached meanings, even in these instances of exceptional preservation and integrity of the archaeological record, requires a very careful consideration of formation processes. As noted above, the presence and size of containers will have an important influence on food preparation techniques and cuisines. Analytical methods for studying food combination and cooking are still in their infancy, although bone fragmentation (Oliver 1993) and 'pot polish' (White 1992) respectively provide indirect and direct evidence from the faunal remains for the use of containers in food preparation. Even so, most archaeological contexts will be too coarse in resolution to demonstrate that foods found in the same assemblage were eaten together.

Fourthly, the scale at which different foods were procured and consumed is also of considerable interest. How does the amount and density of food waste and/or its state of preservation/fragmentation relate to the organization and scale of food preparation and consumption? The issue of scale brings to the fore questions about food storage and feasting. Soffer (1989) and Rowley-Conwy & Zvelebil (1989) have reviewed evidence of food storage in the European Upper Palaeolithic and Mesolithic. The context and scale of food processing and consumption would be key to the identification of feasts in the archaeological record. Although food storage is not necessary for competitive feasts, as shown by Calusa of Florida, storage aids the accumulation of a surplus needed to underwrite a competitive feast (Hayden 1996). Dried meat may have buffered subsistence risk and provided for feasts in addition to constituting a major form of wealth, along with buckskin during the Upper Palaeolithic (Hayden 1981). The production of both dried storable meat and buckskin would have required much labour. Thus, evidence of a feast might come from 'copius food leftovers and much greater wastage than usual . . . for example animal bones often are not completely broken up for marrow, and may not even be completely disarticulated, . . . [since] feasting refuse tends to occur in considerable quantities in single deposits' (Hayden 1996, 138).

The significance of feasting, however, is coming to the foreground. Brian Hayden has been arguing over the last decade for the importance of the social contexts of food consumption and feasting to two of the 'big issues' in the human past, namely the development of food production (Hayden 1990) and social inequality (Hayden 1995). On the topic of archaeological visibility, however, greater emphasis has been given to identifying archaeological signatures of people having 'fought with food' in competitive feasts. Hayden (1996, 137) suggests that competitive feasts might be recognized archaeologically on the basis of the following six characteristics: 1) abundant resource base capable of providing surpluses; 2) special foods used for feasting; 3) special vessels used for serving feast foods (could include carved wooden bowls and gourds); 4) the use of prestige items that feast foods could be converted into; 5) the occurrence of special grounds or structures at which feasting events could be held; 6) the occurrence of Triple A individuals having more wealth and influence than others in the community. While there has been considerable interest in identifying competitive feasts and understanding the commensal politics that accompanied them (Dietler 1996), there has been much less interest in celebratory and mutual aid feasts. Archaeologists have instead focused on identifying aggregation sites, typically focusing on size, location (Butzer 1982), and/or artefact diversity (Conkey 1980). Furthermore, there have been relatively few attempts to identify feasting from food remains, regardless of whether those feasts were competitive, celebratory, or for mutual aid. The case study that follows is used to develop techniques for the identification of feasting from food remains as well as to explore the visibility of non-competitive feasting among prehistoric hunter-gatherers.

Food in context during the late glacial and early postglacial periods of northeastern Istria

Interpretations of food and its consumption in the past require high-resolution data of subsistence remains and the contexts in which they were processed, consumed, and disposed. Such data are a necessary prerequisite if we are to move beyond assertions about the sociality of consumption and the meanings of food to verifiable/refutable interpretations of how such practices were constituted and how they changed over time. Results from the Pupićina Cave Project meet these stringent criteria of resolution and context; they are used to explore the changing role of food and its consumption across the Pleistocene–Holocene boundary in northeastern Istria, Croatia.

The Pupićina Cave Project is investigating prehistoric subsistence-settlement strategies and their palaeoenvironmental contexts in the northern Adriatic Basin (Miracle 1997; Miracle *et al.* 2000; Miracle & Forenbaher 2000), with particular reference to the northeastern portion of the Istrian Peninsula (Fig. 7.1).[1] The analysis of spatial variability and temporal trends within the micro-region of northeastern Istria is a major goal of the project. Seven archaeological sites were tested between 1995–99 (Pupićina Cave, Vela Cave, Vešanska Cave, Klanjćeva Cave,

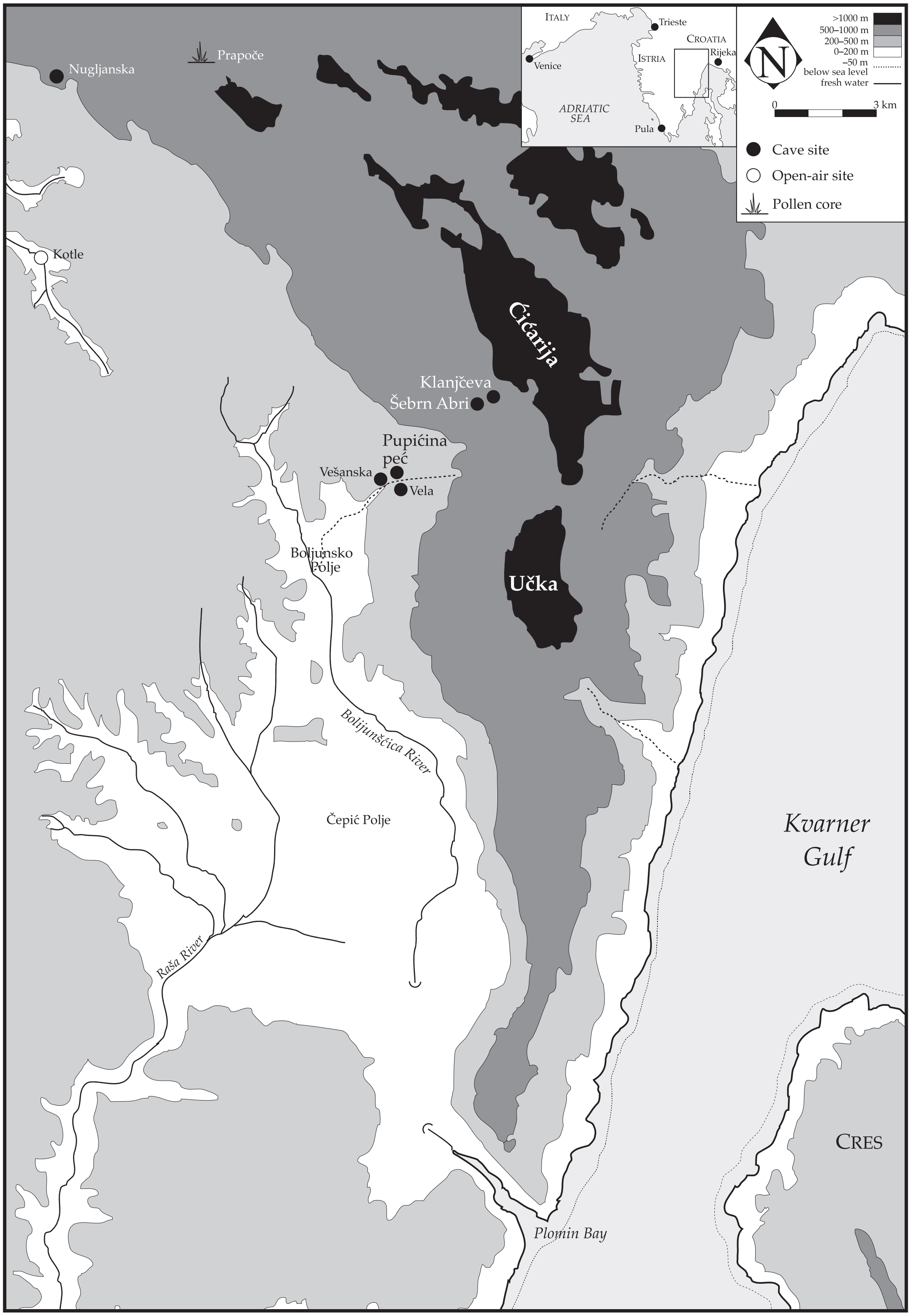

Figure 7.1. *Map of northeastern Istria and the location of Pupićina Cave.*

Šebrn Abri, Nugljanska Cave, and Kotle open-air site), with extensive horizontal excavations (exposure of over 39 m^2 between 1995–99) at Pupićina Cave. My focus is on Pupićina Cave and temporal changes at the site. Sample size and the availability of results have made necessary this focus on an individual site. Preliminary comparisons between Pupićina and other sites begin to put the former site into a regional context (Miracle *et al.* 2000). Further information about variability in intra- and inter-site contexts will strengthen and enrich interpretations of food consumption, although specific elements of said interpretations might change.

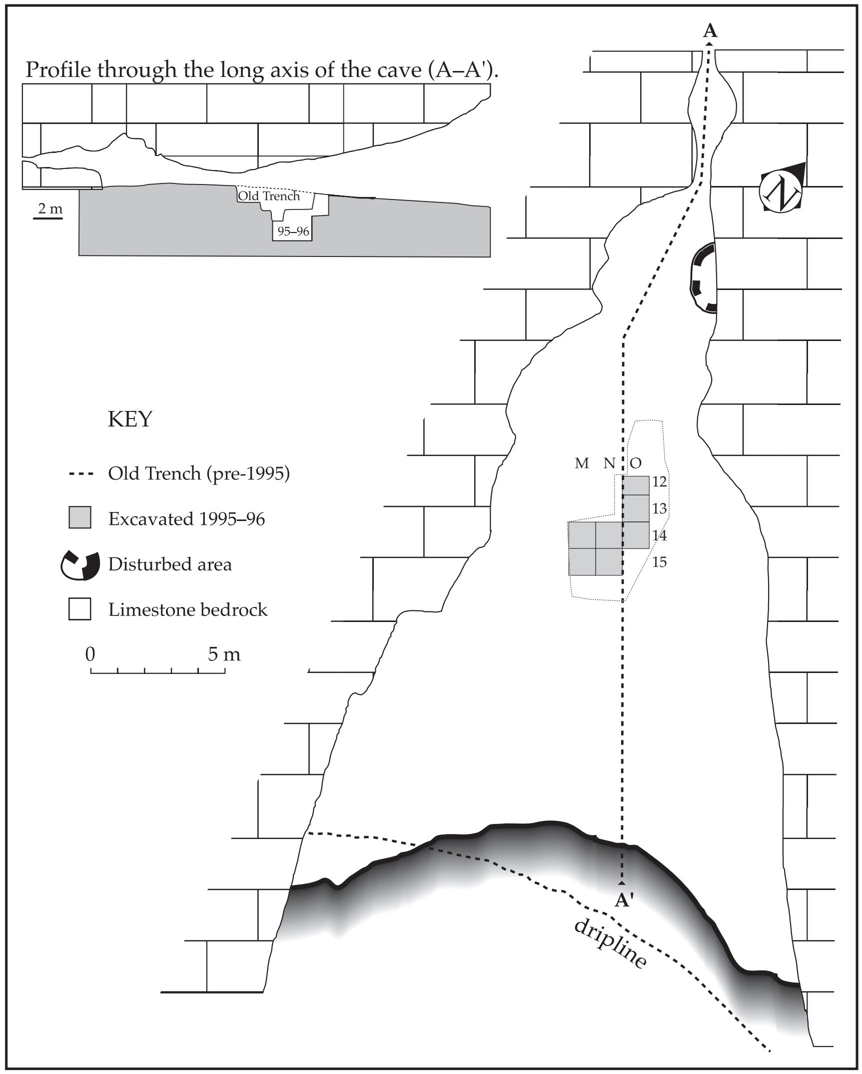

Figure 7.2. *Plan of Pupićina Cave.*

Pupićina is a large (25 m wide at the entrance and 30 m deep), southeast-facing cave located in a narrow, limestone canyon at an elevation of 220 m above sea level. The analyses presented below are based on 3.8 m^3 of sediment excavated over an area of 6.5 m^2 in 1995–96 (Fig. 7.2).[2] More detailed descriptions of site location, excavation strategy, and the lithostratigraphy can be found in several recent publications (Miracle 1997; 2001; Miracle & Forenbaher 2000). Here I limit discussion to the age and nature of the main phases used in the analyses that follow.

Late glacial deposits were massive, yellow-brown, silty-clays with very few clasts (Fig. 7.3). Within these deposits there were two relatively thin lenses (2–10 cm thick) of animal bones, lithic artefacts, and charcoal (Levels 35 & 32), the latter of which was associated with a hearth (Level 33). The three radiocarbon dates are consistent in dating the deposition of these layers to the very end of the Pleistocene (Table 7.2 & Fig. 7.4; see also Miracle 2001). I interpret these lenses of cultural material as originating from very brief and ephemeral occupations at the site at a time of relatively rapid sedimentation during the 'Younger Dryas'. The Early Mesolithic phase was marked by an increase in the frequency of limestone debris and organic clasts (wood charcoal and bone) in the silty-clay matrix. An AMS ^{14}C date confirms continued occupation during the Early Holocene (Table 7.2 & Fig. 7.4). The cave appears to have been occupied more frequently during the initial Holocene than during the Late Pleistocene, although the intensity of occupation was not great enough to obliterate features like hearths.

Moving into the overlying levels, the sedimentary matrix becomes much ashier in the areas of the 'midden' (squares O13–14, M–N/14–15). This 'midden' was identified on the basis of the extremely high density of finds, especially animal bones and large landsnail shells, as well as wood charcoal, frequent limestone clasts, and what appear to be fire-cracked rocks. Two major components of the midden were identified, a 'lower midden' that covered the entire

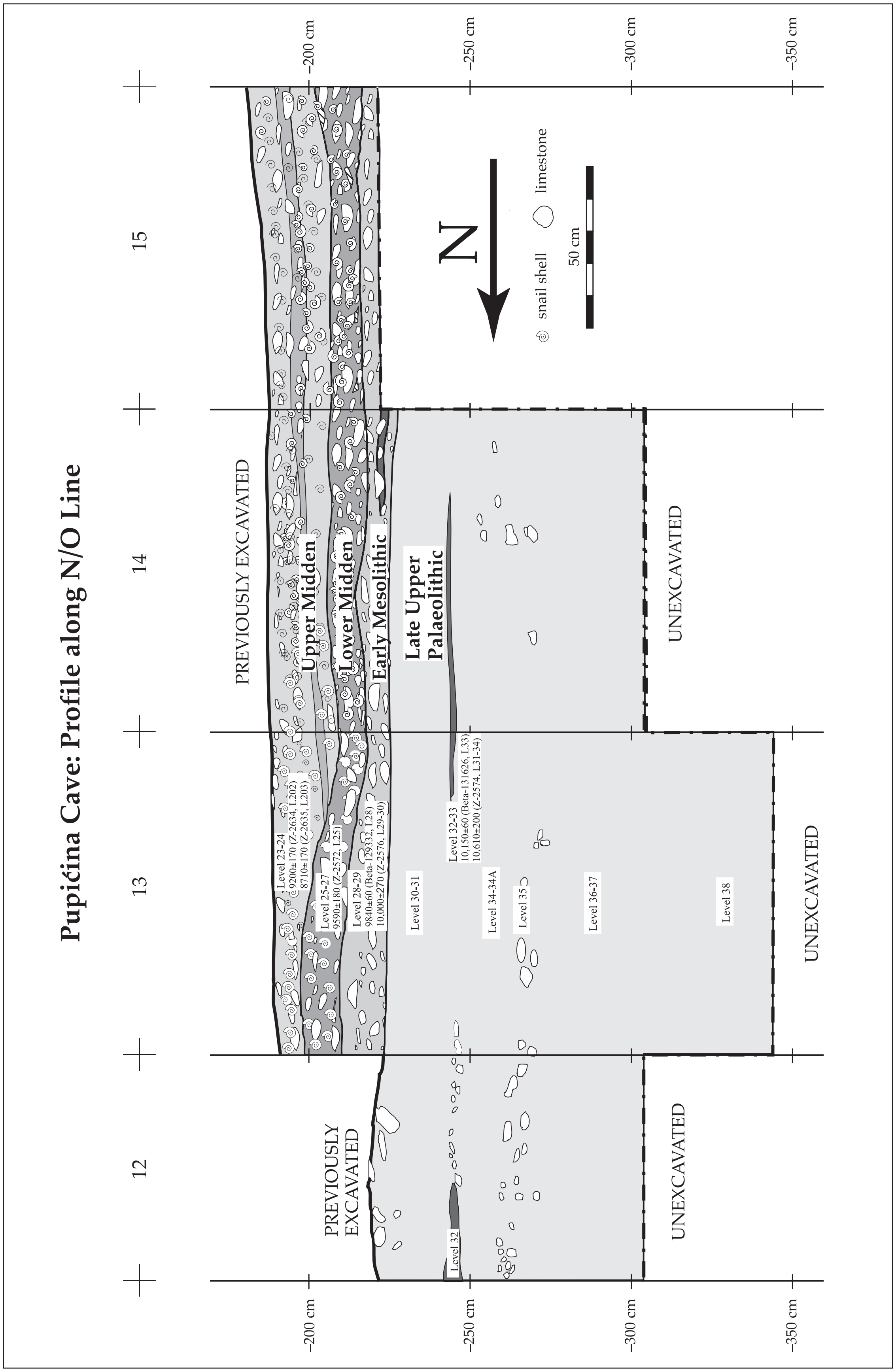

Figure 7.3. *Profile along N/O line in Pupićina Cave, showing Late Upper Palaeolithic and Mesolithic horizons, excavated levels, and* ^{14}*C dates.*

Table 7.2. *Stratigraphic phases, absolute dates, and volume of sediment excavated at Pupićina Cave in 1995–96. Dates in bold are AMS determinations. Dates in italics are rejected.*

Phase	Excavation levels	^{14}C Dates (lab, level) (at 1 σ)	Calendar age BC volume (m^3)	Excavated
Upper Midden (Mesolithic)	24, 202, 202+203, 203	9200±170 (Z-2634, L 202) 8710±170 (Z-2635, L 203)	8690–8240 8200–7550	0.764
Upper Silts (Mesolithic)	204, 205			0.175
Lower Midden (Mesolithic)	25, 26, 27, 203A, 206	9590±180 (Z-2572, L 25) *8770±310 (Z-2578, L 27)*	9220–8740	0.553
Early Mesolithic	28, 29, 207, 208 10,000±270 (Z-2576, L 29–30) *11,160±270 (Z2636 L 207)*	**9840±60 (Beta-129332, L 28)**	9310–9225 10,200–9200	0.387
Late Upper Palaeolithic 35, 36, 36A, 36B, 36C, 37, 38	30, 30+31, 31, 32, 32+34, 33, 34, 34A, 10,020±180 (Z-2631, L 35)	**10,150±60 (Beta-131626, L 33)** *10,610±200 (Z-2574, L 31–34)* 10,150–9300	10,050–9450	1.802

area and contained a relatively high density of animal bones, and an 'upper midden' that contained a relatively high density of *Helix* snail shells. These broad horizons contained multiple episodes of ash dumping and hearth cleaning that could not be differentiated in excavation. A series of radiocarbon dates firmly date this midden to between about 7500–9200 cal BC (Fig. 7.4), although several reversals indicate the complex and potentially mixed nature of these sediments. The 'upper silts' contained a silty-clay matrix with very little ash and only a moderate number of limestone clasts. They appear to have been deposited at roughly the same time as the 'upper midden'. Although still undated, the 'upper silts' are treated as temporally equivalent to and spatially distinct from the ash lenses of the 'upper midden'.

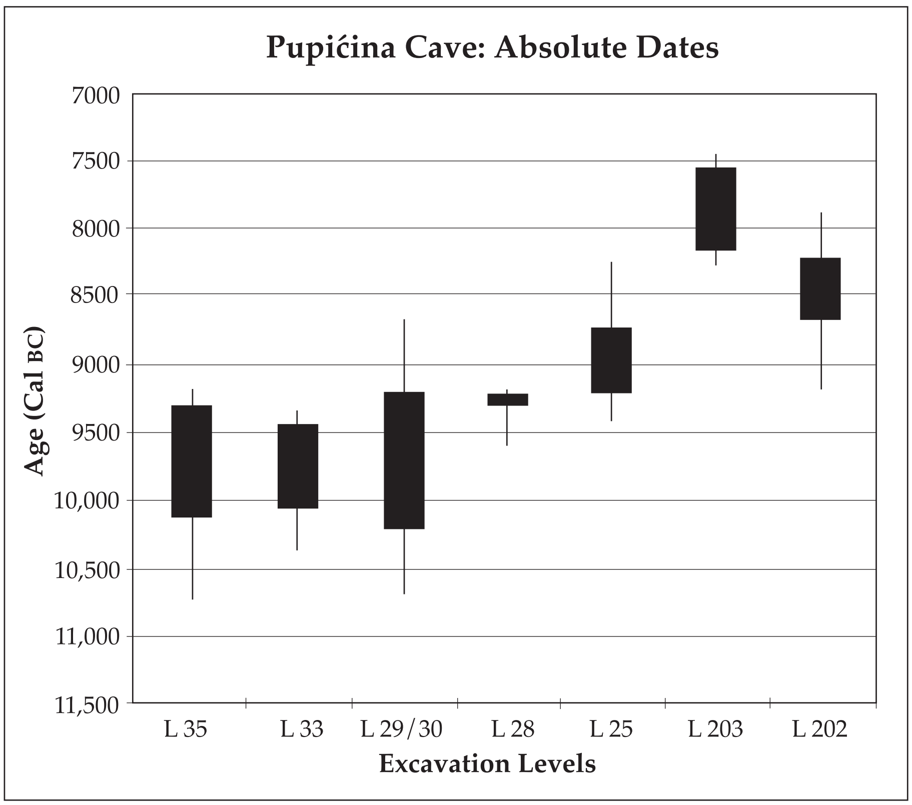

Figure 7.4. *Calibrated radiocarbon dates from late glacial and early postglacial excavation levels at Pupićina Cave. Solid bars show 1 s.d.; lines show 2 s.d.*

The archaeological record from Pupićina Cave will be analyzed using these broad phases (Table 7.2), in part owing to the small sample sizes of many of the excavated layers. This gives a somewhat homogenised view of practices at any point in time. It is particularly regrettable that we cannot further subdivide the midden deposits. Still, these phases capture the general changes in depositional regimes over time as well as giving a hint of some of the spatial contrasts between the 'upper midden' and 'upper silts'.

Changing abundance of mammals at Pupićina

The main taxa throughout the sequence are roe deer, red deer, and wild boar (Table 7.3). The relative frequency of roe deer fluctuates between 10.0–15.7 per cent and does not show a temporal trend. Red deer, likewise, varies in relative frequency from 23.9–51.7 per cent without showing a trend. Wild boar, in contrast, shows a decrease from 18.6 per cent during the LUP to 6.7 per cent in the Upper Midden. There is an increase in taxonomic diversity over time, but this change closely correlates with an increase in Total NISP. While changing species diversity may be simply a matter of sample size, it is important to note that much of this increase in taxonomic diversity is achieved through the addition of relatively small-sized carnivores (e.g. marten, wild cat, badger, fox) and hare. Cut marks indicate that at least some of these species were procured for skins and/or meat. This diversification of resource use is consistent with models of subsistence intensification owing to local factors of duration of occupation (Miracle 1997) and/or regional changes in ecological abundance and variability (Miracle 1996; Miracle & O'Brien 1998).

Taphonomy of molluscs and molluscs as food

Molluscs are abundant in the late glacial and early postglacial deposits at Pupićina. There are a diversity of land snails found at the site, as well as a small, but significant number of marine bivalves and snails. The marine bivalves are mostly of the genus *Mytilus*. These mussels must have been transported at least 20 km from the coastline (Miracle 1997). Most of the mussel shells are highly fragmented. They have not been pierced or otherwise used as artefacts. While many of the mussel shells from the later Neolithic layers have polished edges, shells from earlier layers do not show such modifications (H. Kenny pers. comm.). I interpret these *Mytilus* shells as processing waste; marine mussels were brought to Pupićina as food. The transport of these marine molluscs 20 km from the coast is an interesting topic in and of itself. The presence of *Mytilus* shells in the LUP phase at the very end of the Pleistocene suggests that water in the Kvarner Gulf and eastern coast of Istria was already sufficiently saline to support this species. This is not unexpected since comparison to global sea level curves suggests that the Kvarner Gulf may have flooded sometime between 11,500 and 11,000 Cal BC (Miracle 1995). The geometric density of *Mytilus* increases ten-fold from the LUP to Early Mesolithic, rising from 3 to 34 hinges/m^3 (Table 7.4 & Fig. 7.5). The frequency of *Mytilus* remains more or less constant in the Lower and Upper Middens of the Mesolithic, only to rise to 80 hinges/m^3 in the Upper Silts. The significance of this contrast between the midden deposits and the Upper Silts is still not clear. The increase in marine molluscs at Pupićina does not appear to be a simple function of a closer distance to the coast. As I have argued previously (Miracle 1997), these mussels provide tantalizing evidence about the directionality and timing of contacts between coastal and inland areas. What I would like to emphasize here, in contrast, is that the increasing frequency of marine molluscs also suggests changes in methods of preparing food. Although preliminary analysis suggests that a few mollusc shells have been burned, most do not show any signs of burning despite their frequent association with ashy deposits, wood charcoal, and other evidence of fire cleaning/combustible activities. Boiling and steaming are simple and effective techniques for opening and preparing mussels today. Opening raw mussels is possible, but requires either smashing the shell or prying it open with a metal knife. The evidence to hand on mussel shell modification does not allow us to distinguish between these different scenarios of mussel preparation. However, we consider the contextual evidence and association with burning to be quite important and therefore suggest that boiling/steaming of marine mussels in the Mesolithic.

The land snails present another set of taphonomic issues. Many species of land snail commonly live in or near karstic caves, and a number of

Table 7.3. *Relative frequency of red deer, roe deer, and wild boar by stratigraphic phase at Pupićina Cave.*

Species	Late Upper Palaeolithic	Early Mesolithic	Lower Midden	Upper Silts	Upper Midden
%NISP *Cerrus*	37.1	36.4	51.7	23.9	29.5
%NISP *Capreolus*	15.7	12.0	11.5	10.0	13.3
%NISP *Sus*	18.6	22.8	14.2	9.0	6.7
%NISP Small ungulate	10.0	9.5	5.2	8.0	12.3
%NISP Medium ungulate	14.3	15.3	11.2	29.9	21.6
%NISP Other	4.3	4.1	6.2	19.4	16.6
Total NISP	274	517	2493	201	1966
% Identifiable	14.9	18.3	25.1	27.9	39.1
N Taxa	7	7	13	9	16
N shaft fragments	406	844	1855	231	1251
N articular ends & cancellous bone	157	242	1632	86	672
Total faunal remains	1845	2824	9916	720	5029

small carnivores (hedgehog, fox, mole etc.) eat snails and could collect their shells in caves and rockshelters. Stiner (1994; 1999) has remarked on several modifications of snail shells that point to non-human accumulators, in particular the presence of small punctures on otherwise undamaged shells. She has also remarked on the small size of many of the land snails from the Italian sites she has analyzed.

Table 7.4. *Frequency of main ungulates and molluscs by stratigraphic phase at Pupićina Cave.*

	Late Upper Palaeolithic	Early Mesolithic	Lower Midden	Upper Silts	Upper Midden
Cervus & medium ungulate					
NISP	89	267	1569	108	1063
Weight (g)	903	1714	16706	794	11781
Weight per fragment (g)	10.1	6.4	10.6	7.3	11.1
Capreolus & small ungulate					
NISP	82	111	417	36	503
Weight (g)	155.9	265.1	1034	90.8	1714
Weight per fragment (g)	1.9	2.4	2.5	2.5	3.4
Helix MNI	16	34	831	57	1139
Mytilus hinges	6	13	20	14	26
Inedible landsnail MNI	209	6	9	7	15
Geometric Density (count/m^3)					
Cervus & medium ungulate	49	691	2840	616	1391
Capreolus & small ungulate	46	287	755	205	658
Helix	9	88	1504	325	1491
Mytilus	3	34	36	80	34
Inedible landsnail	116	16	16	40	20

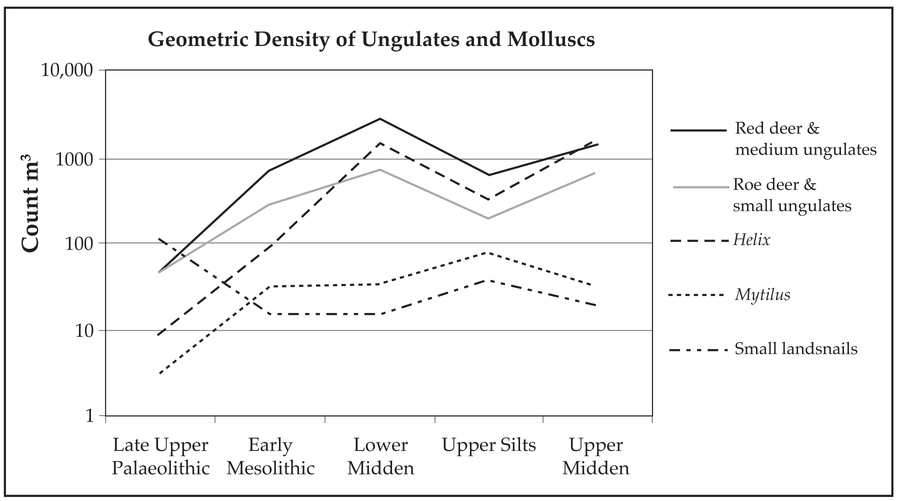

Figure 7.5. *Stratigraphic changes in geometric density of major ungulates (NISP/m^3), land snails (MNI/m^3) and marine molluscs (hinges/m^3) at Pupićina Cave.*

The Pupićina land snail assemblage is divided into two major components. The first includes many relatively small-sized species, many of which are found in the entrance to Pupićina Cave today. The shells of these small land snails are mostly complete and preliminary analysis suggests that burning is very rare. These small land snails are most common during the LUP phase at Pupićina Cave. Their geometric density drops by a factor of 7 from the LUP (116 MNI/m^3) to the Early Mesolithic (16 MNI/m^3) and later levels (Table 7.4 & Fig. 7.5). Interestingly, the density of these inedible landsnails also increases in the Upper Silts relative to other phases of the Mesolithic. These small land snails are most frequent at the site when evidence of human occupation is sparsest.[3] Although a detailed taphonomic study of these snails remains to be done, the associational evidence convincingly argues for non-human agents of accumulation and modification. I agree with Stiner (1994; 1999) that this component of the mollusc assemblage most likely reflects the activities of co-habitants rather than human selection (for food, ornaments, or other uses).

The second component of the Pupićina land snail assemblage is the large-sized 'edible' snail (*Helix secernendra* and *Helix* sp.) which is known from many late glacial to early postglacial contexts around the Mediterranean (Lubell *et al.* 1976; Miracle 1995). The tremendous quantities of *Helix* shells associated with fire-cracked rock and settlement debris are highly visible, if not a defining characteristic of Capsian sites in North Africa. There is general agreement that these *Helix* shells reflect food waste (Lubell *et al.* 1976; Stiner 1999), although it may be worth considering other reasons for accumulating snail shells in a site (e.g. Straus 1992). *Helix* shells are present in very low quantities during the LUP at Pupićina. The geometric density of *Helix* shells increase by an order of magnitude from the LUP (9 MNI/m^3) to the Early Mesolithic (88 MNI/m^3), with a similarly dramatic increase occurring between the Early Mesolithic and Lower Midden (to 1504 MNI/m^3; Table 7.4 & Fig. 7.5). The frequency of *Helix* remains high in the Upper Midden of the Mesolithic, although it is much lower (by a factor of 4) in the Upper Silts. The increase in *Helix* is thus strongly correlated with increases in the geometric density of ungulates (red deer and roe deer), marine molluscs, and other evidence of human occupation of the cave. The changing frequency of *Helix* also presents the mirror image to the small land snails (Fig. 7.5). The high frequency of *Helix* is associated with ashy deposits that appear to have been dumped from hearths and roasting pits, a depositional context very similar to those at the open-air and clearly anthropogenic escargotières of the Capsian Culture of North Africa (Lubell *et al.* 1976). I conclude that the *Helix* land snails were prepared and eaten by people, although this interpretation remains preliminary until taphonomic studies are completed.

While many of the *Helix* shells have been broken, a very large number are complete (well over 1000) and much of this breakage appears to have occurred postdepositionally (in some cases during excavation). Some form of steaming or boiling appears to have been used to extract the snail meat while leaving the shell intact. The mollusc evidence from Pupićina thus suggests a change in the ways in which people were preparing and cooking food at the site; people started to also boil and/or steam food during the Mesolithic.

Feasting during the early postglacial at Pupićina Cave

The increase in frequency of mollusc remains at the site suggests a shift in food selection and preparation. One interpretation would be a diversification of the diet, perhaps in response to regional changes in human population density and resource availability (Miracle 1995; 1996; 1997; Stiner *et al.* 2000). We need to also consider, however, the scale at which such changes could be occurring. Local factors at individual sites may have been just as important as the region-wide processes usually invoked in discussion of the 'broad spectrum revolution'. In the case of Pupićina, I have suggested (Miracle 1997) that these changes in Early Holocene dietary composition may also reflect a longer period of occupation at the site, in addition to changes in group composition and/or individual strategies (particularly the presence of dependants).

What I would like to suggest here is that the increase in *Helix* may also reflect a shift towards more feasting. Land snails can be collected in fairly large quantities. They can also be 'stored' alive for a short time prior to consumption. Such 'storage on the hoof' was practised by the Romans to improve the taste and reduce the toxicity of snails (Renfrew 1993, 64). They may then be 'fattened up' by feeding them grain, wine must or milk. One important aspect of a feast is being able to collect and store foodstuffs in preparation for the feast. *Helix* land snails may have been collected for those reasons. One potential drawback of collecting *Helix* is that it is relatively easy to overexploit a population, and it can take several years (or longer) for a population to bounce back from overpredation. At times when *Helix* was hyperabundant, people could have collected them in large quantities with relatively greater efficiency. People would have then had to lay off snails for a period of several years until local populations recovered.

What separates a feast from other aspects of consumption? Common characteristics might be the scale and context of consumption. With a feast one expects the participation of consumers beyond the usual (local?) social group, including a range of relatives, visitors, and the like. Feasts often include a larger consumptive group, and in particular the consumption of a large amount of food in a relatively short period of time. There should thus be a larger scale of consumption than during regular meals. With a larger scale of consumption, one might expect economies of scale in the processing of food (resulting from much food being processed and consumed at once), evidence of the provisioning of food. There might also be greater waste — due to limitations on the amount that people could eat. Also, there might be greater selectivity for particular food items. There might also be a greater representation of exotic items and unusual foods, both for diversity but more importantly to demonstrate the ability to mobilize resources from a wide range of areas, through trading links, or through the work effort of a large support group. These latter are all aspects of using food to promote position and create prestige.

The larger ungulate fauna at Pupićina presents some tantalizing evidence of shifts in the scale of consumption and processing practices. More informative than the relative frequency of the main taxa is the trend in geometric density of ungulate remains. For this comparison I have treated red deer and medium ungulate together, while roe deer and small ungulate are treated together (Table 7.4). The wild boar is left out of these comparisons. Use of geometric density brings out a major contrast between the LUP and Early Mesolithic, with a 14-fold increase in red deer/medium ungulate density and a 6-fold increase in roe deer/small ungulate frequency. The frequency of both taxa increases again from the Early Mesolithic to Lower Midden; as before the increase is more marked in the larger-sized red deer/medium ungulate than in the smaller-sized roe deer/small ungulate (Table 7.4). These comparisons of geometric density are predicated on the assumption that deposition rates were constant. Unfortunately absolute dates from the site are not adequate for precisely determining the length of stratigraphic phases. Even so, the LUP phase appears to correspond with the 'Younger Dryas', while the three Mesolithic phases may well fit within the 'Preboreal'. The contrasts in geometric density among these phases are unlikely to disappear when we correct for the rate of sediment deposition. The spatial contrast between the Upper Midden and Upper Silts is extremely informative. The geometric density of ungulate remains in the latter deposit is half to a third of that from the former. The midden deposits form discrete and distinctive contexts temporally and spatially.

Aspects of the faunal composition, however, give clear indications of changes in the structure of practices at the site beyond a simple increase in the overall amount of faunal waste being deposited. This is very important since a fundamental question is whether the archaeological record represents numerous small-scale depositions or a smaller number of large-scale depositional events. This problem is continually faced in evaluating occupational evidence; does a rich deposit reflect the accumulation of many short-term and small occupations over a longer period of time or a few long-term and large occupations over a shorter period of time.

The relative frequency of different body parts can provide valuable information about food management and processing. Skeletal elements have been grouped into a series of carcass units as defined in Table 7.5. These carcass units are similar to those used by Stiner (1994) and Gamble (1997), although there are some differences. NISP counts in Tables 7.6 and 7.7 have been 'corrected' by dividing NISP for each carcass unit by the connection factor in Table 7.5, the number of elements present in the carcass unit in a complete deer skeleton. These corrected values were then standardized by dividing values by the maximum value and multiplying by 100. A more detailed comparison of these different methods of quantifying body part frequency is presented elsewhere (Miracle 2001). The MGUI (Binford 1978) and volume density (Lyman 1984; 1994) are used as predictive models of carcass unit selection. Mean MGUI and volume density were calculated by averaging values for the different elements included in each carcass unit.[4] Carcass unit frequency is not significantly correlated with volume density in any

Table 7.5. *Definition of carcass units and correction factors used to study body part representation. Teeth and back (correction factor written in italics) are excluded from further comparisons.*

Carcass unit	Elements included factor	Correction caribou (rank)[a]	Mean MGUI density deer (rank)[b]	Mean volume
antler	antler (base, beam, tine, other)	8	1.0 (9)	
head	frontal, maxilla, nasal, occipital, petrous, premaxilla, temporal, zygomatic, mandible	18	19.5 (5)	0~.57 (5)
upper teeth	upper dp2–4/P2–4, M1–3	*12*		
lower teeth	lower dp2–4/P2–4, M1–3	*12*		
neck	hyoid, atlas, axis, cervical vertebra	8	18.4 (6)	0.20 (8)
back	thoracic vertebra, lumbar vertebra, ribs	*45*		
pelvis	innominate, sacrum	3	47.9 (2)	0.23 (7)
upper front	scapula, humerus, radius, ulna	8	34.5 (3)	0.60 (4)
lower front	carpals, metacarpal	12	12.7 (8)	0.72 (1)
upper hind	femur, patella, tibia (fibula)	6	78.8 (1)	0.66 (3)
lower hind	astragalus, calcaneus, metatarsal	12	29.8 (4)	0.66 (2)
feet	phalanges	24	13.7 (7)	0.39 (6)
other	sesamoids, accessory phalanges (digits I, II, V), accessory metapodials, other teeth, other tarsals, sternum, costal cartilage			

[a] Calculated from data in Binford (1978, table 2.7).
[b] Calculated from data in Lyman (1994, table 7.6). Scan sites are head: DN4; neck: AT3, AX1, CE1; pelvis: AC1, SC1; upper front: SP2, HU4, RA3; lower front: MC3; upper hind: FE4, TI3; lower hind: AS3, CA2, MR3; feet: P13, P23, P31.

Table 7.6. *Red deer and medium ungulates: frequency of body parts and bone modification at Pupićina Cave.*

Carcass	Late Upper Palaeolithic			Early Mesolithic			Lower Midden			Upper Silts			Upper Midden		
unit	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**
antler	1	0.0	0.0	25	12.0	0.0	57	12.3	22.8	6	50.0	0.0	86	11.6	22.1
head	10	0.0	0.0	39	7.7	0.0	275	4.4	1.1	16	0.0	0.0	97	5.2	7.2
upper teeth	4	0.0	0.0	15	6.7	0.0	100	1.0	0.0	4	0.0	0.0	23	0.0	0.0
lower teeth	5	0.0	0.0	10	0.0	0.0	77	2.6	0.0	I	0.0	0.0	38	0.0	0.0
neck	8	0.0	0.0	6	33.3	0.0	69	4.3	17.4	4	0.0	0.0	47	2.1	17.0
back	12	8.3	0.0	27	7.4	0.0	93	4.3	3.2	20	5.0	15.0	166	3.6	9.0
pelvis	2	0.0	0.0	5	0.0	0.0	62	3.2	11.3	2	0.0	0.0	30	3.3	13.3
upper front	13	0.0	15.4	20	5.0	0.0	148	5.4	10.8	9	0.0	11.1	84	14.3	9.5
lower front	2	0.0	50.0	14	14.3	14.3	86	10.5	10.5	4	0.0	0.0	51	9.8	7.8
upperhind	8	12.5	0.0	13	15.4	7.7	91	11.0	5.5	5	0.0	20.0	87	16.1	6.9
lower hind	4	25.0	0.0	17	5.9	23.5	163	9.8	10.4	10	20.0	20.0	78	11.5	10.3
feet	10	0.0	10.0	34	17.6	0.0	169	9.5	0.6	5	0.0	0.0	108	5.6	4.6
other	10	10.0	0.0	42	11.9	2.4	179	9.5	3.9	22	0.0	9.1	168	11.9	1.8
Total NISP	**89**	**4.5**	**4.5**	**267**	**10.5**	**3.0**	**1569**	**6.8**	**5.9**	**108**	**5.6**	**8.3**	**1063**	**8.4**	**8.2**

Table 7.7. *Roe deer and small ungulates: frequency of body parts and bone modification at Pupićina Cave.*

Carcass	Late Upper Palaeolithic			Early Mesolithic			Lower Midden			Upper Silts			Upper Midden		
unit	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**	**NISP**	**%Burn**	**%CM**
antler							6	0.0	0.0				27	33.3	0.0
head	12	25.0	8.3	18	5.6	0	62	1.6	3.2	5	0.0	0.0	97	5.2	7.2
upper teeth	7	0.0	14.3	5	0.0	0	30	0.0	0.0	1	0.0	0.0	23	0.0	0.0
lower teeth	6	50.0	0	0			35	0.0	0.0				38	0.0	0.0
neck	5	20.0	0	2	0.0	0	16	0.0	0.0	3	0.0	0.0	47	2.1	17.0
back	12	8.3	0	14	0.0	0	34	2.9	5.9	5	0.0	0.0	166	3.6	9.0
pelvis	1	0.0	0	3	0.0	0	14	0.0	0.0	1	0.0	0.0	30	3.3	13.3
upper front	5	20.0	40	16	12.5	6.3	45	4.4	2.2	4	0.0	0.0	84	14.3	9.5
lower front	6	0.0	0	6	0.0	0	22	9.1	9.1	2	0.0	0.0	51	9.8	7.8
upperhind	8	12.5	0	9	11.1	11.1	41	2.4	2.4	5	0.0	40.0	87	16.1	6.9
lowerhind	4	25.0	0	11	27.3	9.1	37	5.4	8.1	7	0.0	14.3	78	11.5	10.3
feet	1	0.0	0	8	12.5	12.5	24	16.7	8.3	1	0.0	0.0	108	5.6	4.6
other	15	0.0	0	19	15.8	0	51	3.9	2.0	2	0.0	0.0	168	11.9	1.8
Total NISP	**82**	**13.4**	**4.9**	**111**	**9.9**	**3.6**	**417**	**3.6**	**3.4**	**36**	**0.0**	**8.3**	**1004**	**8.8**	**6.8**

of the phases for either red deer/medium ungulates or roe deer/small ungulates; density-mediated destruction of bones has not significantly patterned body part frequency in these assemblages (Miracle 2001).

There are strong positive correlations between food utility, as measured by the mean MGUI, and carcass unit frequency in red deer and medium ungulates (Figs. 7.6–7.7). The inclusion of antler in comparisons has a significant impact on graphs for the LUP and Early Mesolithic. Since antler was clearly important for uses other than food (Mlakar 1999), there are good reasons for excluding it from statistical comparisons.[5] Correlations between food utility and carcass unit frequency are extremely high and positive in the midden deposits of the Mesolithic. There is not a clear relationship between carcass unit frequency and food value in the Upper Silts, regardless of whether one includes antler in the analysis. There was clearly a very strong selection for the meatiest parts of the red deer (and medium ungulate) carcass during the midden phases of the Mesolithic (Fig. 7.7). All parts of the carcass were being brought to Pupićina during the different phases of occupation. There was a shift over time, however, towards a selection for the meatiest carcass parts so that there was a surplus of high-utility elements relative to the rest of the carcass during the midden phases of the Mesolithic. The collection of antler was particularly important during the Early Mesolithic and Upper Midden phases, probably for use as a raw material for manufacturing antler tools. Turning to the roe deer and small ungulates, we again find temporal pattern in correlations between food utility and carcass unit frequency (Figs. 7.8–7.9). Carcass unit frequency is not significantly correlated with food utility in the LUP. In the Early Mesolithic through Upper Midden, however, food utility is significantly correlated with food utility (Figs. 7.8–7.9).[6]

As with the red deer and medium ungulates, the shift from LUP to Mesolithic is not simply a matter of sample size — sample sizes in the LUP and Early Mesolithic are very similar. These correlations suggest a deliberate provisioning of the site with the meatier elements of red deer/medium ungulates and roe deer/small ungulates during the Mesolithic occupations of the site.

Further evidence of the differential provisioning of Pupićina with meaty carcass parts during the Midden phases of the Mesolithic comes from the differential representation of bones from the right versus left side of the animal. I have recently shown (Miracle 2001) that evidence of a bias for a particular side of the body appears only in the meaty parts of the carcass as opposed to the rest of the carcass, and this bias is present in red-deer- and roe-deer-sized animals in the Lower Midden. These data complement evidence of a selective transport of higher utility elements to the site during the Midden phases of occupation.

Evidence of further processing is more difficult to interpret. The interpretation of burning data is far from clear (Kent 1993) since burning may have little to do with food preparation and consumption, and may be postdepositional in origin (Stiner *et al.* 1995). Likewise, as numerous authors have noted, nicking bone dulls a sharp edge. Cut-mark frequency and location are strongly conditioned by an animal's anatomy, including the location and attachment of major muscles and tendons, as well as in the ease with which bone can be avoided during skinning, carcass disarticulation, and defleshing. On the other hand, there is anecdotal evidence that cultural differences also contribute to distinctive butchery styles (Langenwalter 1980; Lyman 1987; Yellen 1977). Thus while we have some interpretative baselines for the position and form of cut marks on bones (e.g. Binford 1981; Noe-Nygaard 1989; Lyman 1994), little is known about the factors that affect the overall frequency of cut marks on bones. Intuitively, it seems likely that an increase in the range and kind of butchering practices will cause an increase in cut-mark frequency. Likewise, the frequency of 'mistakes' must increase with the overall intensity of skinning, disarticulation, and filleting.

With reference to the faunal remains from Pupićina, my question is whether or not the burning and cut-mark data might be revealing about the scale at which butchery and consumption was occurring. In particular, are there changes in burning and cut-mark frequency that might be interpreted in terms of feasting? The frequency (per cent of NISP) with which different carcass units are burned and cut is presented in Tables 7.6 and 7.7. As a more detailed analysis of these data is presented elsewhere (Miracle 2001), here I only summarize the more robust patterns.

Average burning frequency in red deer and medium ungulates ranges from 4.5 per cent to 10.5 per cent of NISP (Table 7.6). The frequency of burning increases from the Late Upper Palaeolithic to Mesolithic phases, with the highest frequency of burning in the Early Mesolithic. The pattern of burning on red deer/medium ungulate remains suggests that limbs were separated from the trunk prior to cooking (Miracle 2001). This certainly fits with other evidence of upper limbs being introduced to the site; these limbs may have been treated separately from other parts of the carcass, perhaps part of preparation/cooking on a larger scale as part of a feast.

The overall frequency of cut marks ranges from 3.0–8.3 per cent of NISP; in contrast to bone burning, cut-mark frequency increases from the earliest to latest phases under consideration (Table 7.6). I suggest that the increase in cut-mark frequency from the LUP to Upper Midden reflects both an increase in the range of butchery practices and a more intensive butchery of carcasses. The latter could have resulted from carcasses being divided into relatively smaller portions, perhaps related to the transport of already butchered parts to the site as well as a wider or more extensive sharing of meat at the site. Red deer carcasses appear to have been more thoroughly dismembered and filleted during the Midden phases relative to the LUP and Early Mesolithic. The link between this pattern and consumption of food at a larger scale and feasting remains to be established, although this pattern is not incongruent with such an interpretation.

Roe deer and small ungulates show a similar degree of burning and cut marks as found on red deer and medium ungulates. Burning frequency ranges from 0.0–13.4 per cent of NISP, while cut-mark frequency ranges from 3.4–8.3 per cent of NISP (Table 7.7). There are not any clear stratigraphic trends in these data. The anatomical distribution of bone burning shows a pattern similar to that observed in red deer and medium ungulates. In the LUP and Early Mesolithic, adjacent carcass units show very different degrees of burning, suggesting burning after major disarticulation/dispersion, while burning is more evenly distributed among carcass units in the Lower and Upper Midden (Table 7.7). Cut marks on feet in the Early Mesolithic and Lower Midden are probably from skinning; much of the initial carcass

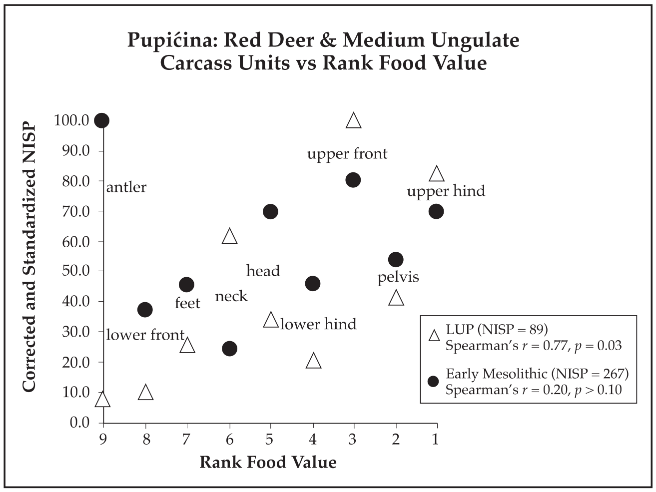

Figure 7.6. *Carcass unit frequency vs rank food utility for red deer and medium ungulates from LUP and Early Mesolithic phases at Pupićina Cave.*

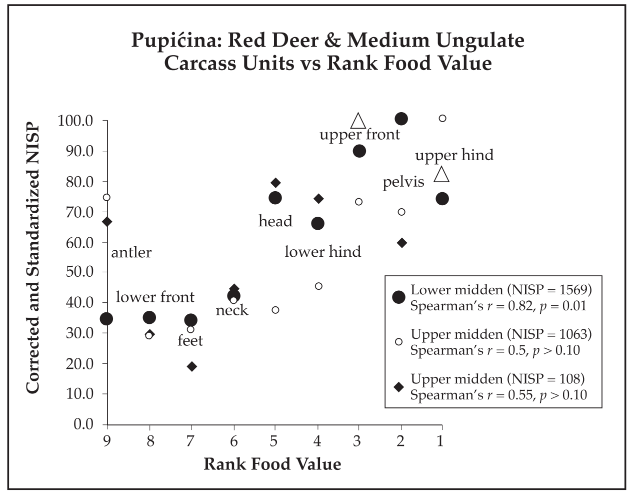

Figure 7.7. *Carcass unit frequency vs rank food utility for red deer and medium ungulates from Lower Midden and Upper Midden Mesolithic phases at Pupićina Cave.*

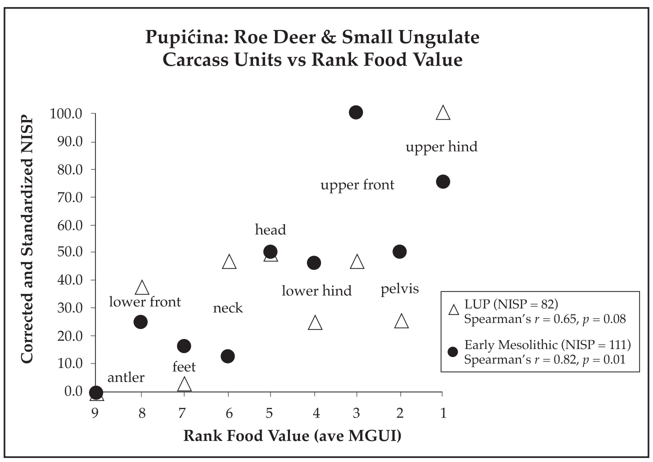

Figure 7.8. *Carcass unit frequency vs rank food utility for roe deer and small ungulates from LUP and Early Mesolithic phases at Pupićina Cave.*

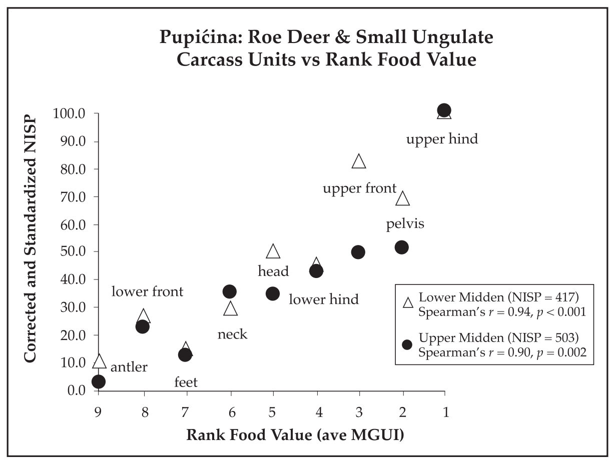

Figure 7.9. *Carcass unit frequency vs rank food utility for roe deer and small ungulates from Lower Midden and Upper Midden Mesolithic phases at Pupićina Cave.*

butchery and processing appears to have occurred at Pupićina. Cut marks are very localized, primarily on limbs, in the LUP and Early Mesolithic; they are more evenly distributed across the carcass in the Lower Midden and Upper Midden.

The intensity with which a carcass was processed for food may give another indication of feasting. A feast involves the consumption of relatively large quantities of food over a restricted period of time. This may lead to the generation of not only large amounts of food waste, but also the wasting of large amounts of food. In some social contexts, this 'waste' is a form of conspicuous consumption, and it might be characteristic of competitive feasting. The operationalization of these observations in most archaeological contexts, however, is quite difficult. The accumulation at a consumption site, through 'structured deposition' or otherwise, of partially to completely articulated animal carcasses that show little evidence of having been used for food would be one indicator of wasting food. Anecdotal observations on the Pupićina faunal assemblages suggest that partially articulated limbs and vertebral columns are more frequent in the Midden phases than during the LUP. These partial articulations, however, are mixed among the rest of the faunal remains in the deposits, and evidence of bone breakage and modification suggest that they represent food waste.

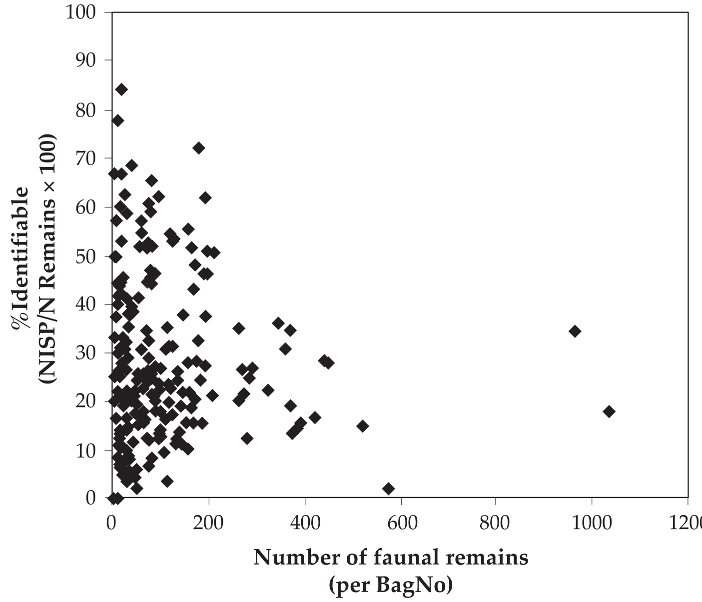

Figure 7.10. *%Identifiable versus sample size by excavation lot (BagNo) at Pupićina Cave.*

Another indication of wasting food might be a less intensive processing of carcasses for bone grease and marrow; this would also suggest that other sources of animal fat were available. The identification of processing intensity from faunal remains comes with other problems (see Miracle 1995), in particular the distinction between human food preparation/consumption practices and post-depositional fragmentation caused by a range of agents. The degree of fragmentation of small, dense carpal and tarsal bones is a good measure of post-depositional fragmentation; since they lack marrow cavities, they are unlikely to be fractured by people during butchery and consumption (Marean 1991; Miracle 1995). Analysis of the completeness of these bones at Pupićina suggests that the degree of postdepositional fragmentation did not change over time (Miracle 2001). The frequency of teeth relative to bony parts of heads gives another indication of postdepositional fragmentation. Since teeth are much denser than bones, an increase in the former relative to the latter should indicate greater postdepositional destruction. Comparison of teeth to heads is also very useful since they are likely to move together (leaving out pierced teeth used as ornaments); therefore the relative frequency of teeth to heads should indicate *in situ* destruction rather than differential transport of heads relative to other parts of the carcass. Using data in Tables 7.6 and 7.7, we can see that the ratio of NISP teeth/NISP head varies from 0.32–0.90 in red deer and medium ungulates, while in roe deer and small ungulates it ranges from 0.20–1.08. The overall bias against teeth argues against severe postdepositional fragmentation. Likewise, there are not any clear stratigraphic trends in these parameters. These analyses show that post-depositional fragmentation does not account for the stratigraphic changes in fragmentation discussed below.

The simplest measure of fragmentation is the percent of remains identifiable to taxon and/or skeletal element. The ease and possibility of identification of remains is a function of their completeness; identifiability decreases as fragmentation increases. This '%Identifiable' is calculated as the NISP/N faunal remains. While this parameter has been shown in some contexts to be strongly dependent on sample size (Grayson 1984), graphic comparison of %Identifiable vs sample size (from individual excavation units) shows that there is no relationship between these variables (Fig. 7.10). The percentage of identifiable remains ranged from 14.9–39.1 per cent and showed a clear stratigraphic trend towards greater identifiability in the later phases. There is also a spatial distinction, with less fragmentation in the Upper Midden (39.1 per cent) than in the Upper Silts (27.9 per cent). Bone fragmentation decreased from the LUP to the Upper Midden.

The mean size of fragments increased over time. I have measured mean fragment size with the weight per fragment (g). In red deer and medium ungulates, the average weight per fragment increases slightly from 10.1–11.1 g from the LUP to the Upper Midden (Table 7.4). The roe deer and small ungulates show a similar trend, from 1.9 to 3.4 g from the LUP to the Upper Midden. As with identifiability, mean fragment weight of both small and medium-sized ungulates is less in the Upper Silts than the Upper Midden. As discussed above, a change in postdepositional fragmentation does not account for this trend in fragment weight. I suggest that these trends show a shift in processing practices towards a less intensive fragmentation, and by inference use, of carcasses from the Late Upper Palaeolithic to Upper Midden, and in the Upper Midden compared to the Upper Silts.

Although these data clearly show a shift in bone fragmentation over time, they tell us very little about the specifics of such fragmentation. Zooarchaeologists have often compared fragmentation rates among skeletal elements; whole bones were clearly not broken open for their marrow or pulverized for their grease. In the case of Pupićina, however, such comparisons are not very useful since most elements, with the exception of the small dense bones discussed above, have been broken. In particular, almost all marrow-bearing bones have been broken, and many show clear evidence of impact scars indicating that they were cracked for marrow extraction. Only 2 out of 227 red deer and medium ungulate first and second phalanxes were unbroken, while all of the 49 roe deer and small ungulate first and second phalanxes were broken. From these data one might conclude that people using the site were constantly under dietary stress and/or were consistently sociable in cracking phalanxes for marrow while telling each other stories (Gamble 1997).

Another indication of processing intensity is the ratio of long-bone shafts to articular ends. Binford (1978) observed that the frequency of long-bone shaft fragments to articular ends was indicative of the intensity with which Nunamiut processed bones for marrow, bone juice, and/or grease extraction. Although it would be extremely difficult to distinguish among these processes using faunal remains, one expects the ratio of shaft fragments to articular ends to increase as bones are more intensively processed, owing to the higher susceptibility of ends to destruction, their higher grease content relative to shafts, and the need to break up articular ends to help free grease. A preliminary study of the ratio of long-bone shafts to articular ends shows that long bones were more intensively processed, perhaps by crushing articular ends for bone juice and/or grease, during the LUP, Early Mesolithic, and Upper Silts relative to the later phases of the Midden (Miracle 2001). Not only did fragmentation decrease over time, but also the pattern of fragmentation shifted from the articular ends to the shafts of long bones. These data are still not very informative about the specifics of past practices at Pupićina, and unfortunately we did not encounter boiling pits or other features suggestive of grease extraction and/or the making of bone juice. These interpretations thus remain preliminary, although I note that they suggest a shift in the importance being placed on the extraction of lipids from bones and that there may be implications for cooking techniques.

Scale of consumption

I have presented a range of evidence showing a patterned shift in animal processing and consumption practices from the Late Upper Palaeolithic to the Mesolithic. Are the remains from the Mesolithic 'middens' sufficiently rich to constitute the remains of feasts? That is, what size of groups over what period of time could have been supported by the remains present in the Pupićina assemblages. These sorts of calculations are, of course, riddled with assumptions about the duration of occupation and the representativeness of excavated samples. Be that as it may, such an exercise is still informative in outlining the overall range within which parameters are likely to fall. The 'known' parameters are the minimum number of animals represented in the assemblage,[7] the average characteristics of such animals in terms of food value (body weight × % edible × caloric value per kg),[8] the average daily requirements for human foragers (weighted average taking into consideration age and sex).[9] These 'known' parameters already make a series of assumptions about, among other things, the size of animals, the sex/age composition of herds, the procurement strategies used by Mesolithic foragers, and the sex/age composition of human groups using the site. Relating the excavated samples to the rest of the site requires making assumptions about unknown parameters like the spatial extent of deposits in the unexcavated part of the site. Assuming that the middens extended north of the 18/19 line and east of the L/M line[10] to the cave walls, then the 6 m^2 excavated in 1995–96 sampled roughly 6.3 per cent of the midden deposits (estimated at 95 m^2). By dividing MNIs by the sample size one arrives at a rough estimate of the minimum number of animals represented at the entire site. There are even fewer constraints on estimates of the duration and frequency of occupations at Pupićina. Seasonality studies of animal remains suggest occupation of the site during the autumn (Miracle 1997), but the length of occupation could be several days to several months. The diversity of resources used may reflect a relatively longer period of occupation during the Mesolithic compared to the LUP; again we do not know if the difference is in terms of days, weeks, or months. There is also great uncertainty about the time span over which the midden deposits accumulated, in part owing to the relatively larger standard deviations on some of the conventional radiocarbon dates, but more importantly owing to the radiocarbon plateau at 9600 bp. The midden deposits could have formed over a period of time as short as less than 500 years or as long as over 1500 years.

The red deer, wild boar, roe deer, and wild cattle in the Mesolithic 'midden' deposits at Pupićina Cave could support at least 3 people camped for 30 days at the site each year over a span of 800 years. This estimate of group size rises to at least 14 people if they were camped for only 7 days each year over a span of 800 years. Reducing the span of occupation to 500 years increases the estimated group size to at least 22 people. These group sizes are not very impressive, with the latter just approaching the 'magic number' of 25 for a hunter-gatherer band. If, however, use of the site was episodic rather than regular from year to year, then these group size estimates start rising rapidly. If the site were used only once every five years for a week over a span of 800 years, then group size increases to 70 people. The structure of the midden suggests an uneven accumulation through discrete depositional events, perhaps suggesting episodic rather than regular use. Also, collected resources like landsnails probably would not have supported continuous exploitation; again the site may have been used only once every several years instead of year after year.

Package size is also an important factor structuring food consumption. A red deer would yield on average 149 kg of edible meat. Depending on the appetite of consumers (probably *c.* 2–3 kg, but up to 7 kg in a single sitting: de Garine 1996), a single red deer could provide a very substantial meal for from *c.* 50–75 people. Procurement of any of the larger ungulates (red deer, wild boar, and wild cattle) would have provided enough food to hold a moderately sized feast. Storage would have been one way of dealing with a sudden bonanza of meat. There is not any evidence of meat storage at Pupićina, but the practice is notoriously difficult to document from the archaeological record. As McCormick (Chapter 4) shows, scalar problems created by large carcasses were still very much a concern during the medieval and historical periods in Europe prior to the invention of refrigeration. I conclude that the food necessary to support a large gathering of people would have been often available at Pupićina. Although we do not know the specifics of occupation duration, frequency, food storage, and many other parameters, the Pupićina mammal remains are consistent with an interpretation of feasting at the site.

Conclusion

One of the goals of this paper has been to show that much information is waiting to be gleaned from Mesolithic faunal assemblages, and that it can shed light on a number of issues related to the social contexts of food consumption. Similar points have been made by Gamble (1997) and others (e.g. Audouze & Enloe 1991) in analyses of Late Upper Palaeolithic faunal assemblages. While these analyses have successfully shown how we might begin to infer the social contexts of food consumption, they have had much less to say about the cultural content and/or specific meanings of acts of food consumption. A strong case can be made for the significance and importance of cuisines for hunter-gatherers of the past and present. Raising the issue is not enough; we still lack methodologies for moving beyond mere 'consciousness raising' about the issue to making refutable inferences about the structure and content of cuisines during the Mesolithic and earlier periods.

The addition of molluscs to the diet at Pupićina may have been accompanied by shifts in cooking practices, particularly through the use of steam to heat and loosen mussels and snails from their shells. Shells could have been placed on damp vegetation over the coals of a fire, or perhaps within the cleaned rib cage of an ungulate. Mussels might have been buried with coals, much as in a clambake. On the other hand, one could interpret the mammal remains as showing a shift from more boiling during the earlier phases to less boiling and more roasting during the later phases. We still know very little about food processing and preparation techniques during the Palaeolithic and Mesolithic. The current paucity of evidence from zooarchaeology is, in part, a methodological issue. The gender dimensions of this topic have been explored by Gifford-González (1993) who suggests that carcass processing and cooking (women's work) have been undervalued in zooarchaeology relative to hunting and procurement (men's work). Further research on these topics should provide methods for inferring processing and cooking practices from animal remains. On the basis of only ethnographic and ethnohistoric evidence, I think that Goody (1982) was too restrictive in limiting pre-Neolithic cooking techniques to roasting and smoking. Stone boiling could have been practised in clay-lined pits, hide-lined pits, hides, or wooden containers. So-called fire-cracked rocks are common features of Holocene archaeological sites, and have often been interpreted as resulting from stone boiling. Critical to these suggestions and often unknown given frequently encountered preservational conditions is the availability of containers suitable for food preparation and/or cooking.

To move beyond culinary techniques to cuisines, one needs to know something about the ways in which different foods were combined and the meanings associated with and created by their preparation and presentation. Jones (1996) suggests a shift from a sequential preparation and consumption of individual foods at seasonally occupied camps in

Orkney during the Mesolithic to a simultaneous preparation and consumption of different foods at more permanently occupied sites during the Neolithic. It is not surprising that the transformation of the 'raw' into the 'cooked' become more complex from the Mesolithic to Neolithic. Of greater interest is Jones' (1996) suggestion that the changes in the spatial and temporal ordering of food procurement, processing and consumption can be understood in terms of cosmological changes associated with the integration of domesticates into past societies. The appearance of pottery vessels with the Neolithic is key to this interpretation since ceramic containers provide the context and technology for combining foods previously separated in time and space. While interesting, Jones' hypothesis is difficult to uphold without firmer evidence about Mesolithic containers. Furthermore, we are only just beginning to understand some of the residues left on the insides of pots (Evershed *et al.* 1992), and ceramic containers need not have been used for cooking. While the presentation and serving of food is a very important part of consumption, the sorts of meanings and metaphors associated with the juxtaposition of different foods might be very different from those created by their common and mutual transformation by heat. Therefore, but I have reservations about claims of the form and content of past cuisines in the absence of either depictions of food consumption and/or written records.

The Pupićina Cave assemblages are more informative on the structure and organization of food consumption. A number of lines of evidence are suggestive of an increase in the scale of animal food consumption at Pupićina moving from the late glacial to early postglacial. These changes are manifest in the following ways:

a) the range and kind of species collected, in particular an increasing emphasis on edible landsnails and marine molluscs;
b) the amount of food refuse deposited on site;
c) the provisioning of the site with carcass parts high in food value;
d) patterns of burning indicating a more systematic use of entire carcasses at once;
e) patterns of cut marks suggestive of more intensive carcass preparation;
f) decreased bone fragmentation in later phases due to a less intensive use of carcasses (perhaps even 'waste' of food?);
g) decreased fragmentation of long-bone ends relative to shafts suggesting less processing of carcass parts for bone juice and/or grease.

Results from these different analyses are not uniformly strong, and some of the suggested links with feasting are rather tenuous at best. Nonetheless, the redundancy of patterning in independent lines of evidence gives credibility to the suggestion that there was a shift in food-consumption practices, with feasting more important in early postglacial than late glacial phases of site use. These new food-consumption practices are accompanied at the site by other changes in material culture, namely the appearance of pierced tooth and shell ornaments and occasional human remains. These later data still await detailed analysis, but reinforce the interpretation put forward here that changes were qualitative as well as quantitative. The record of food consumption at Pupićina suggests that Dietler's (1996, 102) pessimistic assessment of 'our ability to detect feasts in the [Mesolithic] archaeological record' was premature.

The presence of feasting raises interesting possibilities about commensal politics and the basis of leadership and power in Mesolithic societies in the northern Adriatic basin. Dietler (1996) and Hayden (1996) have both suggested that commensal politics may have started to become important during the Mesolithic in Europe. In particular, Hayden (1996, 141–2) has argued 'on the basis of analogies with American Northwest Coast cultures . . . that competitive feasting systems also were operating in the rich coastal and riverine environments of Mesolithic Europe'. While Pupićina is not on the coast, it was clearly part of a settlement system that included the coast. Environmental richness is more difficult to evaluate, but the region seems to have supported diverse and probably abundant natural resources. At Pupićina the appearance of human remains in the midden intermixed with feasting refuse raises the possibility that the manipulation of human relics (including symbolic consumption of flesh?) were important components of feasts. A presencing of ancestors might be accompanied by group affirmation and social bonding, and would better fit Hayden's definition of a 'celebratory feast' rather than a commensal or competitive feast. On the other hand, the involvement of ancestors may have served to highlight social distinctions among feast participants and could thus have contributed to commensal politics. With only preliminary results available, it would be unwise to push interpretations of the Pupićina data in a particular direction; results of analyses of other classes of data will shed further light about the structure and nature of feasts at the site. For the time being, the motives and strategies behind these Mesolithic feasts at Pupićina Cave must remain obscure.

Lévi-Strauss (1969) stressed the role of fire in making the 'raw' into the 'cooked', and suggested this metaphor for the way in which culture transforms nature; the controlled use of fire has a history of at least several hundred thousand years, although the early history of cooking is still unknown (Wrangham *et al.* 1999). The development of cooking and cuisine have significant implications for understanding the emergence of human cultures, not only as evidence of technological control and sophistication, but also through the metaphors and transformations of social life they engender. We need to open our eyes to the possibilities of prehistoric cuisines and acknowledge the factors that might explain their variation. Although the archaeological record of the Palaeolithic and Mesolithic imposes significant constraints on interpretative possibilities, much of the invisibility of food in these periods also reflects limitations of our theoretical and analytical approaches.

Acknowledgements

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Notes

1. The Pupićina Cave Project is a collaboration involving the following institutions: Cambridge University (Department of Archaeology), Zagreb University (Department of Archaeology), Archaeological Museum of Istria, and Croatian Academy of Sciences and Arts (Institute for Quaternary Geology and Palaeontology).
2. Excavation levels followed the natural stratigraphy, with units thicker than 10 cm subdivided using artificial spits. All sediments were dry-sieved using a 6-mm mesh in 1995 and a 3-mm mesh in 1996; a flotation sample (volume of 2 litres in 1995, 8 litres in 1996) was systematically taken from each square (1 m^2) excavated in a layer.
3. This relationship is even clearer is one compares 'occupation' and 'sterile' layers within the LUP phase. The frequency of small land snails varies inversely with other evidence of human use at this much finer stratigraphic resolution.
4. The maximum volume density has been used for each element, which in the case of the limbs comes from the shaft. Limb shafts were identified to element and body size based on nutrient foramina and other diagnostic anatomical features. This use of volume density is appropriate since I am examining the relative frequency of different carcass parts rather than differential survivorship within individual bones. This assumes, of course, that limbs were initially transported and manipulated whole rather than in pieces, i.e. disarticulation was between bones rather than through them.
5. Exclusion of antler strengthens the relationship between body part and food utility in Early Mesolithic (Spearman's $r = 0.68$, $p = 0.06$, 6 d.f.) and Upper Midden (Spearman's $r = 95$, $p < 0.001$, 6 d.f.), while that for the LUP becomes weaker (Spearman's $r = 0.67$, $p = 0.07$, 6 d.f.).
6. The assemblage from the Upper Silts is not included owing to its small sample size.
7. For the Upper and Lower Middens combined, red deer MNI = 21, wild boar MNI = 11, roe deer MNI = 13, wild cattle MNI = 1.
8. Body mass in the autumn and weighted for sex and age composition of populations are estimated as red deer = 229 kg, wild boar = 79 kg, roe deer = 36 kg, wild cattle = 752 kg (Miracle 1995). The per cent edible is estimated as 65 per cent, while the calorific value is estimated as 2358 kcal/kg (Miracle 1995).
9. Average daily requirements are estimated as 2152 kcal per individual (Keene 1981).
10. This edge to the lower midden was exposed in excavations in 1997–98.

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Chapter 8

Oysters, Cockles and Kitchenmiddens: Changing Practices at the Mesolithic/Neolithic Transition

Nicky Milner

Eating shellfish has been a pastime for people worldwide over many millennia and consequently 'shell middens' are hard to define because they vary so greatly in their size, content and form. The large shell mounds in Portugal can be as much as five metres in height, they are composed of highly fragmented shell material and often contain a number of human burials (Arnaud 1989). In contrast some shell middens in Japan are horseshoe-shaped and cluster around a central area of occupation, e.g. Kidosaku shellmound (Koike 1986). The large kitchenmiddens of Jutland in Denmark, on the other hand, tend to be elongated and may stretch along the coastline for as much as 600–700 metres (Andersen 2000, 369). In basic terms shell middens, or mounds, or kitchenmiddens are 'a cultural deposit of which the principal component is shell' (Waselkov 1987, 95).

As different socio-economic activities inevitably occurred in these various locations around the world there is a need to focus in on one particular area for the purposes of this paper, and so the Mesolithic kitchenmiddens of Denmark will be used here as a case study. The tradition of archaeological investigation into the Danish shell middens dates back 150 years when these sites were first recognized as settlements and were termed *Kokkenmødding* or kitchenmiddens (Andersen 2000, 361). Three of the larger kitchenmiddens on Jutland, which will be used in this case study, are Norsminde, Bjørnsholm and the type-site of Ertebølle. The latter two sites were first investigated in the nineteenth century but all three have been excavated in great detail recently and the published reports provide a good source of information which can be used in a study of consumption practices (Andersen 1989; 1991; Andersen & Johansen 1986). In addition samples of shell material have been obtained from Norsminde and various research, including analysis of the microstructure of the oyster, has been carried out (Milner 1998; Milner in prep.).

The kitchenmiddens date to the Late Mesolithic culture of the *Ertebølle* or EBK (5400–3900 Cal BC). At first glance they appear to be mainly composed of discarded oyster shell, but in fact they are also made up of other waste, including other shellfish, fish bone, bird and mammal bone (both marine and terrestrial) as well as cultural material such as flint, pottery and hearths. At some of the middens there are also Neolithic *Trichterbecherkulter* (TRB or funnel-necked beaker culture) layers which overlay the Mesolithic material and this is true for Bjørnsholm and Norsminde. In these cases the Neolithic layers are distinct from the Mesolithic ones with the cockle being the predominant mollusc. Again other faunal and cultural material is present. The Neolithic layers also differ, however, in that they contain a significantly greater amount of soil, charcoal, ash and fire-cracked stone (Andersen 2000, 374).

The three middens vary in size quite notably. Norsminde is about 30 m in length, 5–12 m wide and up to 1.5 m thick (Andersen 1989, 18). The other two are larger, Ertebølle being 120 m by 20 m and 1.9 m thick with an estimated volume at 2000 m^3 and Bjørnsholm being 325 m by 10–50 m wide and up to 1.2 m thick with a volume of about 5000–8000 m^3 (Andersen 2000, 369). The length of use also varies although in all three cases it spans a long period of time. From the radiocarbon dates obtained from these sites the occupation at Ertebølle appears to extend over about 1000 radiocarbon years, at Bjørnsholm about 1500 radiocarbon years (Andersen 2000, 370) and at Norsminde about 700–800 radiocarbon years (Andersen 1989, 29).

The oyster *per se*, the main component of the kitchenmiddens, is rarely focused on as a food, aside from being considered as a low contributor to the overall diet in terms of calorific value or a source of certain vital minerals such as zinc (Bailey 1975; Clark 1975). Rather, shellfish tend to be analyzed as part of the overall resource spectrum or economy (Rowley-Conwy 1984). These types of faunal studies are used to interpret Mesolithic subsistence and have demonstrated the importance of marine resources in the EBK economy and the coastal location of EBK sites. These interpretations have then fed into major debates concerning the transition to agriculture in this area, which tend to argue either for outside environmental influences or internal social pressures as triggers for the acculturation of the Neolithic (see for example Blankholm 1987; Hodder 1990; Larsson 1986; Madsen 1986; Nielson 1986; Paludan-Müller 1978; Price 1996; Rowley-Conwy 1984; Thomas 1988; Zvelebil & Rowley-Conwy 1984).

This paper seeks to take a different approach and firstly it will consider some of the social and ecological aspects of the consumption of shellfish as food, from the act of procurement, to processing and finally the meal. Secondly, this paper will explore how socio-economic change at the Mesolithic–Neolithic transition interrelates with changing practices in consumption as reflected in the kitchenmiddens.

Shellfish consumption practices

Procurement of the shellfish is perhaps more complex than first imagined due to the varying habitats of the different species and habits of the people gathering them. The main species of molluscs found in the middens are oysters (*Ostrea edulis*) and cockles (*Cardium edule* and *C. lamarcki*). There also tend to be mussels (*Mytilus edulis*) in smaller frequencies but their remains are much more fragmentary and degraded than the other shellfish and therefore they may have been consumed more often than it would seem from the archaeological record. Gastropods in the form of periwinkles (*Littorina littorea*, *L. saxatalis* and *L. littoralis*) and dog whelks (*Nassarius reticulatus* and *N. incrassatus*) are also found from time to time. In addition a number of minute gastropods, in general less than a centimetre in height (wentletraps, needle-whelks, spiral tube worms and laver spire shells) were found in the Norsminde midden. These were obviously not consumed but probably would have been brought in on food and therefore will also be considered here. All these shellfish can tolerate fairly similar sea temperatures and salinity but they do all grow in different seashore zones and habitats and therefore require different harvesting considerations.

Oysters are a sedentary, sub-littoral species. At only a couple of weeks of age they settle on a firm substrate on which they cement themselves for the rest of their lives (Yonge 1960; Walne 1974). It is hard to say exactly where the oysters were being gathered from in prehistory but it would seem probable that it was near to the kitchenmiddens. Natural shell beds have been found directly in front of Norsminde (Andersen 1989), two beds were found to the east of Bjørnsholm (Andersen 1991) and one a couple of hundred metres to the west of Ertebølle (Andersen 1986). Unfortunately these have been destroyed and there is no knowledge of their exact positions, what type of shell beds they were (although likely to be oyster) and how far below sea level they might have been.

Tidal cycles, weather conditions and locations would undoubtedly have influenced decisions about entering the sea and gathering oysters and they may have varied slightly from site to site. Norsminde and Bjørnsholm are both situated at the fairly sheltered mouths of fjords. Ertebølle on the other hand is situated in a very exposed bay that is subject to bad weather from the Limfjord and North Sea. At some places it may have been easier to collect the oysters at the more extreme spring tides of March and September. This is when there is the greatest tidal range, i.e. the sea reaches the highest point on the shore and when it recedes again it goes out a great distance, possibly exposing some natural shellbeds.

The methods of collecting oysters will vary but basically they need to be dislodged from their cemented positions and this may be carried out using a stick as a lever, or a rock. In some societies mass harvesting procedures are used by the means of scoops or rakes and occasionally shellfish are dived for in deeper waters (Waselkov 1987).

Cockles are perhaps easier to collect in terms of location because they flourish in inter-tidal zones further up the shore. They bury themselves just under the sand where they can feed on the massive quantities of micro-organisms using their short siphons (Møller Christensen & Dance 1980). They tend to be gathered as the tide is receding and although buried beneath the sand, cockles can be found by looking for the holes from which the siphons protrude for food. They can be gathered using a rake or fork but they can also be scooped out of the sand by hand.

Mussels tend to congregate in large clusters on the middle shore and are therefore easy to gather. They can live in a variety of places by fixing themselves to each other, rocks, stones or seaweed by the means of byssus threads (Møller Christensen & Dance 1980).

The periwinkle, *Littorina littorea*, commonly known as the edible periwinkle, is the largest of the winkles growing up to an inch high. It tends to congregate on small stones, rocks and weed on the middle shore and below, and again is relatively easy to collect (Jackman 1981).

The other gastropods are more likely to have arrived at the kitchenmidden for reasons other than consumption. Dogwhelks are carnivorous scavengers, common around low-water mark. It is generally thought that this is not an edible species and they are even considered so unpalatable that apparently fish do not take them as bait. Tastes can change through time, however, and perhaps they should not be ruled out completely as a food. Alternatively they may have been collected by accident along with other gastropods or clinging to oysters.

Small numbers of the flat periwinkle, *L. littoralis*, are found in the Neolithic part of the Norsminde kitchenmidden. These may have been collected for aesthetic reasons because they tend to be bright attractive colours or they may have been brought to the site unintentionally with other periwinkles or perhaps even on seaweed, *Fucus* sp., on which they live and feed (Barrett & Younge 1958). The minute species may also have been brought in on seaweed or with larger shells. For instance, the laver spire shell (*Hydrobia ulvae*), associated with mud and the weeds *Enteromorpha* sp. and *Ulva* sp., is found in much greater quantities in the Neolithic layers and therefore is probably connected either with the gathering of cockles or seaweed.

Taste may also be a factor that affects which shells are gathered and consumed. The Anbarra people of Arnhem Land have been shown to only target certain species despite the broad spectrum available to them. It has also been noted that some species have a hidden importance in their diet, i.e. they may not be particularly nutritional but they provide variety. Gastropods are often eaten as an hors d'oeuvre before a main course of bivalves (Meehan 1982) and although mussels and gastropods are found in small quantities in the Ertebølle middens, they may have been gathered for similar reasons.

Just as it is impossible to be sure of which shellfish tasted better to the Ertebølle people, it is also difficult to assess exactly who the prehistoric shellfish gatherers were. However, as other resources are obviously being hunted, fished and gathered near to these sites there may have been some divisions of labour, possibly by gender, age or kin. It has been noted that in ethnographic studies it is mainly women and children who gather shellfish, although male participation is often more productive (Claassen 1991; Waselkov 1987). Claassen (1991) identifies shellfishing for women and children as recreation and family time as opposed to the concept of 'work' which is used when viewing gathering from an economic or subsistence stance or when modelling optimal foraging theories. It appears that the mothers of the Anbarra will sometimes use shellfish gathering as an excuse to leave their small children back at camp with a guardian, although usually they cannot get away without the children noticing, and they end up accompanying their mothers on the trips (Meehan 1982, 81). At the coast there is no competition for resources between women and they tend to work within talking distance of each other; 'conversation interspersed with laughing and joking continues throughout' (Meehan 1982, 86).

The different sizes of shells found at the sites does suggest that most were scooped up rather than being selected for size and as the shells were gathered they may have been collected in baskets, nets or clothing to be taken back to the midden areas. It is hard to say how far they must have been carried but as already mentioned there is evidence for shell beds in front of several of the middens and it is likely that it was not very far. It is also possible that some shellfish were consumed on the shores as a snack or meal but any evidence of this would have been fairly rapidly destroyed by the sea.

Once back at the middens the meat has to be removed from the firmly closed valves of the shell. Waselkov (1987, 100) lists four methods which people may employ to extract shellfish: roasting (including baking and steaming), boiling, cracking, and using a shucking tool. It is unlikely that the oysters were boiled at the Ertebølle sites for this process requires containers and although pottery is found, the vessels were not large enough to contain many oyster shells at a time. It is possible that some of the smaller shellfish such as cockles or winkles were boiled in these pots and they may even have been combined with other foodstuffs. It also seems unlikely that the oysters were cracked or opened with a shucking tool. Although a proportion of the shells in the middens are fragmentary, this is likely to be the result of formation processes such as trampling and the weight of the midden. Using a shucking tool tends to remove a notch out of the side of the shell but from personal observation this has not been noted on any of the complete shells examined. In addition, both the latter methods are time-consuming, each shell having to be opened in turn, and cracking may also mean that pieces of shell get into the meat. The most feasible method for opening the shells is therefore roasting.

Roasting is a highly efficient method because thousands of shells can be cooked in minutes. The temperature relaxes the muscles and causes the valves to gape, allowing the meat to be removed and the juices sucked out. There are various ethnographic accounts of such cooking methods (Waselkov 1987) but in many cases it is the heat causing the shell to open which is of importance, rather than complete cooking, after all shellfish are often eaten raw. It appears that various methods can be employed for roasting. The Anbarra stack their shellfish with the hinges upright. Small sticks and dead grass are set alight on top and after a few minutes the fire has burnt out and the debris is swept off. The shells are left to cool and then the meat and juices consumed. Another method which is used when large quantities have to be cooked, such as at ceremonies, is to tip huge quantities of shell into the embers of a large burnt out fire. These are then covered with green branches and bark, which prevents the escape of steam, and they are roasted for a couple of minutes (Meehan 1982, 87–9).

Gastropods may be removed from their shells in a number of ways. Most snails will retreat into their shells and seal the aperture with a solid calcareous or chitinous deposit known as an operculum. Roasting or boiling, as with bivalves, releases the muscles and allows the meat to be extracted using a pointed object. The shells may also be broken using a stone, for instance the Diola of southern Senegal break the apex of the spire and suck the snail out (Waselkov 1987).

It is usually of no advantage to inspect the shells for evidence of burning because they will not scorch unless exposed to fire for a fairly long time. Shells from the Mesolithic layers have not been recorded as being heavily burnt and having personally examined some of the Norsminde material there only appeared to be a small minority which had been scorched, but these may have had prolonged contact with fire if discarded near or below a hearth. In addition, moisture from the shellfish or water poured over the top creates steam preventing scorching, as would steaming shellfish in succulent plants (Waselkov 1987). If seaweed was brought to the sites, it may have been that it was used for this purpose. It has also been suggested that many of the small stones found in the middens arrived there attached to seaweed (Andersen 1995) and many of these do appear to be scorched. However, seaweed can be used for a variety of other purposes including being eaten, and preserving wild-fowl and seal-meat (Clark 1952).

Various types of hearths have been found in the Mesolithic levels of the middens, although many may have been lost in time due to exposure and the occasional influx of the sea. Two types of hearths were found at Norsminde. Three were stone built and were about a metre in diameter, occurring in a grey ash horizon beneath the midden. The other type was identified by areas of the subsoil coloured reddish-yellow from heat (Andersen 1989, 25). At Ertebølle two types of hearth were identified. Horizontal layers of burnt shell powder and charcoal were found within the midden layers. There was also a steep-sided fire pit, 2.5 to 3 m in diameter with three successive layers of clay, charcoal and burnt shell (Andersen & Johansen 1986, 47). The only types of hearth which were found at Bjørnsholm were circular layers of burnt shell material and charcoal, similar to those at Ertebølle and these occurred in all levels of the mound (Andersen 1991, 77). These various types of hearths may indicate different sorts of meal, both at each site and possibly between sites. There is no doubt that the large pit found at Ertebølle was used on several occasions and it may indicate a 'feast' or large-scale cooking event. The smaller hearths on the other hand do not appear to have been used for opening large numbers of shells at a time and it is possible that these represent smaller meals.

Rather than eating the shellfish directly there are a number of other ways of using them. Ethnographic accounts record that it is possible to dry the shellfish meat and also to smoke it although the methods used are rarely recorded (Waselkov 1987, 105). The preserved meat may then have been stored in containers, possibly the pottery found at the sites. It is also often suggested that the shellfish were being collected for bait and Smart (2000) suggests that the shellfish found at the Ertebølle sites may have been gathered for this purpose. The method of fishing using wicker weirs does not usually require bait because the weirs direct fish into traps. There is, however, evidence from these sites for specially designed traps with inner funnels and separate chambers, and therefore bait, in the form of shellfish, may have been used in traps as well as on fish hooks.

From oysters to cockles

These various brief insights into the different aspects of procuring and preparing shellfish for consumption are an important reminder to the archaeologist that kitchenmiddens are not simply repositories of environmental and economic information. Kitchenmiddens, in part, represent a palimpsest of meals through time, and of course not only of shellfish but other foodstuffs as well. The food had to be gathered and then prepared, and at every stage of the process from, for example, prising an oyster from the substrate to sitting around a hearth and eating it, the act of consumption must have served a variety of social, biological and economic functions.

From this perspective it is interesting to consider the difference between the EBK and TRB in terms of kitchenmidden composition (from tightly packed shellfish to alternating strata of shells and burnt stones) and in terms of species (from a predominance of oysters to cockles). These physical differences reflect a change in the consumption practices of people through time. Firstly, the act of procuring the shellfish must have altered. If it is assumed that all shellfish were dumped on the midden site and that there was a real decrease in oyster gathering, then people must have shifted their locations of gathering to inter-tidal zones further up the shore where cockles thrive. The techniques of processing the shellfish also may have changed. There appears to have been a lot more burning on the kitchenmiddens and the form of the hearths change. There are no longer discrete hearths within the kitchenmidden but instead large spreads of burnt shells and small stones. This suggests some change in cooking/heating or processing which may or may not be related to the change in species composition.

These changes can be explored in greater depth by considering further the ways in which various aspects of the consumption process may have altered. In this section I wish to explore some of the possible reasons for a shift in practice, in some cases providing a methodology for testing the hypothesis.

In past studies, the oyster has played an important role in the understanding of the EBK economy and has been used in environmental explanations for the Mesolithic/Neolithic transition. Although Bailey (1975) and Clark (1975) both suggested that the oyster contributed very little to the overall Ertebølle diet, usually less than 10 per cent in terms of calories, Rowley-Conwy (1984) saw it as an essential resource and a key factor in the transition to agriculture in Denmark. By assessing the seasonal availability of all food resources it was proposed that the lean time of the year would have been the spring. However, this is a time when oysters are at their best in terms of calorific value and they were therefore seen as essential in 'plugging a gap' in the seasonal resource cycle. This would have enabled the Ertebølle people to remain sedentary at the coast and there would have been no economic incentive or need to adopt agriculture until something disrupted the equilibrium. The change in species composition of shellfish, and in addition a decrease in the size of oysters through time was seen by Rowley-Conwy (1984) to reflect certain environmental changes. A Litorina Sea regression at about the time of the Mesolithic–Neolithic transition was argued to have restricted the ingress of salt water into the Danish waters. It was suggested that the oyster, which was probably already at its limits of salinity tolerance, would have been drastically affected by this change, thus explaining the observed size decline and species change in the kitchenmiddens. A dramatic reduction in oysters would mean that this species could no longer serve to fill the gap in the seasonal resource cycle, thus causing a shift in subsistence practices from hunting, gathering and fishing to a farming economy.

It is possible to test this hypothesis by examining the oysters within the midden to determine how the environment may have affected their growth. Work of this nature is currently being undertaken (Milner in prep.) and requires analysis of the microstructure. The shell of the oyster grows incrementally in a similar manner to trees. It lays down calcium carbonate throughout the year at differing rates and a break of growth in the late winter causes a line to form in this incremental structure (Milner 2001). These lines can be used as yearly markers and counted to calculate the age of the shell. This can then be correlated with the size of the shell to determine why there is a decrease in shell size through time. A sample of smaller shells that have a similar age profile to a sample of larger shells may indicate that environmental change has caused the decrease in size (the annual rate of growth is slower resulting in small annual growth bands and therefore smaller shells). However, a fall in average age through time (which is why the shells *appear* to be become smaller in size) may indicate human over-exploitation, the intensity of the exploitation preventing the oysters from reaching the older ages (see for example Swadling 1976). At present it is not possible to comment on the influence of environmental change and human predation pressure on the oysters in the Danish kitchenmiddens, except to say that from preliminary investigations change in size through time may be a combination of both factors (Milner in prep.).

An alternative approach is to consider the shift from oysters to cockles as a *result* of a change in human practice as opposed to an environmental or ecological approach where the observed change is seen to be the *cause* of cultural transformation (from hunter/gatherer/fisher to farmer). A major change in socio-economic lifeways, which occurred with the acculturation of the Neolithic and adoption of agriculture, is very likely to have had an impact on the consumption of wild resources, such as shellfish. This may be reflected in a number of ways including changes in the species exploited (as already noted), the seasons in which they are consumed, the ways in which they are processed and the division of labour within society.

It is usually assumed that the Ertebølle people were more or less sedentary at the larger shell middens, where large quantities of marine resources could be exploited. This is likely to have changed in the Early Neolithic when site location may have shifted and the coastal sites may have been visited more sporadically or seasonally (Johansen in press). Seasonal exploitation can be tested in various ways for many of the faunal remains found on archaeological sites (Monks 1981) and this is now possible for oyster shell by analyzing the incremental microstructure (Milner 2001). Seasonality work has been carried out on oysters sampled from layers through the Norsminde midden. It appears from the analysis that the oysters in the EBK layers had predominantly been gathered in the spring, but that the TRB oysters had been gathered right through spring and summer (Milner 1998; Milner in prep.). As already noted, the spring is a time when oysters are at their best in terms of calorific value and it may have been that they were targeted in these leaner months for the reasons proposed by Rowley-Conwy (1984). There are numerous other possibilities, such as ritual spring feasting, but whatever the reason it is clear that something changes with the advent of the Neolithic. Interestingly the summer is the worst time of the year for eating oysters because this is when meat condition and glycogen content drop due to spawning (Sloan 1993), although it is a good time for eating cockles and it should be noted that the summer is a lean period of the farming calendar. The extended season of oyster gathering through into the summer may therefore be related to other activities which occur at the site at this time, such as gathering cockles or fishing.

Fish bones are plentiful in the Mesolithic layers at all three sites, e.g. at Bjørnsholm huge amounts of eel bones (*Anguilla anguilla*) were excavated. The majority of fish bone found at the site was eel and as eel bones are very fatty in nature and are less likely to be preserved it was noted that '. . . the absolute dominance of eel bones can only mean that fishing at Bjørnsholm was no less than an eel adventure!' (Enghoff 1991, 115). As with the oysters far fewer fish bones are present in the Neolithic layers and in fact at Norsminde no fish bones or otoliths were found in the Neolithic part of the midden at all, despite using careful wet-sieving techniques. Absence of evidence is not evidence of absence however, and we cannot rule out the possibility that fish may have been caught on the coast and then taken elsewhere for consumption. This may also be true for oysters, which would account for the drop in numbers in the Neolithic layers of the kitchenmiddens.

In other parts of the world it has been argued that changes in species composition through a shell midden may be connected to fishing and changes in the division of labour. For instance Bowdler (1976) believes that the adoption of line fishing in Australia 600 years ago signals the advent of women as fishers. This is accompanied by a change in midden composition to more easily procured shellfish such as mussels, the collecting of which would fit in with the more time-constraining fishing activities, as compared to the species gathered prior to this which can only be obtained at low tides. Variation in the division of labour in other activities, such as farming, may also have resulted in the changes observed in the Danish kitchenmiddens although it is difficult to see how to test this.

Finally, the act of opening the shells, the shellfish meal and discard should also be considered. There are various forms of hearths found in EBK layers and it has been suggested that heat was used to open the shells though it is also probable that these fires were used for many other purposes including cooking other food and keeping warm. Although the size of some of the hearths suggests large quantities of food may have been heated/cooked it is difficult to be sure of the form that some of the meals may have taken, i.e. were there often feasting events or did shellfish only contribute to small-scale snacks. This could perhaps be tested by examining the different forms of hearths within the middens and also assessing the deposition of shell. It is however, very difficult to interpret the stratigraphy of a shell midden and the rates of accumulation. A large dump of shells may have accumulated over a relatively long period of time or may simply represent one event, but unless there are clear lenses of other species of shellfish, cultural material or hearths through the dump it is very difficult to reconstruct deposition events. Even with good stratigraphic evidence it is hard to be certain of the time taken for the material to accumulate, i.e days or years, and there is the added problem that the material may later have been piled up or moved around. The difference in composition of the Neolithic layers in terms of the amount of burnt material again suggests some change in practice which may be related to shellfish consumption, although this much burning should not be needed to process cockles and it may be connected to other activities. One possibility is that some of the food, including shellfish and maybe even fish, was preserved for delayed consumption elsewhere. These foods could have been dried, although the evidence of major episodes of burning may reflect smoking.

Conclusion

In sum, this discussion has presented several different hypotheses and some methods for testing them. The decline of the oysters in the kitchenmiddens may reflect three different things: either oysters were still being gathered but taken elsewhere, or they simply were not being targeted anymore, or environmental/exploitation pressures caused a decline in numbers. An environmental change may be seen as a catalyst for the transition to agriculture but equally the changes seen in the kitchenmiddens may be a result of other socio-economic transformations that were taking place at the same time. The shift from oysters to cockles and midden composition may be linked to changes in seasonal gathering of wild resources, other reasons for visiting the sites, division of labour and other processes such as smoking food for preservation. This approach should not be seen as an attempt to explain the adoption of agriculture — it simply seeks to understand more about the changes in consumption of shellfish through the Mesolithic–Neolithic transition.

Ethnography may help us to hypothesize about the past but it cannot provide a view of the long term. The kitchenmiddens are invaluable in this respect because they were created over such long spans of time and archaeology can use various scientific techniques and methods to further identify change through time. Some of the ideas outlined in this paper should be tested and explored further. For example, it might be possible to investigate the seasonality of the cockles through time, or some species of fish, and the accumulation rates of the middens and a study of hearths may provide a better understanding of the types of meal at these sites.

Finally, the kitchenmiddens should not be taken in isolation. This paper has used three kitchenmiddens for a case study but it may be more appropriate to concentrate on a particular site and then explore food consumption in the landscape context. This is particularly important when considering long time spans and the extent to which change in consumption practices is a reflection of wider socio-economic change, or vice versa.

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Chapter 9

Prudent Producers and Concerned Consumers: Ethnographic and Historical Observations on Staple Storage and Urban Consumer Behaviour

Hamish Forbes

In Greece in 1973, the outbreak of war between Israel and neighbouring Arab states, and the oil crisis in which the Organization of Petroleum Exporting Countries (OPEC) formed a cartel to generate a substantial increase in the value of oil by reducing the amount in world markets, had profound social as well as economic effects. The prospect that war in the Middle East might spill over into the wider eastern Mediterranean area and involve Greece in some way was openly discussed by ordinary people. The effects of the rapid rise in oil prices pushed up costs of a wide range of products alarmingly, and shortages of various commodities developed. Inflation levels reached 40 per cent and there was a serious economic recession. For those who made a living by unskilled and semi-skilled work in urban areas, work became scarce, and many households found it difficult even to feed themselves. Regular announcements by the military government of the time that it was taking measures to ensure adequate supplies of wheat were not helped by continued rumours that supplies of wheat and flour were drying up. In Greek society, where bread provided the primary item in the diet of poorer people, these rumours were particularly alarming.

High levels of inflation meant that those who had spare cash or savings saw them rapidly lose value. In order to counter the rapidly falling value of money, those with spare cash invested it in whatever durable form they could. It was rumoured that a major reason for the cessation of many building projects at this period was because much of the stocks of steel concrete-reinforcing rods had been bought up as a hedge against inflation. No one wished to sell them while their nominal cash value was increasing so quickly due to inflation. Other people bought up toilet bowls, while others invested in sugar, and so on. During the summer and autumn of that year much of the conversation of ordinary working people was of imminent war affecting Greece, though there was little agreement about what the cause(s) of this future war might be. Some thought it would be civil war, while others thought that continuing instability in the Near East might spill over into Greece. By the late summer of that year it was possible to hear people saying openly in public that they had substantial supplies of wheat but they would not be selling any of it because of the threat of war and ensuing famine.

At that time, even more than now, Greece was, for historical reasons, primarily a nation of small agrarian producers. In 1973, the average farm size was 3.6 ha: in the 1970s some 94 per cent of all farms were under 10 ha in size, and 80 per cent were below 5 ha (Frieris 1986, 181–2). These figures had changed little from those of the 1920s when 96 per cent of all farms were under 10 ha (Frieris 1986, 47). The vast preponderance of small farms was the result of deliberate government policies originating in the nineteenth century and continuing well into the twentieth century (McGrew 1985, 207–14; Frieris 1986, 45–7). This was achieved particularly by the expropriation of large estates on which many landholders at that time restricted wheat growing in order to keep domestic prices high. One of the aims of these policies was the encouragement of wheat production in order to ensure Greece's self-sufficiency in bread: the transfer of land from large estates to small owner farmers who grew more subsistence crops, including wheat, ensured that the surpluses could be sold on the open market. These policies were additionally bolstered from the inter-war years onwards by a system of price supports (Frieris 1986, 46, 94; see also McGrew 1985, 213). Price-supports, to encourage domestic wheat production in the face of low world market prices were strengthened by the military government, so that the cost to the government of importing wheat of some £16.7 million in the mid 1960s was cut to negligible levels by 1969 (Yannopoulos 1972, 124).

According to the military government, Greece was essentially self-sufficient in wheat by the early 1970s — a statement which was politically highly significant in view of the dependence of the poor on bread, but probably also broadly correct (see above). In the autumn of 1973 the government announced that they intended to increase the support price of wheat, to persuade farmers to grow more. In the event, however, little was done to raise prices. The fact that in these circumstances there was a significant and developing shortage of wheat could therefore be blamed neither on a substantial short-fall in cereal production, nor on a limited number of 'fat cat' large-scale producers or merchants colluding to raise prices at a time of adequate supplies. Rather, the shortage was the result of a very large number of small-scale producers all choosing *not* to sell their wheat, but to retain it in store because of high levels of uncertainty about the immediate future. It was reported that in the early months of 1974 the government was importing North American wheat at above the support price of home-produced wheat, but its room for manoeuvre was very limited because most of the country's dollar reserves were being spent on importing high-priced oil.

The developing shortage of wheat became so severe that eventually bakeries were forced to ration bread supplies. Serious problems with the bread supply were already evident in major civil disturbances in Athens in November 1973 which indicated widespread and deep-seated dissatisfaction with the regime: by the time they were ended by military force, there had been 20 deaths according to the government, though other observers suggested substantially more (Woodhouse 1982, 201). In particular, slogans juxtaposing the need for political freedom with the need for bread, and highlighting the problems of hunger were widespread (Andrews 1980, 72–4). Nevertheless, food shortages amongst the poorest sectors of society had existed even before this period, as highlighted by a characteristic statement made by the head of the *junta* in 1969: 'the Greek people must eat less, work more and demand less' (Yannopoulos 1972, 126).

In this situation the right-wing military *junta*, never particularly popular with the urban working class, found itself dealing with bread-riots in Athens which were widely reported throughout Greece, and which further undermined its support in other sectors of society. It is against this background that the abortive, Greek-instigated *coup* in Cyprus occurred, apparently an attempt by the *junta* to win back its popularity (Woodhouse 1982, 205). The primary reasons for, and the circumstances surrounding, this attempt to annex Cyprus, and the apparent lack of will or ability on the part of other NATO members to forestall it are a subject of continuing debate, and allow full rein to those who prefer to see world events dominated by conspiracies against small states by the world's major powers. Others prefer to emphasize the stupidity of the *junta*, while noting that the American State Department was primarily engaged in 'shuttle diplomacy' between Egypt and Israel and that the American presidency was at the same time paralyzed by the final stages of the Watergate affair (Woodhouse 1982, 207). However, it was evident to me at the time that the appearance, during the winter and spring of 1973–74, of widespread slogans — generally presumed to have been instigated by the government — painted on walls in Athens, declaring Cyprus to be Greek, coincided with increasingly serious concern over bread shortages and the rapid rise in food prices generally. The frequency of the air-time given on the radio to a piece of music memorializing the previous leader of the movement for union of Cyprus with Greece also at this time must likewise be born in mind.

The *coup*'s failure as a result of the Turkish invasion of northern Cyprus, and the subsequent threat of a Turkish invasion of Greece, led directly to the collapse of the *junta* (Woodhouse 1982, 207). While the inability to ensure an adequate supply of wheat and the subsequent bread riots are only one of many elements involved in the decline of popular support for Greece's military *junta*, they were, nevertheless, a high-profile and very visible one in a country where the question 'have you had anything to eat?' took the form of 'have you eaten bread?'. They were also brought on in part by the aggregate of decisions by small-scale agrarian producers throughout the country to keep their wheat in storage rather than to release it for use by non-agriculturalist consumers. It may be difficult to accept that the European Union's continuing political difficulties with Turkey over the admission of only a part of Cyprus to the EU lie partly and indirectly in the reactions of urban consumers to the results of peasant conservatism. However, having been in Greece at the time, witnessing discussions on the deteriorating situation among dwellers in Athens and in the countryside, and with a contact in the agriculture section of one of the western embassies, I am in no doubt of the correctness of this observation. It is aspects of the production of food by small-scale agrarian households, the decisions they make concerning when and how to release surplus commodities from storage and onto the market, and the reactions to those decisions by non-agrarian consumers, which are the focus of this contribution.

Storage as an archaeological and social phenomenon

Storage is a behaviour (or, more usually, a range of archaeological features and artefacts) with which archaeologists are very familiar, but the topic does not regularly enter wider archaeological discourse. The only exception to this rule is discussions of the origins of food production in the Near East, where the appearance of storage pits (assumed to have been constructed for food preservation) is considered an indication or precondition of the very earliest phases of a dependence on food production. In actuality, storage seems to be a basic feature of human behaviour, involving far more than the simple 'saving it for later' of cultivated foods (e.g. Testart 1982; Forbes & Foxhall 1995, 69–70). However, while there is evidently considerable scope for discussions of a wide range of aspects of storage within archaeology, in this article I shall restrict my discussion to storage of agricultural food products. In that context, storage must be seen as integrated within the complex series of decision-making processes which farming constitutes, since deposit in store is in one sense the (impermanent) end-point of many food-production activities. It is also, by its very nature, integral to consumption, since food storage obviously involves saving produce for later use. Therefore, certainly in the case of food, but also with many other commodities, storage must be seen as the fundamental link between consumption — the focus of this volume — and the initial production of a commodity.

Although storage does not feature regularly in the archaeological literature, it is discussed from time to time, mostly in the context of aspects of food storage. Recent examples include storage among the Inca and other peoples of South America (Murra 1984, 122–3; Earle & D'Altroy 1982; D'Altroy & Earle 1985), storage pits in British Iron Age hill forts (Gent 1983), storage vessels in a Late Bronze Age Cypriot village setting (Webb & Frankel 1994), *koulouras* in Minoan palaces (Strasser 1997; Halstead 1997), and storage in the context of food-supply policies within the Roman empire (Rickman 1971; 1980). Some of the theoretical aspects of storage and exchange, the latter defined as 'social storage', feature prominently in a number of contributions to a recent volume on cultural responses to risk and uncertainty (Halstead & O'Shea 1989a). However, discussions of storage in relation to risk and uncertainty found in that volume are set within an underlying agenda addressing issues of social change, particularly the rise of social complexity and of elites (see especially Halstead & O'Shea 1989b; O'Shea & Halstead 1989; Halstead 1989).

The fact that much of the discussion of the significance of storage installations noted above is also set within the context of complex societies and, indeed, multi-ethnic empires (e.g. the Inca, the Roman empire) can hardly be coincidental. Most historical sources tend to reflect the views of élites, and the most visible archaeological remains also reflect the power of élites, whether these be medieval castles and monasteries — and, significantly, tithe barns — Late Bronze Age Aegean palaces, Roman military installations or Inca roads and state-organized storage structures. By contrast, the archaeological remains left by non-élites, either members of egalitarian societies or those in the bottom strata of society, are frequently unimpressive at best: it goes without saying that they rarely contain unequivocal evidence of storage.

Aim of this contribution

The aim of this contribution is to broaden the issue of storage and consumption by focusing on groups which are sometimes ignored in archaeological discussions of pre-modern societies: peasants and the urban poor. In particular I wish to investigate aspects of the reverse of 'consumption' — food shortage. I use the term food shortage rather than famine, since famine as a social and biological catastrophe is, and apparently always has been, rare. Food shortages, which can be defined as reductions in the amount of available food supplies, seem to have been a relatively common phenomenon. While they fall well short of catastrophe, however, food shortages can lead to economic, social and political disruption (Garnsey 1988, 6).

The discussion starts, however, with the issue of the production by peasants of the basic foodstuffs that are consumed by non-agrarian households, and the way peasant households control the flow of these products onto the market for food. The term 'peasant' has been the subject of much debate in social anthropological circles which I do not intend to extend here. A basic definition which covers the most salient features is as follows:

> Peasants are farm households, with access to their means of livelihood in land, utilising mainly family labour in farm production, always located in a larger economic system, but fundamentally characterised by partial engagement in markets which tend to function with a high degree of imperfection (Ellis 1988, 12).

In this definition the most important aspects are, first, the fact that peasant farming is practised generally on relatively restricted holdings, small enough that they can be worked primarily with family labour. A second essential feature of the term as usually defined, is the setting of these family farms within complex societies and their economies. However, the markets of these societies, whether for capital, credit, or land, and the circulation of goods and market information, operate under conditions far removed from the 'free market economics' of modern western societies (Ellis 1988, 11–12). Under such circumstances, peasants usually 'engage in', rather than being integrated within, markets, often engaging in the market but rarely, preferring to emphasize self-sufficiency in their economies rather than market integration. Although possibly a relatively extreme example, Gallant's (1991, 98) reconstruction of ancient Greek peasant behaviour summarizes the situation well:

> . . . in general peasants in ancient Greece did not *regularly* mobilize their surplus production through the mechanism of the market. They chose instead to store it physically at the levels discussed earlier, invest it in the production of secondary commodities like livestock, or use it to create bonds of obligation through participation in reciprocal feasting with co-villagers. [Italics mine]

Under pre-industrial conditions it is generally accepted that the superstructures of most states were supported primarily by the production of these small farms. Not only did peasants feed themselves, but the bulk of the food supply for those not directly engaged in agriculture was produced by the peasantry. In many societies, of course, some of this food reached the market through landlords to whom it was paid as rent and through governmental agencies to whom it was paid as tax. Nevertheless, it is evident that even under these conditions many peasant households have been able to generate substantial surpluses of food. In many parts of the world even now the non-agrarian sector is still heavily dependent on food produced on these small-scale farms. Archaeological discussions of storage facilities, which like tithe barns, Inca storage structures and Roman granaries, were often produced by groups close to the centres of political power, do not usually consider the fact that they were built to contain primarily the surplus produce of peasants.

Surplus production and peasant economies

In the literature on peasant societies, which represent a classic type of subsistence-based society, it is frequently noted that the producing group and the consuming group tend to be one and the same. This fact, plus the notion that production ceases once the group's needs have been fulfilled, is a fundamental feature of the hypothetical agrarian subsistence unit in Marshall Sahlins' *Stone Age Economics* (1974, 41–99). Sahlins explicitly states that peasants provide an especially clear example of his idealized self-sufficient household type (Sahlins 1974, 88–9). Given this starting point, a question raised by anthropologists and others concerns why peasant households (and other small-scale agrarian producers) engaged in subsistence agriculture in which the producing and consuming groups are essentially the same, should ever generate any surplus above their own consumption needs. For Sahlins, scrutinizing the overall productivity of small communities with little centralization of political power (1974, 101–48), the cause of production beyond subsistence needs lies in the embryonic political centralization produced by emerging leaders. Indeed, he sees production beyond households' domestic needs as the essential 'social glue' which holds societies together (Sahlins 1974, 123–48). For most Marxists on the other hand, particularly those studying societies with a greater degree of socio-political complexity, coercion by those who hold political power is the cause of production beyond subsistence.

Much of the social anthropological debate over surplus production uses primarily or wholly social terms of reference in attempts to explain its emergence. The existence, in aggregate terms and under normal circumstances, of a significant quantity of food which is surplus to the domestic requirements of small-scale producers is a well-established social fact in a number of societies. It is a *social* fact not least because, particularly in more politically centralized societies, it is what supports non-agrarian specialists, including élites, and those non-agrarian workers on whom they depend — as Gordon Childe (e.g. 1942, 82–5; 1963 [1951], 155) pointed out long ago. Nevertheless, we must acknowledge that social facts need not necessarily have *wholly* social explanations.

A substantial contribution to the debate over the causes of surplus has been provided by Halstead (1989). Drawing on both his own field research in Greece and on the classic work of Allan (1965), he argues that, at least in environments with marked interannual variability, a surplus over domestic needs under average climatic conditions is inevitable. Only by producing such a *normal surplus* can subsistence-based households survive the poor years which are inevitable in any farming society and which are likely to be very marked where fluctuations from year to year are substantial. Halstead quotes Allan (1965, 39), in noting that among the Tonga in East Africa normal surpluses varied from 10 per cent to 140 per cent over a 14 year period, with an average of 40 per cent. This was a society in which there was a minimum of political centralization and in which there was very little market integration for sale of surplus: in this particular context neither the 'social glue', nor the 'coercion by élites' explanation for the existence of surplus convinces. A comparable ethnographic example involving a peasant society will be presented below.

Ethnographic setting

The peninsula of Methana, in the northeast Peloponnese (Fig. 9.1), was the focus of a two-year ethnographic study of traditional farming strategies from 1972 to 1974 (Forbes 1982), supplemented by several visits during the 1980s. At the time of the main fieldwork the population was very largely composed of independent farming families intensively cultivating small land-holdings primarily for household consumption. It is important to note, in the context of the discussion of surplus production that follows, that only a very small minority of households rented any land, and all owned some. In addition, taxation was restricted to that on goods for sale (cf. Wolf 1966, 2–4, 60).

Methana lies in one of the driest and most climatically variable parts of Greece. This semi-arid zone is characterized by relatively high temperatures and a low and unpredictable rainfall regime. In common with much of the Mediterranean zone it is characterized by hot, dry summers, with rainfall concentrated during the cool winter months (Forbes 1989, 88–9). Most arable crops are sown in the later part of the autumn, being harvested in May and June. The most important crop to mature over the summer months is the olive, a tree very well adapted to surviving under conditions of high summer temperatures and low rainfall (Forbes 1982, 230–89, 312–13).

Rainfall is the primary factor affecting plant growth. For agriculture the overall amount falling during the year is only one factor. Also important is its timing, particularly the onset of rains in the autumn and their cessation in spring, since cereals, particularly the local cereal staple wheat, are highly sensitive to low soil moisture levels at the beginning and end of their growing period (Leonard & Martin 1963, 285–6; Forbes 1989, 89). The amount of rainfall in each rainfall event is also important, since a large number of light rainfalls will not adequately penetrate deeper soil levels: under these conditions olives and other tree crops will lack the necessary soil moisture reserves to ensure adequate growth through the rainless summer months. Alternatively, if a normal year's total rainfall is concentrated into a few exceptionally heavy falls, many arable crops may suffer from drought in the long gaps between falls (Forbes 1982, 318–20).

Not surprisingly, agriculture in this environment carries with it a serious risk of crop failure. Garnsey & Morris (1989, 98) provide figures from Attica, an area not far from Methana (Fig. 9.1), which suggest that the probability of harvest failure for wheat is one year in four, based on the number of times annual rainfall is less than 400 mm. Rather more anecdotal evidence from Methana suggests that perhaps twice per decade, on average, farmers experienced crop failures of a severity so great that they might receive a return on their wheat of little more than the amount of seed sown, or even less.

Family holdings in the pseudonymous village of Kosona on Methana, in which fieldwork was concentrated in 1972–74, averaged 3.3 ha (*c.* 8 acres). These holdings were worked by household members with subsistence as the main objective. In this context I use the term subsistence to mean that the primary aim of households was to produce agricultural commodities for their own consumption. While no household was entirely self-sufficient, nearly all were self-sufficient in the three dietary staples of wheat, olive oil and wine, and the value of crops grown specifically for cash sale was less than the value of crops grown for household consumption, virtually without exception (Forbes 1989, 87–9; 1982, 158–99). Kosona households thus had a cash-poor, subsistence-orientated economy typical of many small-scale agrarian producers worldwide who live under pre-industrial conditions. Furthermore, although their domestic economies were more subsistence-based than those of many other areas in Greece, they can be considered to be

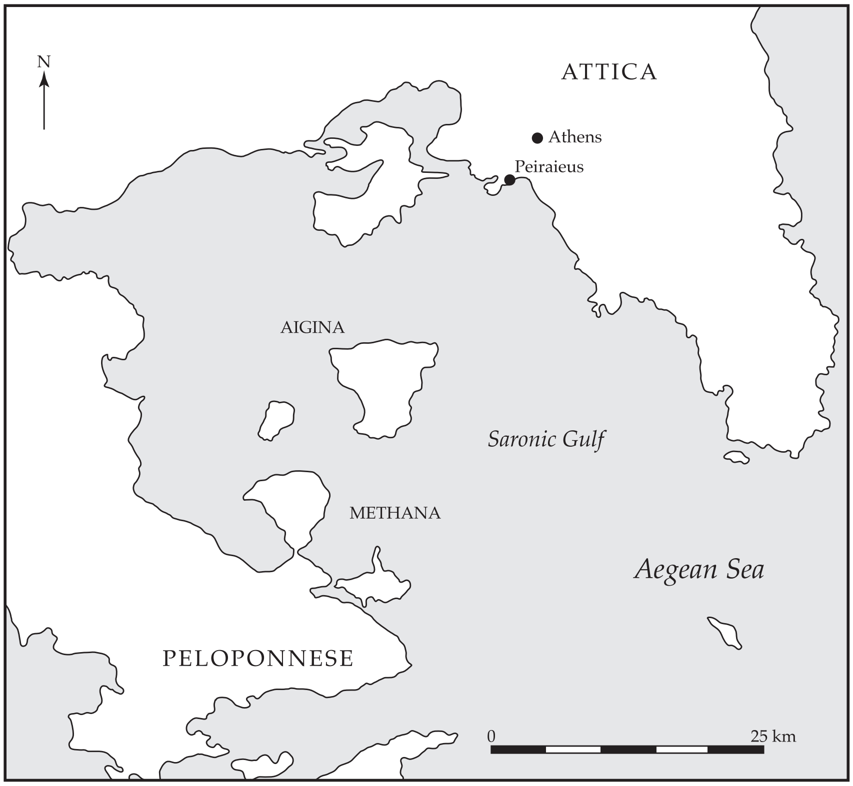

Figure 9.1. *Methana and the Saronic Gulf, Greece.*

broadly representative of the ways in which small-scale, risk-averse, farm operations were managed throughout Greece at the time.

Because of the highly variable climate, Methana farmers practised a number of risk-buffering strategies in order to reduce the risk of crop failure. A number of these are documented in Forbes 1989 and in more detail in Forbes 1982. Two are relevant in this context. The first of these is *production strategies*, in which households planned to produce a normal surplus — i.e. a surplus under average climatic conditions — to ensure sufficient for survival under below-average conditions. For Kosona as a whole, the normal surplus for their cereal staple, wheat, under average climatic conditions was estimated at 55 per cent, with the figures of the one household which grew wheat for sale (see below) excluded — see Figure 9.2 (Forbes 1982, 356–76; 1989, 91–3). Such overproduction represented the generation of a built-in surplus which could be expected in more than 50 per cent of years, since many households still had a surplus in mildly below-average years.

Only 4 households, out of 32 which indicated areas of wheat sown, reported sowing so little wheat that they could have been expected to produce less than sufficient for domestic consumption under normal climatic conditions during the growing seasons 1970–71, 1971–72, 1972–73 and 1973–74. Two of these 'deficit sowing' households had a steady cash income from regular paid employment, which would have more than covered any shortfalls in cereal harvests. Of the other two, one had a head of household who was alcoholic and the other not only had a reputation for being particularly lazy, but also had two sons who had good jobs elsewhere and who may have been sending cash home on a regular basis. Significantly, only the household whose head worked full time in the merchant marine reported sowing less wheat than would cover subsistence needs under normal conditions in more than one of the years documented (Forbes 1982, 359–65).

Since Methana farmers were operating in the context of the monetized economy of a modern nation state, in which there was a substantial demand for wheat to feed the nation's non-agrarian — especially urban — consumers, it would be tempting to explain their normal surplus as a response to this demand. However, a number of lines of evidence indicate that this was not the case, and that their surplus production was indeed one of the buffering mechanisms employed by households purely for subsistence purposes. This evidence has been documented in detail elsewhere (Forbes 1982, 356–76; 1989, 91–4).

Farmers in Kosona stated that the market price of wheat was so low that, after deducting the input costs of labour, fertilizer, threshing, etc. from the value of their crop, they grew it at a loss. They grew it, they said, because it was their staple: they could not survive without it. These statements highlight the degree to which households emphasized subsistence and self-sufficiency in their planning and decision-making, rather than factors associated with cash-production and the market. Only the poorest household in the village stated that they grew wheat specifically with the intention of producing a surplus for sale. Their surplus over consumption needs averaged 214 per cent during a three-year period: this compares with the households with the highest normal surplus, which averaged 135 per cent and 119 per cent over three years (Forbes 1982, 361–7). The isolated group of two returns at the high end of the bar chart (Fig. 9.2) represents two of their three reported production years.

The second risk-buffering strategy to be discussed here is *storage strategies*. Methana farmers were well aware of the relative frequency of serious crop failures, against which production of a normal surplus was an inadequate response. They therefore preferred to keep at least an additional year's supply of wheat in storage beyond the amount sufficient to feed them for the current year. Thus, in the event of a complete crop failure, they had sufficient to feed themselves for another whole year (Forbes 1989, 93–4; 1982, 377–91). The extent to which Methana farmers were regularly able to maintain extra years' supplies of grain has recently been questioned, as has the efficacy of storage itself as a risk-buffering mechanism (Gallant 1991, 94). However, as has been clearly stated elsewhere (Forbes 1982, 377–91; Forbes & Foxhall 1995, 75) all the available evidence indicates that the storage of extra years' supplies of staples was a normal practice, not simply an aspiration.

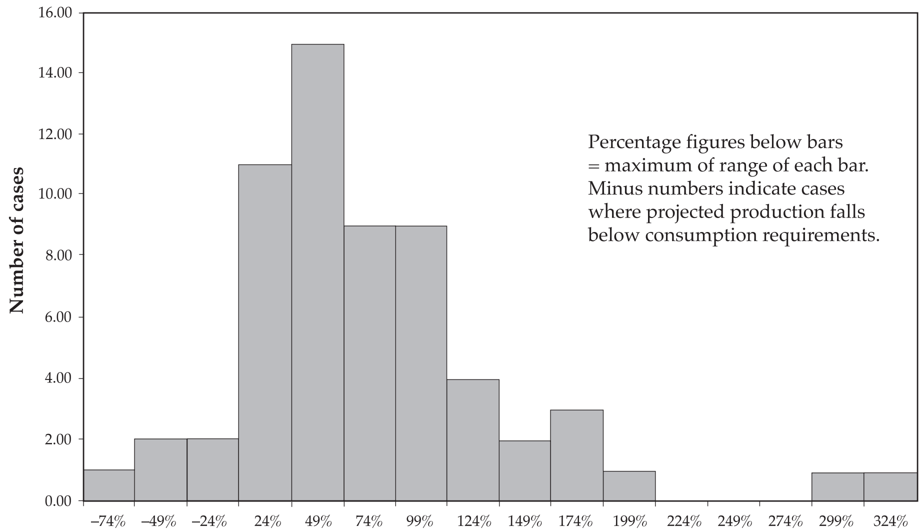

Figure 9.2. *Kosona 1970–74: households' projected wheat production, assuming average conditions, compared to requirements. Bars indicate production as percentage over or under consumption.*

These two behavioural suites, production of a normal surplus, and maintenance of at least an additional year's food supply in store, have been documented as risk-buffering mechanisms beyond the confines of the Methana peninsula (e.g. Halstead & Jones 1989; Halstead 1990). There are also indications from the ancient world that storage of more than a year's supply of grain was standard (Gallant 1991, 95).

It must be accepted, therefore, that it is quite common for peasant households to own substantial surpluses of stored cereals for much of the time, despite growing them as part of a self-sufficient household economy. Looking beyond Europe, a West African study notes that individual Diola granaries can hold ten tons of rice. As single Diola households may have several separate granaries, it is evident that they can maintain very large amounts of grain in storage (Linares 1984, 427). In the Ethiopian Highlands area the preferred staple grain, *teff*, is kept in storage for up to nine years (Tertia Barnett pers. comm.). Storage over such a long period would clearly not occur without very substantial reserves. During the 1980s a prolonged drought affected Ethiopia and surrounding areas. News reports indicated that some communities exhausted their food reserves only after the rains had failed for five consecutive years. It can fairly be assumed that some of these communities had depended on stored *teff*, although they had doubtless exploited a far wider range of foods during this emergency. This admittedly anecdotal example indicates the levels of stored food reserves, including animal fodder eaten as famine food (see below), which may be available to subsistence-orientated producers in many parts of the world.

A critical question in the context of this volume is: 'what happens to this surplus?'. Foodstuffs, after all, are produced to be consumed. Furthermore, all foodstuffs have finite lives, so producers must sooner or later withdraw them from storage and dispose of them in some way. Who, or what, consumes the surpluses that households generate as part of the risk-buffering behaviours in their subsistence-based economies? Not surprisingly, a number of Methana households sold their surplus wheat, despite the fact that they believed that the price received did not cover the overheads. Some, however, did not, preferring to plough it back into the household economy in the form of feed for livestock (see the quote from Gallant 1991, 98, above). Since the price of feed barley was lower than the price of wheat, it would have been possible to sell wheat and buy barley with the proceeds.

The fact that some farmers preferred to keep out of the cash market emphasizes yet again the extent to which a number of small-scale agrarian producers are not directly influenced by market considerations. It is also symptomatic of the wish of many peasants to keep risks of failure to a minimum. Integration into the wider market economy introduces an extra array of opportunities but also risks of making mistakes. By shunning the opportunities provided by the market economy, farmers also avoid the risks (Wolf 1966, 17; Ellis 1988, ch. 5, esp. 93–4; see also below). Gallant (1991, 101) notes directly comparable situations in ancient Greece and relates them to a passage from Aristotle (*Politics* 1257b, 13–15): 'a man rich in currency will often be at a loss to procure his basic subsistence; and surely it is absurd that that thing should be counted as wealth which a man may possess in abundance and yet nonetheless die of starvation'.

The next question is: what prompts farmers to remove cereals from store and sell them for consumption by non-agrarian consumers? Thus far we have discussed storage as a way of coping with potential environmental hazards. There are, however, other dimensions to storage behaviours. The inhabitants of Methana have been enmeshed in a monetized economy for millennia. Yet, even in the 1970s, household economies were cash-poor. Few Methanites had any trust in banks: older generations could remember periods when rampant inflation destroyed the value of paper money. They were also aware that agricultural produce is less prone to problems of devaluation due to inflation than ordinary currency, and that the value of foodstuffs tends to increase in periods of economic hardship. Significantly, they evaluated the true buying-power of money in previous decades by the cash value of another food staple — olive oil — thus highlighting their distrust of wealth in the form of cash and their preference for stored produce (Forbes & Foxhall 1995, 81).

For these reasons Methana farmers preferred to keep foodstuffs in store for as long as possible, rather than selling them off at an early opportunity for cash. The ideal was to sell them only when they needed to make a specific purchase of a substantial kind. To this end, wheat and other commodities like olive oil, almonds, etc. were kept as the equivalent of money in the bank. These commodities tended only to be placed on the market for consumption by others when a major purchase was necessary. Of course, this policy had to contend with the problem of the deterioration of food-stuffs in storage. No straightforward figures on storage lives were obtained from Methana farmers, but the observations of the ancient writer Theophrastus *(Hist. plant.* 8.11: quoted Garnsey 1988, 54–5) probably give us a 'ball-park' figure under east Mediterranean conditions. For seeds generally, he notes, those kept longer than three years are generally infertile, but are still quite edible. In the twentieth century, a storage life of up to five years for grain is quoted for parts of Thessaly (Halstead 1990, 151). On several occasions it was clear that farmers preferred to keep produce in storage even though its quality was deteriorating (e.g. through pest infestation), rather than sell without a good reason. As the quality of the commodities fell, so did the price. Nevertheless, during the fieldwork period farmers often preferred to obtain a rather lower price for their commodities and retain them in storage for longer, rather than sell them off sooner and put the money in the bank. For them, money in the bank was a greater uncertainty than keeping commodities under their direct control.

As indicated above, decisions on whether to sell surplus wheat, feed it to livestock, or to keep it untouched in store could be influenced by a range of 'non-economic' factors. These included such considerations as whether the farmer wished to avoid the added effort of finding a buyer, whether a relative had made a specific request to purchase grain, which might be difficult to refuse without giving offence, or — as in the case noted above — whether the producer was concerned about future social and economic instability and therefore retained produce in store 'just in case'. The most important feature of these observations is that small-scale, subsistence-based farmers like those on Methana are not automatically constrained to sell their surplus produce on the open market by some inherent 'power of the market'.

The shortage of grain which contributed to the social and political crisis faced by the Greek *junta* in 1973 and 1974 can be seen to have been related to the aggregate of storage behaviours of thousands of small agrarian producers who withheld their surplus supplies from the market. In the conditions of the time it was hard to say with certainty whether the primary reasons for refusing to sell were related to fears of future increased social and economic disruption or because farmers felt that the price was too low. Producers highlighted extreme uncertainty about the future rather than perceived low prices as the primary reason for retaining surplus food supplies in store. However, under the conditions and the thinking of the time these factors were inextricably related, since farmers could not foresee how rapidly prices might rise in coming months. This behaviour is in line with Scott's (1976, 4: quoted Garnsey 1988, 47) characterization of peasants generally:

> Typically, the peasant cultivator seeks to avoid the failure which will ruin him rather than attempting a big, but risky, killing. In decision-making parlance his behaviour is risk-averse; he minimises the subjective probability of the maximum loss.

In fact it is likely that under most situations of food shortage world-wide, when a significant sector of the population is suffering serious hardship, there is also likely to be a serious social and economic crisis (see below).

Discussion

In 1973 many Greek farmers could remember the last genuine famine, when thousands died of starvation in the cities, and many people in the countryside went hungry. It happened during the period of the German Occupation in the Second World War. Farmers who kept all their surplus in store immediately before and during the war were fortunate (and prudent), because the outbreak of the war saw the requisitioning for the war effort by the Greek government of the beasts of burden on which most farmers depended for ploughing and transport, and the disruption of supplies of fertilizer on which many had already come to depend. One informant on Methana admitted that he had not been prudent: he was tempted by the high prices to sell all his reserve year's grain. With the requisitioning of his mules and poor weather conditions in the growing season 1939–40, his harvest was very poor. He survived but suffered severe hunger, since no one would sell him grain, which they needed for their own households. Those who had any significant wealth in paper currency saw it made worthless by rampant inflation and then replacement, first by the invading Germans, and again by the Allies at the end of the war. Wealth in gold held or increased its value, but one of the basic features of German-occupied Greece was the widespread tendency of partisan forces to 'liberate' people's gold without liberating the people.

In their article on urban food supplies in pre-industrial Europe, Jongman & Dekker (1989, 116–17) argue that for subsistence agriculturalists, including peasants under pre-industrial conditions, the need was to maintain a farming regime in which the fluctuations in production were kept low in order to minimize the risk of starvation. Once a market for food emerged, however, they argue that the incentive for farmers to minimize fluctuations in yields was removed, since farmers would be financially compensated for disappointing harvests by higher prices. In other words, with the appearance of a market for foodstuffs, the laws of supply and demand ensured that agrarian producers were to a large extent insulated from the effects of very poor harvests because their small quantities of commodities would have been offset by greatly increased prices (Jongman & Dekker 1989, 117–18).

By contrast, they argue that urban consumers were very vulnerable, because even small fluctuations in the quantity of staples on the market led to large price fluctuations. This, they suggest, is explicable on two counts. First because most of the available food supplies were already in the market: increasing prices did not readily lead to increased supplies made available to consumers. Had this been possible, prices would have stabilized. Second, consumers had little ability to reduce their demand for staples when food prices rose, since food was essential for survival. The possible role of grain traders and their potential for creating food shortages through collusion and speculation is examined, but found unconvincing in most circumstances (Jongman & Dekker 1989, 115–17). Thus, they are explicit in their formalist explanation of the periodic food supply crises of, for example, eighteenth century Europe, by the fact that 'the price elasticity of supply and demand [for staples] is low' (Jongman & Dekker 1989, 117).

A salient feature of Jongman & Dekker's discussion of urban food supply in Europe is that their post-medieval examples are taken mostly from the Low Countries, concentrating particularly on food shortages in the eighteenth century. By that time, however, the Dutch already had an economy completely dependent on imported cereals, a large amount of which were shipped from the Baltic (Jongman & Dekker 1989, 115). Half the population lived in cities, and a substantial proportion of the rural population produced cash crops other than grain (Jones 1967, 21; Jongman & Dekker 1989, 118). In the later eighteenth century the costs of these imported cereals rose significantly and wars periodically interrupted supplies (Jones 1967, 21). Although the discussion of the political effects of food riots is instructive, the Dutch examples of grain supply and its problems are probably highly unrepresentative of pre-industrial situations. They do not represent a situation in which urban consumers are dependent on production of staples by the hinterland's farmers. Likewise the idea that, where a market for grain existed, farmers were unconcerned about poor harvests because increased prices would compensate for small returns also applies mostly to large-scale estates specializing in cultivating produce for the market. Even these enterprises — *contra* Jongman & Dekker (1989, 115–17) — are likely to have retained grain in store after a poor harvest rather than selling it on the market immediately, in the expectation of higher prices later in the year as food shortages became more serious. For peasant farmers cultivating primarily for subsistence, who probably made up the bulk of farming households in much of the pre-industrial world, a short-fall in their staples would have spelt serious hardship. Although risk-averse storage strategies and the cultivation of a 'normal surplus' might mean that they did not go hungry, they would have had little if anything to sell. It is therefore inadvisable to use Jongman & Dekker's discussion as a basis for a more general understanding of the relationship between peasant storage behaviours and periodic food crises affecting urban consumers in pre-industrial contexts.

The claim that most available food supplies were already on the market depends on the assumption that the perceived failure of increased prices to make more produce available to consumers is proof that there was little extra (surplus) produce that was not already on the market. This argument only works, however, if one assumes a producer population entirely geared to, and integrated within, an economic market for foodstuffs. That assumption fails to recognize the ability of producers *not* to make foodstuffs available, but to retain much of them in store for unspecified periods, especially during periods of instability, as a 'hedge' against possibly worse to come (see below). By concentrating almost exclusively on simple issues of supply and demand, Jongman & Dekker have relegated agrarian producers to the level of ciphers, controlled entirely by the market.

At the same time, they have also failed to take account of ways in which urban consumers, especially the poor, could reduce their dependence on normal staples. Reduction of food intake is brushed aside as a possible way of reducing demand (Jongman & Dekker 1989, 117). This is despite the fact that, however unpleasant, and indeed injurious to short-term and long-term health, it is a widely known phenomenon when demand for food among members of households cannot be met by the household's resources (e.g. Colson 1979, 19–20, 25; Gross & Underwood 1971). A specific example of this has already been noted. Secondly, consumers switch to less expensive forms of food: the consumption of animal fodder during periods of hunger is a well-known occurrence in twentieth-century Greece (Halstead & Jones 1989; Forbes 1989) and in previous centuries elsewhere in Europe (Thirsk 1967b, 172; Bowden 1967, 626–7).

The products of the uncultivated landscape have also provided a source of food during times of scarcity (e.g. Clark 1976a,b). In temperate Europe and Russia, acorns were especially commonly exploited. Thus the official hunger-bread of Tsarist Russia consisted primarily of acorn-flour, and acorns were also used to make bread during times of food shortage in sixteenth-century England (Clark 1952, 59). In the Mediterranean zone both acorns and chestnuts provided sustenance during food shortages (Clark 1952, 60). These and other supplementary and emergency foods doubtless built a greater degree of 'elasticity' into the demand side of the equation during food shortages than a purely economic evaluation might suggest.

Although people had to eat to survive, it is evident that in pre-industrial Europe at least, there was greater elasticity in the demand for standard staple foods than Jongman & Dekker would admit. It is also evident that, on the supply side, 'the power of the market' is no guarantee that producers who are poorly integrated into market structures will place their commodities onto the market. For causes of the failure of substantially increased prices to bring more staple food supplies into circulation we must therefore examine the supply side of the equation.

The Greek market for grain and other foodstuffs in this and former centuries certainly did not persuade the highly 'risk-averse' small agrarian producers of Methana to embrace market-orientated agriculture and the cash economy with open arms. Similarly in medieval England, despite a ready market for an almost limitless range of products of the cultivated and uncultivated landscapes, the primary goal of most peasants was self-sufficiency, not maximum profits (Miller & Hatcher 1978, 161–4; *contra* Jongman & Dekker 1989, 117).

Quite apart from the fact that peasants must first take care of the consumption needs of their own households, which may themselves be threatened by poor growing conditions, they do not live in a semi-vacuum in which only the principles of supply and demand operate. Most important, they are integrated into the much wider socio-political systems of complex societies, and dependent on them in various ways. This fact introduces numerous risks and opportunities which are not directly connected to factors of the natural environment. Peasants' repertoires of risk-averse behaviours usually reduce both risks and opportunities entailed in this socio-political integration, not least by keeping themselves at arm's length from the wider world (Wolf 1966, 17, and see above).

One of the recurring features of food shortages is their association with other crises. War, epidemic disease and civil strife generally accompany them, as either cause or effect (e.g. Garnsey 1988, 18–31; Le Roy Ladurie 1971, 66–7). Crafts and industries also decline sharply because incomes become exhausted in obtaining high-priced food supplies, and workers are therefore laid off (Jongman & Dekker 1989, 115). In addition, under pre-industrial conditions, one must expect transportation to be disrupted during food shortages because supplies of many forms of animal fodder to feed draught animals will be diverted to human use. If the shortages coincide with warfare, draught animals may be commandeered for military use, as in the case of Greece at the start of the Second World War (see above). If food shortages approach famine proportions, personnel associated with transportation may become unavailable, not least due to the effects of the famine (and often associated diseases) in weakening or killing those involved. Draught animals may likewise be killed for food. In other words, severe food shortages and famines can generally be expected to be associated with a large scale breakdown in public health, economy and civic life. In this situation, important non-agricultural products like iron, salt, and mill stones, on which agrarian producers have traditionally depended (Miller & Hatcher 1978, 162; Farmer 1991a, 351–2), could become scarce and expensive (e.g. Garnsey 1988, 168, 176; Farmer 1991b, 465–6). Prudent agrarian producers, therefore, will keep as many options open as possible, not least because they cannot foresee future events or weather conditions. As noted above, this will normally entail retaining foodstuffs in store.

A possible example of the prudent use of storage strategies to safeguard households in time of crisis comes in a passage in the Roman historian Livy (2.50–52.1). Livy states that in 477 BC war with the Etruscans led to a severe grain shortage and serious social breakdown. In the following year, after the war was concluded and the food crisis had ended, people brought out stores of food which had been concealed (Garnsey 1988, 169, 174, 176). It is doubtful whether the passage can be taken at face value, since the events supposedly reported occurred several centuries before Livy's time. Nevertheless, even if substantially less than a faithful record of what actually took place, the passage would not have been written if the events described had not been credible to Livy's readership. Garnsey treats the passage under the heading of speculation by wealthy members of society. However, at the very least, those who only brought out their surplus food for sale *after* the crisis would have made only a relatively moderate profit. In light of the discussion in previous paragraphs this behaviour seems like that of small-scale producers holding on to their surpluses during a crisis, not to make a killing on the market but to ensure the maximum possible safety margin in the face of the unknown.

The urban poor

Thus far the focus has been on the producers. What of low-income households which do not produce their own food and are thus dependent on the food producers for their own food consumption needs? Although by no means exclusively so, these are generally found in their largest concentrations in urban areas. Low-income urban consumers are the focus of this section since, once they reach a particular 'critical mass', they have the potential to become a powerful political force (see below). Under pre-industrial conditions, the bulk of the income of the urban poor tends to be consumed in purchasing basic food supplies: a figure of perhaps 75 per cent of total income spent on the purchase of food in normal years has been suggested by Jongman & Dekker (1989, 117), while Le Roy Ladurie (1987, 109) suggests that grain consumption alone accounted for more than half of an ordinary wage-earner's budget in sixteenth-century France. Even moderate food price increases put a very heavy squeeze on the incomes of this group. In periods when there were food shortages, the costs of food were beyond what the poor could afford. In addition, as the budgets of wealthier households were increasingly consumed in the purchase of the bare necessities, so demand for the goods and services provided by the urban poor dropped substantially. In this situation poor consumers faced a 'double whammy': costs of basic foodstuffs outstripped normal incomes at the same time as incomes fell.

As food shortages develop into serious crises, those most affected tend to blame their governing authorities for their hunger, even though the shortage may be beyond the authorities' control. Very high prices are also frequently blamed on speculation or other kinds of collusion on the part of wealthy merchants or other highly placed members of society. Jongman & Dekker (1989, 115–16) discuss whether speculators could actually create a famine or food shortage in a year with a normal harvest. Although there are scholars who think that such a situation was possible in previous centuries, Jongman & Dekker's (1989, 115–16) treatment of the debate suggests that claims of collusion and speculation are part of the paranoia of populations hit by hardship. Significantly, news items on 19 and 20 January 1998, as part of this contribution was being written, reported two days of food riots in Harare, the Zimbabwean capital. The riots were in reaction to increases in the price of food of 20 per cent and more. The Zimbabwean government was reported as blaming the price rises on the white business community (i.e. 'merchants') as a whole, but the news reports stated that outside observers considered the rises to be the result of the collapse of the nation's economy.

In post-medieval Europe, merchants were a regular target for both governmental and popular displeasure (Jongman & Dekker 1989, 121). Grain-dealers were also a target in ancient Greece (Garnsey 1988, 30,146–7, 152, 157). It is not surprising, therefore, that in ancient Greece we see examples of wealthy grain-dealers very publicly providing cut-price grain during serious shortages: the likelihood of serious consequences for them in the mounting hysteria of a food crisis meant that they could have suffered more than the substantial financial losses involved through their generosity had they tried to maximise their profits (Garnsey 1988, 154–6). In ancient Rome, documentary sources again attest to demonstrations against, and even attacks on, those in government during severe food shortages — especially senators during the republic and the emperor himself during the empire. The wealthy, who were believed to hold large stocks of grain while others were starving, were also subject to attack by hungry Romans, as were grain-dealers, who, as Garnsey (1988, 176) points out, were not necessarily the same as grain-hoarders (Garnsey 1988, 174, 200–2, 206–7, 223, 240–43, 260).

As suggested above, when food shortage reaches the point of engendering civil strife, those who suffer from violent popular displeasure in urban population-centres may or may not be directly responsible for famines in each individual case. Actual production of food supplies occurs in the countryside, often a long way from the scenes of violence. The evidence presented in earlier parts of this contribution suggests that when the possibility of food shortages or other forms of disruption appears, agrarian producers — large numbers of whom are often peasants — react by keeping as much of their produce as possible in storage. In the face of uncertainty about what may occur in future months, it pays to keep as many options as possible open: the best way to do this is usually to ensure direct control of the household's resources by keeping produce in store. If this behaviour does not actually cause shortages in the first place, it certainly exacerbates what in many cases are problems short of full-scale crises.

Livy's description of grain-hoarding during a severe food shortage indicates that, although the authorities tried to ensure that grain was not kept back, they were not particularly successful. Peasants may have been an especially difficult target. Many peasant communities are very remote from urban centres, both physically, and in terms of links with wider political and administrative aspects of the nation state (Wolf 1966, 91–5). In addition, their often very partial engagement with the wider market (see above) makes them economically remote. Furthermore, in many societies they are so numerous, and their individual surpluses are, relatively speaking, so small, that it can be a very time-consuming business for officials, who are often not very familiar with them anyway, to extract worth-while amounts of produce. During the events of 1973–74 outlined at the start of this contribution, even a military dictatorship was unable to squeeze the surplus supplies of wheat held by the country's small-scale producers out of their store rooms and onto the market. In previous centuries, the inhabitants of Methana were able to ensure that they kept their stores of food out of the hands of even more ruthless and unaccountable governing officials. Only food supplies for immediate consumption were kept in their houses. The rest was placed in storage structures and/or caves hidden in isolated locations on the mountain-sides. In this way, when officials or bandits (the behaviour of both being comparably rapacious on occasions) appeared, households could plead hardship and a lack of any surplus on hand (Forbes 1997, 109). Documentary sources suggest that the area which included Methana was left, in governmental terms, pretty much to its own devices towards the end of the Turkish period. A western traveller of that time remarked with surprise on the fact that houses in a neighbouring community contained large amounts of stored produce. He related this observation to the reported lack of direct intervention in the area by external governmental officials (Dodwell 1819, vol. 2, 278–84; Forbes 1997, 107). In so doing he also indicated his perception that few Greek peasant houses of the time held appreciable quantities of stored produce on the premises, and that this fact was directly related to farmers' reluctance to let officialdom get their hands on it.

Governments, therefore, have not found it easy to extract the surpluses that peasantries might possess in order to alleviate the distress of poor urban consumers in times of food shortage. Yet, as Garnsey & Morris (1989, 105) note: 'no governing class could have survived which was unprepared to feed the people in time of need', since, as we have seen, starving citizens have a habit of turning on their officials, especially if those officials are drawn primarily from the wealthiest levels of society. Destabilization of existing power-structures is something governing elites cannot afford. Thus we see, for example, regular instances in ancient Greece of *euergetism* in this context (Garnsey & Morris 1989; Jongman & Dekker 1989, 119–20). In times of food crisis, an *euergetes*, a public benefactor from the wealthiest class, would step forward to alleviate the crisis by providing large amounts of grain at a low price, or free. Frequently, though not invariably, the grain was from his own estates. The *euergetes* can be seen as a benefactor, but refusal to act in this way could have created a revolt. Similarly, in early modern Europe, substantial quantities of grain might be provided by requisitioning it from the stores of the bourgeoisie: Jongman & Dekker (1989, 120) note that they were nearly always left with more than enough to get them through the food crisis period. They emphasize (1989, 121) that pressure from the poor is evidently the key to an understanding of public action. It is clear that poor urban consumers could constitute a potent political force if roused.

One response of civic authorities to the threat of food shortage in early post-medieval Europe was to control food prices — something also attempted on occasions in ancient Rome (Jongman & Dekker 1989, 118–21; Garnsey 1988, 182). This system, however, tends to break down when food shortages become serious. In order to support a policy of controlling prices, many states have resorted to their own storage strategies by constructing public granaries for the storage of reserves. At times of high prices, municipal stocks could be sold at below the prevailing price. The granaries at the port of Ostia, and the large civil grain warehouses in Rome, associated with the feeding of its citizens, are especially well known. Yet these are probably mostly for the short-term storage of grain over the course of a single year, because of the difficulties of shipping grain during the winter months (Rickman 1971, 86; 1980, 128; Forbes & Foxhall 1995, 70). Many European cities also had municipal granaries for the alleviation of hardship during severe food shortages (Jongman & Dekker 1989, 119).

These measures were costly from a financial point of view. Nevertheless, failure to take action to alleviate hunger could be costly in political terms. Over the centuries a number of high-ranking Romans were killed by enraged mobs during food crises, and many more escaped that fate by the skins of their teeth (Garnsey 1988, 206–43). During the eighteenth century, direct intervention by states in their grain-supplies was gradually replaced by a market-dominated system. As Jongman & Dekker (1989, 121) note: 'this decreasing intervention made the eighteenth century — all over Europe — the century *par excellence* of food riots and *taxation populaire*'. It is possibly no coincidence that the eighteenth century also experienced the French revolution — a particularly glaring example of the political costs of ignoring poor consumers who had no bread.

Conclusions

Much of the study of 'consumption' focuses on consumption as display in one form or another. Hence many discussions tend to concentrate on the higher-status end of the scale. Here the focus is on consumers (as also producers) from the bottom of the status hierarchy — and circumstances surrounding shortages of staples for consumption. For most of history this group has been neither represented nor its needs considered important by governing authorities most of the time. Although generalization is dangerous, it is probably fair to say that this group is so large and so disparate that normally members do not act in concert. But in the face of hunger there is a tendency to do just that, and to do it violently, often blaming key high-status individuals and the social and political system in which they operate. Under this circumstance governing authorities must take measures to ensure their own survival and, where possible, that of the *status quo*. Hence the (often expensive) measures noted above.

However, in most pre-industrial economies, much of the food which reaches the market is produced by peasants. Because of peasant production and storage strategies, many can be expected to have appreciable surpluses of produce in storage even in times of scarcity. It is argued here, however, that this produce does not flow to urban consumers in a manner governed by straightforward economic laws of supply and demand despite the existence of a market for staples in pre-industrial contexts. The reason for this is that the same risk-averse behaviour which lies behind the generation of a surplus, even where commodities are grown for subsistence, also lies behind the tendency to retain that produce in storage rather than releasing it onto the market in exchange for cash. In poorly monetized economies it is to be expected that peasant households will only let go of produce when they have direct need of commodities or services that they cannot produce for themselves. Otherwise they will tend to keep their produce in storage, where they have direct control of it, rather than selling it and keeping the proceeds in the form of cash until needed. In the event of a perceived food shortage, these small-scale producers can be expected to stop supplies of food coming onto the market in case of worse to follow. Furthermore, there may be little that the authorities can do to exploit peasants' surpluses for the benefit of dependent consumers. Peasant storage strategies therefore also contribute significantly to the difficulties of urban consumers — and the difficulties their governments face in ensuring that they are fed.

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Chapter 10

Archaeological Correlates of Ideological Activity: Food Taboos and Spirit-animals in an Amazonian Hunter-gatherer Society

Gustavo G. Politis & Nicholas J. Saunders

As a science of ideas and abstract speculation, ideology is a uniquely human concept. When it comes to such basic activities as eating and sex, only humans will deny themselves on the basis of abstract metaphysical principles. Hitherto, interpretations of hunter-gatherer archaeological sites have consistently adopted cost–benefit materialist approaches, thereby often denying the potential of ideological imperatives to shape the archaeological record and inform our views of the past.

Here, we address the consequences of one ideological factor, animal-food taboo, in patterns of faunal exploitation and the resulting formation of archaeological bone assemblages. Although we present new ethnographic data on taboo, it is not our intention to review the extensive anthropological literature on this subject, nor rehearse the arguments concerning their origins or universality. We also do not wish to be drawn into the debate on the use of the term 'taboo' rather than, in this instance, 'food restriction', or 'food avoidance' (see Knight 1998). We acknowledge that the word taboo is a blunt instrument in such a discussion, but, as we endeavour to be specific where the evidence allows, we retain it as a generic term of ritual prohibition or avoidance as used by others (e.g. Ross 1978; Kiltie 1980; De Boer 1987). We maintain that while materialist factors retain the potential to affect human predation on animals, ideology plays an equally significant, and, on occasion, greater role. Previously, this view has often been avoided on the basis that ideology is difficult to identify or control in the archaeological record of hunter-gatherers. We acknowledge the difficulties, but believe that it is possible to take an initial step towards tackling them.

Archaeology cannot hope to reconstruct the lifeways of past societies on the basis of an assumed inability to understand the resulting patterns of past activities. Archaeologists need to consider how and why certain events might have occurred in the past, suggest their possible archaeological correlates, and develop a methodological framework to interpret them.

In spite of innumerable references to animal-food taboos in the ethnographic record, their potential physical consequences have received scant attention in the archaeological literature. In seeking to address this issue we explore a range of evidence concerning species avoidance in Amazonia, drawing specifically from fieldwork among the Nukak (see below). In so doing, we hope to contribute not only to the debate on the various models related to hunter-gatherer processing, transport and discard patterns (e.g. Binford 1978; Turner 1989; O'Connell *et al*. 1990; Lupo 1994; Yellen 1991b) but also, in a wider sense, to improving understanding of the archaeological record of hunter-gatherers (e.g. Bettinger 1991; Binford 1988; Yellen 1977; Gamble & Boismier 1991; Gould 1969; Lee 1979; 1984; Haynes 1987).

The broader issues of Nukak hunting, transportation, butchering, processing, consumption and discard, and their relationships with models of prey exploitation have been addressed elsewhere (Politis & Martínez 1996). They are part of an ethnoarchaeological project begun by one of us (GP) in 1990. In this paper we concentrate on what we consider to be the archaeologically identifiable consequences of ideological behaviour, and make use of data collected over seven field seasons between 1990 and 1996.[1]

The Nukak world

The Nukak are a highly mobile forager society in the northwest Amazonian rainforest of Colombia (Fig. 10.1).[2] They are part of a wider population known generically as Makú (Correa 1987; Métraux 1948; Reid 1979; Silverwood-Cope 1972), for whom ethnic affiliation is based on linguistic criteria (Cabrera *et al*. 1994; Mondragón n.d.; Reina n.d.). Makú groups share a common adaptation to hunting and gathering in the inter-riverine *terra firme* of the tropical rainforest of Northwestern Amazonia and have done so in the recent past.

While sporadic contact between Nukak and encroaching white colonist settlements has occurred since mid 1960s, it was only during the 1980s that New Tribes missionaries established regular contact with some northeastern bands. In 1988, formal contact with colonists (non-missionaries) began when a group of about forty Nukak appeared in the village of Calamar, in the current southwest frontier of Nukak territory (Azcárate n.d.; Chaves & Wirpsa 1988; Wirpsa & Mondragón 1988; Zambrano 1992). Since that time, other Nukak groups have established more frequent relationships with colonist settlements, especially in the western part of Nukak territory, such as Caño Seco, El Retorno, La Charrasquera, and Guanapalo.

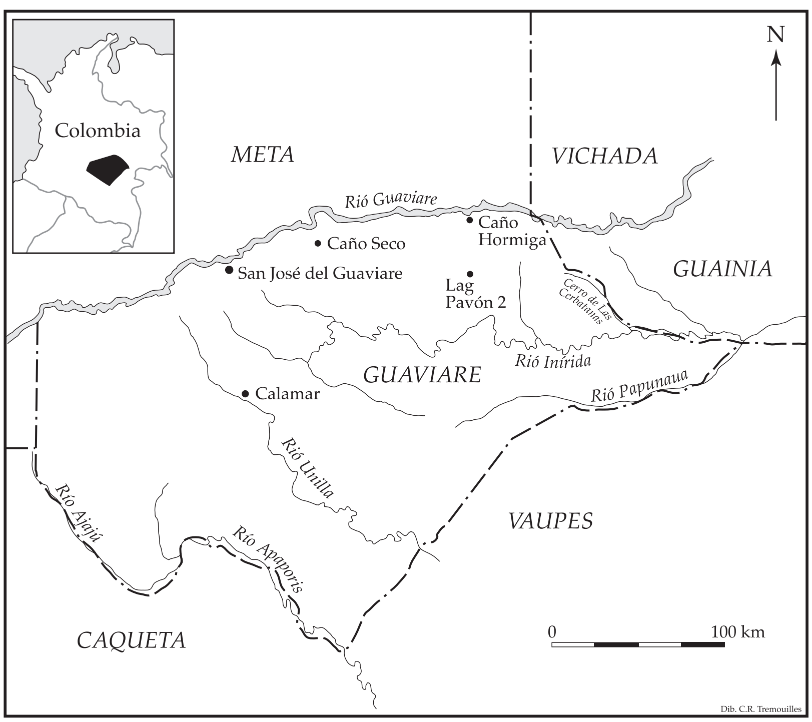

Figure 10.1. *Map of Nukak territory, Colombia.*

In recent years, ever more Nukak territory has been colonized by outsiders. Today, Nukak society is undergoing rapid acculturation, particularly where bands are settling near to colonist farms (Ardila & Politis 1992; Cabrera *et al*. 1994; Politis 1996b), the majority of which are concerned with the growing of coca. The reduction in Nukak territory during the 1990s has impaired their traditional mobility. In addition, contagious diseases such as influenza and measles have decimated their population. The situation of the Nukak has become increasingly desperate and their population is now under serious threat.

Nukak are organized in autonomous exogamic bands, composed of several families (usually no more than five), with between 12 and 44 individuals. Most co-resident groups have between 20 to 30 individuals (Politis & Rodríguez 1994; Politis 1996a,b; see also, Torres 1994; Mondragón n.d.). Such bands are part of a larger affiliation group which share adjoining territories, and within which, larger group re-organizations, marriages, social visits and rituals take place (Cabrera *et al*. 1994; Politis 1996b, 59–65). At least six of these greater affiliation groups have so far been recognized.

Nukak territory, located between the Guaviare and Inirida rivers, currently extends over some 10,000 km^2. At the end of the 1980s, New Tribes missionaries estimated Nukak population at between 700–1000; today this figure is *c.* 450 — a population density of about 1 person per 22 km^2 — almost half that of ten years ago. While speculative, these figures nevertheless suggest the likely scale of Nukak demography. Nukak move camp between 70 and 80 times a year, almost all such movements occuring within the territory of the band (or co-resident group) — an area estimated at between 200 to 500 km^2. There are marked seasonal differences in residential mobility.[3]

Nukak recognize five territorial dimensions (Politis 1996b, 147–53). First is an area habitually exploited by a band or co-resident group. Second, a larger area (varying between 1000–2000 km^2), is exploited by the greater affiliation (i.e. the regional group), within which band members move with little or no restriction to visit other camps and utilize local resources. The third dimension is composed of distant regions sometimes occupied by bands with whom they have had no or only sporadic previous contact. In this territory, a sort of annual range (*sensu* Binford 1981), there are places, such as *Cerro de las Cerbatanas* ('The Blowpipe Hills'), which are visited by parties of men at least once a year in order to obtain canes suitable for the manufacture of blowpipes. The fourth dimension is represented by distant places (or sites outside the Nukak world), whose existence is known to Nukak, but which none or very few have ever visited, and knowledge of which is passed on by oral tradition, rather than personal experience. For the Nukak, this is basically the territory of 'the others'. The fifth dimension — a mythical region in Nukak cosmology — is composed of three stratified levels: 'intermediate', where Nukak live, an 'underworld', where Nukak originated and which people and spirits still inhabit, and an 'overworld', where the main ancestor spirit prevails, and where the Nukak-Sun and Nukak-moon live (New Tribes Report 1989; Politis 1996b, 65–70).

Nukak economy is characterized by the traditional exploitation of non-domesticated plants and animals (Politis & Rodríguez 1994; Politis & Martínez 1992; Cabrera *et al.* 1994; Politis 1996b; 1999). Subsistence centres on hunting, gathering, fishing, and collecting insects and insect products (e.g. honey and larvae). Some small-scale cultivation in *chagras (*i.e. small multi-strata cultivated fields) takes place, and larger slash-and-burn fields are sometimes located nearby colonist settlements, from whom some products are obtained.

Even though Nukak also cultivate, their traditional life remains that of hunter-gatherers — their economy and mobility rely on and revolve around the exploitation of tropical forest resources. This dependence means they should remain in this politico-economic category despite not being 'pure' hunter-gatherers; in this they differ little from other so-called hunter-gatherers studied in recent decades.

One significant component of Nukak subsistence is the exploitation of vertebrates,[4] the most commonly hunted of which are monkeys — howler (*Alouatta* sp.), capuchins (*Cebus apella*), woolly (*Lagothrix lagotricha*), titi (*Callicebus torquatus*) and tamarins (*Saguinus negricollis*), and peccaries, especially the white-lipped peccary (*Tayassu pecari*). Eaten also on a regular basis are land turtles (*Testudo* sp.), and birds (mostly the locally called *panjuile*s, *pavas*, and *gallinetas*.) Occasionally, agouti (*Dasyprocta* sp.), caiman (*Caiman sclerops*) and armadillo (*Dasypus novemcinctus*) are also hunted. Other researchers (Cabrera *et al.* 1994; Mondragón n.d.) have reported that Nukak also occasionally hunt American opossum (*Didelphis marsupialis*), paca (*Agouti paca*) (but see below), and coatimundis (*Nasua nasua*). Fish, honey, other bee by-products, and palm grubs are also part of the Nukak diet (Politis & Rodríguez 1994; Martínez *et al.* 1996; Cabrera *et al.* 1994).

The Nukak, therefore, appear a traditional Amazonian tropical rainforest hunter-gatherer society. Less acculturated than two other Makú groups, Bara (Silverwood-Cope 1972) and Hupdu (Reid 1979), they nevertheless share a common adaptation to the physical environment, and a metaphysical orientation in which humans, animals, and mythical supernatural beings occupy a continuum.

By identifying and describing the conceptual framework within which animals are situated we seek to gain insights into how Nukak conceive of and represent themselves in relation to the natural world *in extenso*, and animals in particular. Only in this way can we hope to make any sense of why some animals are taboo, wholly or in part, and how such ideological behaviour may have affected the archaeological record.

Animals in Nukak and Amazonian worldview

Like other lowland Amazonian societies, Nukak do not regard the natural world as a discrete domain, separated from the social or supernatural realms. This integrated, holistic, and fundamentally shamanic worldview — called *ecosofía* by Århem (1990) — endows animals with a range of human-like attitudes, motives, and behaviour, for a variety of mythological and cosmological reasons. Along with plants and 'inanimate' objects, animals are integrated in several hierarchical levels, their use mediated by a mythic system in which some animals played a significant role as 'owners' of places, and 'managers' of situations (Reichel-Dolmatoff 1971; Reichel-Dussan 1995; van der Hammen 1992).

For Nukak, like any society, animal species are not natural kinds, but 'cultural appraisals', embodying and representing values and ideas regarded as significant by the classifying group (see Douglas 1990, 25–6). With significance bestowed by culture rather than nature, animals are concepts, 'bundles' of meanings, whose place in local taxonomies defines the emically logical criteria for their full-, partial- or non-exploitation.

The intersection of the economic, spiritual, and ideological realms which constitutes the heart of Nukak taboo is epitomized by the belief that some animals contain or represent spirits of the ancestors. Nukak believe that, at death, each of the individual's three (main) spirits removes to a different place. One goes to the sky-like 'overworld', where spirits have an easy life and there is plenty of food. This spirit, according to the Nukak, is 'the one you see in the mirror' (and see Saunders 1988).

The second spirit, *yoore'hát* (signifying 'whiteness'), remains in the 'intermediate' world, beneath the surface, where the 'House of the Tapir' (i.e. *Tapirus terrestris*) is located (see below). Once inside this house, *yoore'hát* 'puts on the clothes', or 'takes the appearance', of the animal which is the ancestor of his clan,[5] and with whom it shares a mythical origin. Appearing thus, in the shape of a tapir, deer (*Mazama* sp.), or jaguar (*Panthera onca*), it goes at night to the surface of the earth and prowls the forest.

The third spirit is *nemep* ('black'), associated with a person's shadow during life. Remaining on the surface of the 'intermediate' world, it hides in hollow trees during the day, but emerges at nightfall to cause mischief. This spirit is represented as a large, dimwitted monkey with long hair, whose malevolence is tempered only by stupidity.

Tapir, deer, and jaguar, are variously regarded as spirit-animals, ancestors, or as being 'like people', by many indigenous Amazonian groups apart from Nukak. The quality of 'likeness' is never a complete identity however, as Amerindians acknowledge differences in appearance and behaviour (e.g. animals neither talk nor eat like humans: see Reichel-Dolmatoff 1978, 286). Among the Achuar, the anthropomorphization of animals may be seen just as much the manifestation of mythical thinking as a metaphorical code serving to translate a form of 'popular knowledge' (Descola 1994, 98).

Nevertheless, Århem (1990, 115) records a Makuna belief that tapir is a person, who, when he enters his dwelling, casts off his tapir clothing and eats, drinks, and dances like people. Tapir appears in animal form only when he wanders outside of his 'house'. Similarly, the Tukano believe the tapir is an ancestral animal which must be treated with respect, and, while not subject to formal taboo, in general they avoid hunting or eating it (Reichel-Dolmatoff 1978, 285). For the Matapí, the tapir is considered a blood relative, a grandfather, which it is forbidden to kill or eat (van der Hammen 1992, 294). A Yukuna myth of the transformation of animals into people recounts Tapir giving his daughter to the hunter. The tapir became the father-in-law of the Yukuna, and hunting it requires careful negotiation with spirits and the 'owners' of the *salados* (salt-licks frequented by tapir and other mammals at night) (Van der Hammen 1992, 296).

The jaguar, similarly, is considered by Nukak a powerful ancestor, one which possesses the spirit of death. Not all jaguars are seen as fierce spirit-animals which attack people — some are simply dangerous predators. Although Nukak do not hunt jaguar, they will kill one if it threatens people, as was the case when an old jaguar was killed by three hunters at *Cerro de las Cerbatanas*, because it had attacked a young Nukak (Andres Jimenez pers. comm. 1995). On this occasion, the men removed the large canine teeth making them into a necklace, but did not use the animal's skin or consume its meat. Nukak appear to prohibit the consumption of jaguar, as well as deer and tapir, for different reasons, but partly also on the grounds that they are metamorphosed human beings, or, more accurately, zoomorphic manifestations of erstwhile human souls.

Other animals also are restricted inasmuch as their flesh is regarded as in some sense 'unsafe'; certain kinds of duck, the red *pava*, capybara, and sloth, are all edible from a western perspective, but for Nukak, their consumption would cause discomfort, illness, or perhaps even death. Clearly, indigenous Amerindian taxonomies enshrine behaviour-shaping attitudes which adhere to their own principles of logic and reason rather Linnaean ones (Saunders 1991, 16). In this regard, it is unsurprising that different Amazonian societies prohibit the hunting and consumption of different animals. Thus, the Yukuna do not consume black caiman, which is considered acceptable food to the Makuna, nor the anteater which is regarded as the 'proper food' of the Tanimuka. Capuchin monkeys are considered good to eat by the Yukuna, as is sloth for the Miraña (van der Hammen 1992, 294).

Cutting across the cultural specificities of lowland Amazonian animal taboo is the role of diurnal/nocturnal oppositions, and the consequent ritual marking of nocturnal animals. The obvious point that humans are (mainly) diurnal hunters while many animal predators (and their prey) are nocturnal, is extended into the social and spiritual realms. Shamanic activity, particularly shamans 'hunting' their supernatural prey or sending illness, occurs mainly at night. In general terms, the night is when human and spirit worlds come into closer proximity — a time of increased potential danger requiring caution. Nukak behaviour is in accord with this inasmuch as they do not venture beyond the camp during hours of darkness. For Nukak, night is the time when a person's *nemep* spirit is abroad causing mischief.

Similar attitudes towards diurnal/nocturnal oppositions are explicit also for the Hupdu Makú and the Yukuna, where humans are classified as diurnal, but shamans have 'become' nocturnal (Reid 1979, 249; van der Hammen 1992, 287). The general notion, that during daylight 'we eat it', and at night, 'it eats us', resonates with Achuar ideas of animal-food taboo, where edible game is diurnal, while nocturnal animals, especially predators, are unfit to eat (Descola 1994, 91). For the Hupdu Makú, similarly, animals associated with nocturnally active shamans, or who are endowed with human attributes or are carnivorous, are usually regarded as inedible — an attitude recognized by the position of these animals in Hupdu metaphysical and cosmological schema (Reid 1979, 251). Among the Yukuna, a myth enshrining the human origin of hunting indicates the dangers of the night, because this is when shamanic transformations occur (van der Hammen 1992, 287). This mythic drama is played out in ritual dances, where the shaman becomes a jaguar, and the dancers other forest animals.

Significantly in this respect, Nukak regard tapir, deer, and jaguar as nocturnal. Metaphysical beliefs are based partly on the natural relations of predation, where tapir, deer and peccary (amongst others) are the usual prey of the jaguar (Kricher 1989, 300; Saunders 1991, 25–6; 1998a, 21). The fact that the jaguar is widely regarded as the pre-eminent predator and dangerous forest- or shaman-spirit (Reichel-Dolmatoff 1975; Saunders 1991, 65–75; 1998a, 29–33), and sometimes also the 'master of animals' (Reichel-Dolmatoff 1975, 44) or the 'owner' of hunting (van der Hammen 1992, 288), might signify that, as the jaguar's favoured prey, deer and tapir are ideologically out of bounds for humans. For the Nukak, a symbolic inversion occurs in the 'House of the Tapir', where the jaguar loses his supremacy, and is considered a pet of the tapir.

The widespread association of the jaguar with shamans and spirits of the dead (e.g. Goldman 1979, 262–3; Karsten 1968, 268–9; Reichel-Dolmatoff 1975) is found also among the Nukak. Here, the animal is regarded as 'fierce', and as having attacked group members in the past. When jaguars approach the camp at night, Nukak prepare their spears and shout loudly and aggressively. That the jaguar may in fact be a zoomorphized spirit of a dead person (e.g. Weiss 1975, 288–9) is indicated by the Nukak habit of constructing a wall of *seje* (*Oenocarpus bataua*) leaves around the camp — a physical and symbolic barrier against malevolent spirits represented by the noctural prowling feline (Cabrera *et al.* 1994, 154). A similar association is reported for the Paraguayan Héta (Kozák *et al*. 1979, 372) and for the Peruvian Machiguenga (Snell & Snell 1954).

For Nukak, the living jaguar's nocturnal predatory behaviour together with its supernatural associations with shamanic power, magical transformation, and spirits of the dead, make it an understandable choice for food taboo. In fact, for the Hupdu Makú, the jaguar is the only animal which is regarded as taboo to hunt and eat. For Nukak and other Amazonian groups, animals signify more than zoological species, and are conceptualized as human-like in many respects. Referring to the Yukuna, van der Hammen (1992, 331) concluded:

> La relación con los seres de monte pone en evidencia una vez más la prelación de los aspectos simbólicos sobre los eminentemente utilitarios y prácticos, que muchas veces priman cuando se trata el tema de la cacería entre grupos indígenas en la Amazonia.
>
> [The relationship with bush people yet again underscores the priority of symbolic aspects over those eminently utilitarian and practical, the latter very often paramount in treatments of hunting among indigenous groups of Amazonia. (*trans. by* Manuel A. Arroyo-Kalin)]

Ideology of Nukak taboo

Some animals, such as tapir and deer, are widely tabooed in lowland Amazonia, a fact which has been the subject of intense debate (e.g. Balée 1989; Beckerman 1979; 1980; Descola 1994; Kiltie 1980; Reichel-Dolmatoff 1985; Ross 1978; 1980). Some materialist ecological models (e.g. Ross 1978) have sought to explain such taboos as an adaptive mechanism to preserve scarce prey, or as having their origin in a long-term information chain related to the low return of rarely encountered prey (Kaplan & Hill 1992). However, the proposed adaptive advantage of these taboos has not been tested against long term data, and appears somewhat fragile when compared with the large meat returns offered by a chance encounter and kill. Basic assumptions may also be flawed, inasmuch as, for example, the Desana restrict access to certain animals even though they are encountered fairly frequently (Reichel-Dolmatoff 1978, 283).

Hitherto, from an archaeological perspective, little consideration has been given to alternative, non-materialist factors which may account for, or at least contribute to, the practice of tabooing certain animal species. This despite the fact that in the anthropological literature, animal taboos have long been recognized as possessing complex symbolic as well as utilitarian motivations (e.g. Douglas 1957; 1966; Tambiah 1969; and see, Garine 1994, 246–50). The influence of worldview, religion, and ideology — so prevalent in ethnographic accounts — have been virtually ignored in the literature on optimal foraging and patterns of faunal exploitation, thereby perpetuating the rift between anthropological and archaeological approaches, and narrowing our interpretative horizons.

Viewing animal-food taboos through a non-materialist lens, they appear less real-time adaptive responses than ideological imperatives whose efficacy derives from their locations within mythic structures as outlined above (e.g. Lévi-Strauss 1969; Reichel-Dolmatoff 1978, 284). This view is in accord with widespread Amerindian conceptualizations of animals, and further situates taboos meaningfully within local ethnoclassificatory schema. In the Nukak case, associations between their graded sequence of taboos, hunting strategies, patterns of consumption, and subsequent bone discard, cannot be understood solely on the basis of cost–benefit analysis.

It is certain that Nukak, like other tropical forest foragers, make decisions concerning their exploitation of rainforest fauna which are based, at least in part, on ideological criteria. Food taboos in particular appear to be a critical factor when decisions about hunting, processing, consumption and discard are made. Some Nukak taboos are highly selective and situation-specific. Certain foods can only be eaten by certain people at particular times, reflecting what Reid (1979, 250) notes for the Hupdu Makú, and Reichel-Dolmatoff (1978, 283) for the Desana, that the edibility of a particular food depends on the physical and ritual state of the consumer. The ramifications and implications of this point highlights the serious shortcomings of the term taboo as an analytical tool where detailed evidence is available.

The relativity of taboo is everywhere apparent in Amazonia, where different groups do not always proscribe the same animals, or, if they do, not necessarily for the same reasons, nor in the same way. This reality is situated within a wider theoretical debate — that which recognizes that such societies have multiple taxonomic systems which cover the same empirical ground in different ways by selecting a different set of criterial attributes according to social context (Crocker 1985, 153–4).

Against materialist explanations, Descola (1994, 338) shows convincingly that the Achuar not only hunt and kill large and supposedly scarce animals, but prohibit more numerous smaller ones. Among the Siona and Secoya of northeastern Ecuador, the scarce tapir nevertheless is hunted and consumed at every opportunity, while more abundant deer (red deer (*Mazama americana)*, and 'deer of the yuca' (*Mazama* sp.) are hunted only rarely because they are considered as evil spirits or 'devils' (Vickers 1989, 302). While sloth are not consumed because of their 'grey' flesh, capybara have a double status, edible for some, but sickness-producing for others (Vickers 1989, 304).

For Nukak, most larger animals, despite their high meat to bone ratio (and thus calorific attractiveness) are subject to formal taboo. Tapir, deer, and jaguar, are proscribed, at least in part because, as already noted, they are considered sacred, and appear in an anthropomorphized form in the mythical framework which supports Nukak spiritual life. For the Makuna, similarly, tapir are regarded as people with souls, and, specifically, as ancestors (Århem 1990, 115); for the Achuar, the brocket deer (*Mazama americana*) is the transformed shadow of a deceased person (Descola 1994, 92).

Attitudes towards eating tapir are particularly revealing of the diverse ways in which lowland Amazonian societies articulate complete, or partial taboo with everyday life. Nukak take every step to avoid tapir, and will ignore the animal's tracks if they come across them. When tracks are encountered (a not infrequent occurrence), Nukak identify them, indicate the direction taken by the animal, but never follow it. The Bara-Makú, probably the ethnic group most closely related to the Nukak, display the opposite reaction. They track tapir during the day (when the animal usually sleeps) and ambush and kill them during the night, regarding the abundant meat as especially tasty (Silverwood-Cope 1990, 59). Achuar, like Nukak, say they do not hunt tapir, but, in fact, will shoot one if encountered, even though they regard it as a reincarnation of a human being (Descola 1994, 92).

Makuna also eat tapir, though because it is regarded as possessing a soul its meat is potentially dangerous and has to be purified by the blowing of shamanic spells (Århem 1990, 115). Although infrequently encountered, and subject to formal taboo, the calorific (and trade) value of hunting tapir is demonstrated by the Hupdu Makú. Reid (1979, 49) recorded that one kill of tapir yielded 250 kg of meat which provided enough protein for thirty-five Hupdu for a week; there was also enough left over to engage in trade with nearby people (Reid 1979).

This point is reinforced by Reichel-Dolmatoff (1978, 289), who notes that the Tukanoan tribes of the Pira-paraná regard tapir (as well as deer and peccary) as taboo, yet will kill it and sell or barter its smoked meat to other groups who don't have such beliefs. By contrast, the Bara-Makú hunt every available animal, not just because they like the food, but because of the high exchange value which smoked meat has among other riverine groups, and for which they receive cassava, pepper, and tobacco, as well as second-hand western goods such as scissors and clothes (Silverwood-Cope 1990, 70). Of a total of 2873 kg of meat produced during fieldwork observation, Silverwood-Cope (1990, 70) recorded that 1182 kg (i.e. 40 per cent) of meat was traded away. The influence of acculturation should not blind us to the possibility that similar activities took place during pre-contact times.

Figure 10.2. *Nukak men eating white-lipped peccary on the camp's periphery.*

While it can be argued that in some areas tapir are infrequently seen, the idea that 'scarcity' elicits a taboo appears increasingly untenable. Bara-Makú, Hupdu Makú, Siona and Secoya exhibit an opportunistic hunting attitude towards tapir that appears oblivious to western notions of conserving 'rare' species. Whereas Nukak proscribe tapir as a nocturnal creature and powerful ancestor spirit, Bara-Makú, Yukuna, and many other Amazonian groups actively hunt and kill the animal at night in the *salados*. Nowadays, white colonists living in Nukak territory also hunt tapir.

A similar case can be made for deer, which Nukak consider totally taboo, yet are hunted by Bara-Makú (Silverwood-Cope 1990, 66), and Hupdu Makú, yielding, in the latter case, significant quantities of meat (Reid 1979, 68). Yet, as Descola (1994, 337–8) shows for the Achuar, taboo is a complex business, caught between the ideational and the practical. While the brocket deer is subject to a universally observed taboo, it is only one of four available cervids. The other three, i.e. *Mazama simplicornis*, *Mazama bricenii*, and *Odocoileus gymnotis,* are killed and eaten, and their flesh regarded as a delicacy (Descola 1994). This example highlights the sensitivity and precision required of archaeologists who seek to identify and interpret evidence of possible taboo in faunal remains.

Arguably the most revealing case of partial or specific taboo among the Nukak concerns the white-lipped peccary (*Tayassu pecari*). In Nukak mythology, peccaries originally were people, who ate *seje* fruits from the ancestral palms and became peccaries. The animal cannot be eaten by Nukak women and children — in fact women show great discomfort even at the idea of eating peccary or smelling its smoked meat. Armed with spears, Nukak adult and adolescent males hunt these animals at some distance (usually several km) from the residential camp. While women may play a supporting role on occasion, they do not participate in the killing, processing, or consumption of the meat — a sequence of activities which lasts about four days and is a solely male preserve (Politis & Martínez 1996, 235–42). Significantly, the processing and consumption of peccary meat and marrow does not take place within the female domain of the camp, but rather beyond and on its periphery (Fig. 10.2) (see below).

As with tapir, an explanation of this taboo as a conservation mechanism is not convincing. At a rough estimate, *c.* 20 per cent of the meat spoils during the smoking process (Politis & Martínez 1996), a juncture at which wastage of such a precious resource could be avoided if women were available to help and consume at this time. In other words, a significant amount of meat is wasted by choice rather than being eaten by women or children. Far from being treated as scarce, there is an abundance of peccary meat available, between 50–60 kg after butchering, since Nukak hunt as much as they can in each event. White-lipped peccary are highly mobile and not territorial, and the possibility of locating another herd soon is not guaranteed. Bara-Makú also kill as many as they can when they encounter a herd, and most of the peccary hunted during Silverwood-Cope's fieldwork were obtained in only very few events (Silverwood-Cope 1972).

Other, smaller (but potentially calorifically significant) animals are also subject to either total, gender-, age-, or situation-dependant restrictions, exemplifying what Ross (1978) calls 'specific taboo'. Although we do not have sufficient information to construct a detailed table of gradations in food taboos (e.g. Aunger 1994), a broad outline can be attempted.

Nukak taboos surrounding smaller animals appear to be highly selective. In general, Nukak women cannot eat all that men eat, particularly when pregnant, and children can eat even less than women. For example, when a woman is pregnant, her husband can only bring her certain kinds of food, such as toucan (*Ramphastidae* sp.), and certain unspecified types of tortoise, a situation paralleled by the Ka'apor in relation to the yellow-footed tortoise (*Geochelone denticulata*) (Balée 1989, 494–5). Pregnant women as well as their husbands are forbidden foods which at other times they can consume (New Tribes Report 1989). Parents of a recently born baby are forbidden to eat certain kinds of animal food such as howler monkey, and various kind of birds and fish for a period ranging from two to four weeks. During certain periods, a father will not hunt monkeys and the family diet is based on wild and domesticated vegetables and honey.

Some species of fish, duck and *pavas* appear to have a status as 'anti-food', inasmuch as they may cause wasting, a situation which closely parallels the Barasana notion of *wisiose* (Hugh-Jones 1979, 92). When adults or children are sick, they are also forbidden to eat certain kinds of animal food which at other times are permissable (New Tribes Report 1989). Nukak attitudes in this matter are directly contradicted by the Hupdu Makú, who state that children should first eat fish, then tapir, and finally 'small jaguar' (Reid 1979, 250).

The case of the diurnal agouti (*Dasyprocta punctata*) and the nocturnal paca (*Agouti paca*) is indicative of the complexities of species avoidance, the imprecision of the term taboo, and a powerful argument against over-simplified materialist assumptions. Both animals occupy more or less the same habitat by day and night respectively. In accord with their attitudes to the night, the paca as a clan ancestor (and a form adopted by *yoore'hat* {See above}), Nukak regard the paca as taboo — despite the animal's abundance (Kricher 1989, 285–6) and the relative ease with which it can be hunted. Contrary to what might be expected from a materialist perspective, the less numerous (diurnal) agouti is killed, albeit opportunistically. Here, ideological imperatives appear to overide economic considerations, thereby exemplifying the potency of Nukak ideas concerning nocturnal danger, and clan ancestors, and simultaneously undermining the scarcity / conservation argument. By way of contrast, the Bara-Makú hunt both species regardless (Silverwood-Cope 1990, 66).

The case of nocturnal monkeys reveals a similar pattern. Almost all available diurnal monkeys are hunted by Nukak, regardless of size. Nocturnal monkeys, however, are almost never hunted. Only Cabrera *et al.* (1994) mentioned the rare hunting of a nocturnal monkey (*Aotus trivirgatus*). Nocturnal monkeys are not animal-spirits associated with *yoore'hát*; they were created by the dominant mythical ancestor, *Mauro'jumjat,* who also created other plants and animals. The reason for the taboo on nocturnal monkeys is not known, but is in accord with the equation: day-for-people, night-for-spirits.

Other small animals which are also considered inedible for Nukak include sloth (*Chloepus* sp.), and the coatimundi (*Nasua* sp.). Yet, while Nukak do not purposefully hunt them, opportunistic kills are made. In one case, a coatimundi was hunted and killed but not eaten; one hunter stated that he could not eat the animal because it would make him 'thinner', while the another hunter commented that eventually he would eat it. Several genera of ducks, the local *pato agujeto*, *pato real*, and *pato negro*, are also forbidden for all members of the group, not for any obvious mythical reason but because their meat causes wasting. The same principle works for others birds such as the red *pava*.

Animal food restrictions are manifested also in terms of the way in which certain animals are cooked. For Nukak, on certain occasions, it is forbidden to mix different kinds of meat in the cooking process (New Tribes Report 1989). For the Bara-Makú, Silverwood-Cope (1990, 172) notes that whereas boiling the meat of certain animals reduces the amount of *salidna* (i.e. 'hot blood' essence), roasting is not totally effective. Fish may be grilled but it is the ritual state of the eater that is the decisive factor. The notion of gradations in 'heat' relates to the realm of ideology, where certain types of animal are 'hotter' than others, and thus, consequently, are more or less edible. Carnivores like jaguar eat their meat and blood raw, and thus are believed to have more 'heat', and should not be eaten by humans (Silverwood-Cope 1990, 162–3).

The link between 'hairy' and 'dirty' is evident in the way Nukak process their prey. All mammals have their hair removed by burning over a fire prior to boiling or smoking, which completes the cooking process. This is true for peccaries, monkeys, and agouti, and also for some hairless animals such as birds and caiman. This is not just the first step in the cooking process, it is also a way of 'purifying' the prey since hair is considered dirty, and possesses negative connotations. Nukak maintain their own hair extremely short, and depilate eyebrows, forehead, and (for women only) the pubis. Embodying the negative associations of bodily hair, the malevolent and ugly *nemep* is, as previously noted, described as a big monkey with long and stinky hair. Only hairless animals, like turtles and fishes, are boiled without initial burning.

Consumption of aquatic animals also is subject to prohibitions. In Nukak mythology, a 'house' for floodplain animals is located beneath the ground, and harbours animals who are perceived as 'crowded' and abundant. The nature of this 'house' is poorly known but seems to be different from the 'House of the Tapir' (see below), since the animals who live there are not considered spirit-animals in the same sense. Caiman, capybara, and various kinds of fish are associated with this house. Caiman were Nukak in ancestral times, but when the flood occured they plunged into the waters and became caiman. Nukak say that their parents and grandparents did not eat caiman and capybara, but nowadays they hunt caiman, though only men consume the meat. Fieldwork registered only one case of caiman consumption, and that by men. Piranha have a different status: some are taboo for all people, some for women only, while others are edible for everyone. Nukak recognize a wide variety of fishes, which can be subject to total, partial, or no taboo.

An interesting feature of Nukak ideology is the attitude toward *salados*. While for many Amazonian groups salt-licks are preferred locations for hunting big mammals, Nukak regard them as 'doors' to the 'House of the Tapir'. They believe that tapir, jaguar, deer, and other animals — whose tracks can be seen in the *salados* — use these locations to emerge from the underworld at night. In this sense, *salados* are sacred places rarely visited by Nukak. Similar spiritual associations concerning *salados* are present amongst other Amazonian groups, despite the acknowledgement that such locations are strategic hunting spots. Among the Yukuna, *salados* are not only places to hunt animals, but have mythical connotations. Each *salado* has it 'owner' with whom shamans have to negotiate hunting activities (van der Hammen 1992, 294).

It is worth noting at this point that apart from prohibitions on hunting and consuming certain species, there exists another category of taboo — specific beliefs which directly affect patterns of bone breakage and discard. Among the Shuar of the Ecuadorian Amazon, a good hunter must never break the bones of his prey to get at the marrow; if he does, he will lose his skills as a hunter (Bianchi 1981, 20–21). Also, bones of certain animals must not be given to dogs or randomly discarded; instead, they must be kept in a bowl, and subsequently disposed of in the river by women. These examples illustrate the presence of behaviours which inevitably produce a sub-representation of certain species in the archaeological record which archaeologists must be prepared to recognize.

The complex and diverse nature of lowland Amazonian taboos undermines much of the force of adaptive / cost–benefit models of explanation. It also places the inquiry at an arguably more convincing level — the realm of mythology and ideology. This conclusion has potentially significant implications for archaeology. At the very least, two contemporary sites occupying identical tropical rainforest locations, and belonging to (presumably) similarly adapted hunter-gatherer societies, could produce archaeological records exhibiting two significantly different patterns of bone distribution.

Archaeological correlates of Nukak taboo

In light of the above, we now consider the effects of ideological behaviour on the archaeological record — specifically the recognition of patterns of Nukak bone discard. In this we aim to identify some of the potential archaeological correlates of Nukak taboos, as well as highlight interpretational difficulties.

White-lipped peccary and monkey

One of the most interesting cases is that of the white-lipped peccary, from whose processing and consumption Nukak women and children are excluded. This gender and age-specific taboo should be visible in the archaeological record as the animal's bones are discarded in three spatially distinct locations (Fig. 10.3).

First, the head and some viscera are discarded (and the hair burned off) in a temporary butchering spot close to a swamp. Second, the ribs, vertebrae, pelvis and scapulae are discarded in the area around a grill located on the outskirts of the base camp. Some long bones, such as humerus and femur, may also be left here, and are sometimes broken for marrow

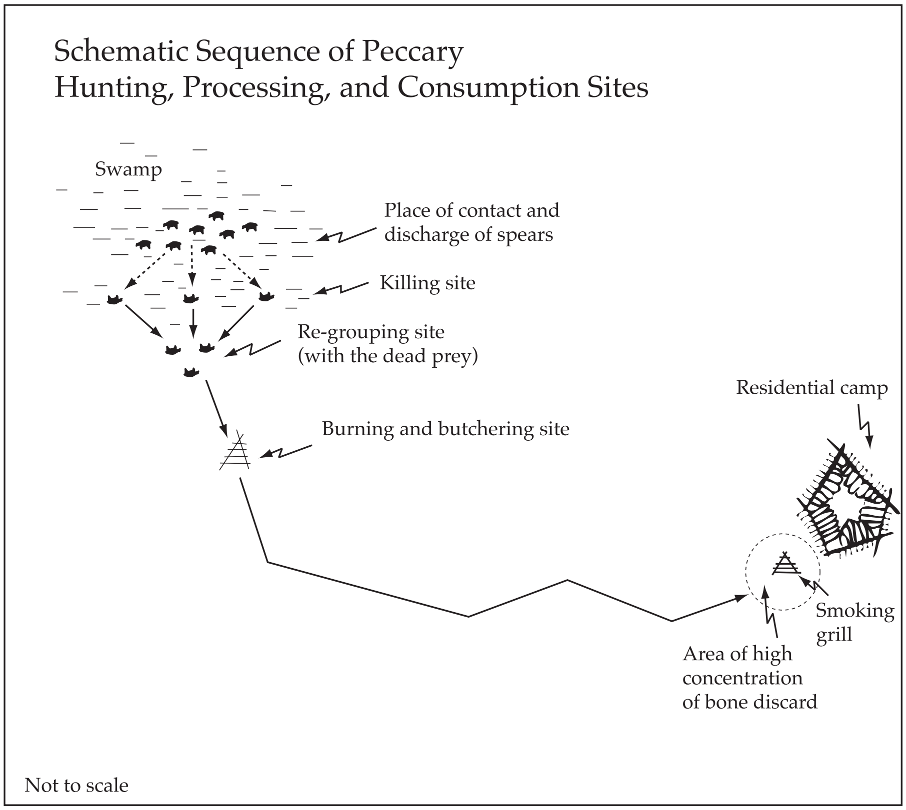

Figure 10.3. *Schematic sequence of Nukak peccary hunting, processing and consumption sites.*

extraction. Third, other long bones, e.g. tibia, fibula, ulna, metacarpals and metatarsals, carpals, tarsals and phalanges, are discarded within and around the base camp.

It is apparent that the male-dominated nature of white-lipped peccary processing, consumption, and subsequent discard takes place almost entirely outside of the household sphere. Investigation of a Nukak archaeological landscape would reveal a wide distribution of bone discard, significantly different from that of either a non-tabooed or a wholly tabooed animal. The head, associated with the grill used to burn off body hair, would be found several km away from the residential camp. Nearer, but still outside the camp, another grill surrounded by peccary ribs, vertebra, pelvis and scapula, could be identified. Finally, within the camp, fractured long bones, metapodials, and phalanges could be recovered. However, this picture is complicated by the fact that immature peccary are sometimes taken to Nukak camps to be kept as pets in a corral. Those which were observed did not survive, and their remains would have entered the archaeological record of the campsite probably as disarticulated bones due to the activities of dogs and children.

In contrast, the discard of (diurnal) monkey bones reveals a quite different patterning to that of white-lipped peccary. Monkeys are hunted on a daily basis by exclusively male hunting parties armed with blowguns and curare-tipped darts. The carcasses are transported whole to the base camp, where they are butchered and cooked exclusively by women (Fig. 10.4). The cooked meat is consumed by all members of the camp, usually at night, and often in their hammocks. Cooking locations and subsequent meat distribution varies with the quantity and size of monkeys — a fact which affects the way in which the animal's remains are disposed of.

Although monkey bones are generally discarded in a random fashion around locations of consumption, some household areas show a higher bone concentration than others, such as the hearth, the hearth area, and the zone between the hammock and the leafy walls of the winter dwelling. The monkey's head usually remains in the hearth of the hunter's family, and is the last body part to be consumed, though not by the hunter himself. Nukak believe that if the hunter eats the head of the prey, he will fail in future attempts at hunting the same species. The Nukak habit of sometimes taking monkey heads with them on moving camp — and occasionally abandoning them *en route* — would lead to archaeological recovery of more disarticulated skeletons than matching skulls — a situation which could easily lead to erroneous (and perhaps imaginative) interpretations.

A further complicating factor is that a small percentage of monkey bones is occasionally used as raw material for both 'expedient' and curated tools. Expedient tools are used in the processing of monkey carcasses, e.g. prising the mandible from the skull; curated monkey bones, with polished ends, are kept in a basket (along with other similarly curated items), and used, variously, for body painting, seed extraction, and perforation. Often, the animal's canines are removed, perforated, and strung as a necklace (and see below).

Comparing the patterns of processing, transportation, and consumption for white-lipped peccaries and monkeys, it appears that differences can be explained, at least in part, as the result of an age- and gender-specific taboo on the former. Arising from these two patterns of bone discard, another factor argues against cost-benefit analyses. Occasionally, immature peccaries, weighing around 6.5 kg, are killed and transported in the same way as adults, despite the fact that they weighed less than some monkeys (e.g. an *Alouatta* monkey can weigh up to 9 kg). In other words, body size was not the only factor taken into consideration when butchering and transport decisions were made. Peccary have to be processed outside the camps in *ad hoc* hearths, while monkeys are processed in the domestic hearth of the household sphere. Ideological concerns clearly influence where bones are discarded — producing a distribution pattern related directly to the kinds of taboo associated with particular animals.

Figure 10.4. *Nukak woman butchering monkeys and birds.*

This raises an important point for archaeologists. What factors are taken into account when decisions related to transport and dismemberment are made? Although some consideration is given to the weight of the prey (Politis & Martínez 1996), it seems that those prey which are consumed by everybody have to be taken *whole* into the camp, so women can participate in tasks related to processing. In this sense, monkeys, birds and agouti pass from men's hands to women's hands through a continuing process of acquisition, preparation, and consumption.

Piranha

While 'sacred' or 'spirit' animals are, in one sense, invisible in the real world, traces of their natural forms might be disernible in the archaeological record due to the semantic overlap between sacred and taboo status. Difficulties of interpretation concerning such animals are exemplified by the piranha. Among Nukak, piranha taboo appears both partial and unlike that applied to other animals inasmuch as it is not a common food resource. This may be due, in part at least, to its sharp predator's teeth — and local taxonomic associations with other animals possessing similar dentition (e.g. Crocker 1985, 285–6). Nevertheless, Piranha jaws have two kinds of uses: as hair-cutting implements — 'purifying' instruments with ideological-aesthetic significance in making Nukak clean and attractive. Second, they are used to notch hunting darts and, more generally, function as knives and carving tools throughout Amazonia (e.g. Descola 1994, 224; Métraux 1946, 293).

Archaeologically, in household contexts, all parts of piranha can be recovered with the exception of the highly curated jaw. Almost complete skeletal remains could be interpreted as indicating that piranha was primarily a food resource, rather than a provider of jaw-tools possessing two categories of use. A similar conclusion might be reached if piranha bones were not discovered in household remains yet jaws were recovered from a midden context. In both cases, it would be difficult to identify the existence and nature of the partial taboo known from the ethnographic record. The more subtle status of piranha flesh as a specially restricted food for men during the couvade (e.g. among the Palicur of Guiana) would arguably be impossible to ascertain (Métraux 1949, 373). While hardly conclusive, piranha illustrate that unusual bone distributions have the potential for alerting archaeologists to a range of possibly ideological factors influencing the archaeological record.

Duck

Similarly complex problems of interpretation surround other animals whose remains might also be interpreted erroneously as food resources. Some kinds of duck are totally taboo for all Nukak, while others are eaten only by some people. While some species are consumed solely by men, and outside rather than within the camp, others are killed solely for their white feathers. This has the potential for producing a highly ambiguous archaeological record. Duck species found within the camp could be regarded wrongly as food, whereas those that were consumed (albeit only by men) remain 'invisible' beyond the boundaries of the camp. The possibility of interpreting duck bones as not having been consumed might rely on the lack of observable evidence for butchering (i.e. cut marks), cooking (i.e. burnt bones), and consumption (i.e. chewed or broken bones) — evidence which, however, could easily be erased by the activities of 'secondary consumers' such as dog.

Deer and jaguar

By contrast to animals whose taboo status is partial or ambiguous, deer and jaguar would appear to offer a clear cut case of total proscription for all Nukak. This might be expected to yield a complete absence of deer and jaguar bones in the archaeological record. Yet, this is not the case.

Nukak make flutes, *mikuapát*, from deer tibia and jaguar humerus. These are used usually by men during rites associated with initiation into manhood. Young Nukak men carry bone flutes when they are visiting other bands or colonist settlements, and usually play them after sunset. While this might suggest a liminal position for such instruments in the Nukak scheme of things, the way in which flute-bones are acquired is the first part of a 'cultural biography' of these objects (Kopytoff 1986), and particularly informative of the complex ideological relationship between sacred animals and taboo status, and of the effects of this on the shape of the archaeological record.

Nukak acquire deer bones usually by scavenging them from the remains of a deer killed by jaguar, and jaguar bones from chance finds of a dead animal. The spiritual importance of the jaguar and its favoured deer prey, may go some way to explaining the latter's taboo as a food resource — but it does not preclude the use of the deer's bones once the jaguar has consumed the flesh. The Hupdu Makú, for whom deer is proscribed, obtain its bones from dense heaps of the animal's skeletal remains found in a spot where a jaguar has eaten its meal, usually nearby water where the deer has come to drink or lick salt (Reid 1979, 262). The Cuiva, for whom the jaguar also is sacred, scavenge the front part of the deer left by the jaguar after it has consumed the rest of the carcass (Ortiz 1978, 264). There is clearly a close physical and symbolic relationship between jaguar as archetypal predator, and deer, as possibly an archetypal prey, which deserves further investigation (Saunders 1991, ch. III).

In the absence of ethnography, the paucity of deer bones in the archaeological record might suggest they were hunted for food but consumed away from the camp, with some bones subsequently made into curated flutes; alternatively, they may have been hunted solely for their tibia/flute bones. Both explanations are false, and, in assuming human predation, highly misleading.

Given the widespread special status of the jaguar in Amazonia (e.g. Reichel-Dolmatoff 1975; Roe 1998), it is worth noting that, while the animal will likely be invisible in any food discard context, necklaces of jaguar teeth are sometimes interred with the dead in burials which lie within the residential camp. As such objects may be found alongside jaguar- or deer-bone flutes, it might be inferred that jaguar were hunted to obtain status or prestige items (as widely noted in the ethnographic record), rather than their remains being scavenged from carcasses. The potential for further confusion lies in the fact that necklaces of monkey teeth are also sometimes buried with the dead. This suggests a possible symbolic association with deer and jaguar despite the non-tabooed status of monkeys as discerned by the frequent presence of monkey bones on the campsite floor with clear evidence of human consumption (e.g. burning and butchering marks and breakage patterns).

What emerges from this data is a picture of taboo far more complex than recognized hitherto. Nukak attitudes and practices highlight the potential for mis-interpreting the archaeological record by ignoring the ideological nature of taboo and its embeddedness within wider mythic structures. The Nukak data also offer possible clues to the identity of animals which are neither hunted nor consumed, yet whose appearance in the archaeological record suggests they played a significant role in society. In the Nukak archaeological landscape, the status of deer and jaguar is hinted at by the presence of specific bones as distinctive artefacts *and* the absence of identifiably consumed body parts from the same two species. Narrow-focus, cost–benefit approaches to such ambiguous remains could easily mask consideration of their origins as scavenged materials as well as their inter-relatedness with concepts of sacredness and taboo.

'House of the Tapir'

A distinct yet related issue, is the effect which food taboos and ideas of spirit-animals can have on settlement patterns of hunter-gatherers. For the Nukak this is exemplified by the 'House of the Tapir'.

As we have seen, the tapir is not only the subject of Nukak food proscriptions, but also an important ancestor spirit-animal in Nukak beliefs. Nevertheless, it might be considered unexpected to see it playing a part in the potential settlement archaeology of a Nukak site area — leaving a unique archaeological signature of a specific tabooed animal.

Figure 10.5. *'House of the Tapir' in the corner of a cultivated Nukak field.*

The 'House of the Tapir ' is a structure built by Nukak in the corner of a cultivated field. It is made of about thirty *seje* palms, is usually six metres in length by four metres wide, and two metres in height (Fig. 10.5). It takes two to three days to build and, significantly, is constructed to a better quality than Nukak residential dwellings (Cabrera *et al.* 1994).

Although such structures may be used for storing blowpipes, cotton, and fish-hooks, they are primarily conceived as symbolic dwellings for the tapir. These physical, surface-world buildings, are regarded as being related to the sub-surface house where the supernatural tapir dwells like a human being (see above). Nukak believe that by building an earthly house the tapir will have somewhere to go as it roams the surface-world forest during the night and therefore will not become angry with humans.

Significantly for archaeology, the floor of the 'House of the Tapir' is kept scrupulously clean, and would yield little or no evidence suggestive of its use. Thus, the most elaborate, time consuming, and substantial Nukak structure, relates not to chiefly or shamanic occupancy (as might be expected), but to a powerful spirit-animal whose natural prototype is a tabooed food resource, and, consequently, is archaeologically invisible. How, one might wonder, would archaeologists interpret such data if there was no ethnographic dimension? The 'House of the Tapir ' illustrates the problems faced by archaeologists when the most energetically expensive structure has no 'obvious' real-time material benefit, and is consecrated to an animal which is excluded from the human food chain.

Conclusions

It is clear from this study that for Nukak, food taboos and related conceptions of mythical/ancestral spirit-animals actively shape the archaeological record. Beliefs about certain animals directly influence the selection of potential game resources, modes of predation, preparation, and consumption, and, consequently, can result in highly specific or confusingly complex distributions of faunal remains across the landscape.

The archaeological record is the product of a complex array of attitude-shaping beliefs and actions — of which only some are likely to correlate with modern western ideas, or be amenable to analysis by cost–benefit/optimal foraging theories. Dreams, myths, traditions, and daily events, are constantly taken into account when decisions about game hunting are taken. Negotiations with spirit 'owners' of animals, plants, and places are the key tasks to be performed, before, during, and after utilizing rainforest resources. It is doubtful whether hunting decisions are ever taken solely on the basis of an animal's weight, meat to bone ratio, or the storability of its flesh. As animals are cultural appraisals, use-value and mythic status are both highly relative notions as the Nukak and comparative evidence presented above have shown. Hitherto, many studies have denied the relativity of the former, and ignored the existence of the latter (see also, Yellen 1991a, 23–4).

We have argued that the consistent underestimation of the ideological nature and consequences of food taboo has been a major factor influencing the lack of fit between cost–benefit models and the archaeological record of Amazonian hunter-gatherers. In a recent critical analysis of factors governing and influencing the mammalian zooarchaeological record in the lowland American tropics, there is no mention of taboo as a possible explanation for the poor representation of deer and tapir (Stahl 1995, 154–80; and see Meggers 1997, 163). Archaeologists should be prepared to encounter the 'anomalies' of unusual patterning of faunal remains and the 'inexplicable' absences of available prey, and to acknowledge that they might be explained, in part at least, by the existence of taboos which owe more to indigenous rather than western conceptions of the relationships between humans and their natural environment.

Seven points arise from our analysis of the Nukak data:

1. Apart from any bias in preservation or retrieval, the absence of major food animal remains in the archaeological record may be due to one or several kinds of taboo. The presence of one or more species of a genus (e.g. cervids), does not preclude another species from the same genus being taboo. Indigenous classifications do not treat 'western species' as metonyms for 'western genera'.
2. The 'intermediate' or partial taboo status of some animals, such as white-lipped peccary or piranha, may produce highly distinctive bone distributions.
3. The presence of curated, and apparently ritual items (e.g. jaguar- and deer-bone flutes, and necklaces of teeth) together with the absence of any other remains of these animals in food-discard contexts might be an indicator of the symbolic importance of these species, and may hint at 'unusual' modes of bone acquisition.
4. Some animals may be present in the archaeological record with no apparent indication of human use. In standard archaeological bone analysis, isolated bones with no traces of butchering, cooking, or consumption, are usually interpreted as introduced into the archaeological record by natural (taphonomic) causes. Among the Nukak, duck species hunted for plumage not food possess no diagnostic marks, yet were brought to the site and used by humans.
5. Nukak evidence indicates the existence of what might be seen as a paradox *vis-à-vis* hunting/kill locations. *Salados,* which would be prime locations to look for kill-sites based on cost–benefit expectations or optimal foraging principles, are virtually devoid of archaeological remains. As 'doors' to the 'House of the Tapir', *salados* are sacred places avoided by Nukak.
6. While a major taboo animal, such as tapir, may be 'invisible' in terms of faunal remains, it may nevertheless leave a highly visible and distinctive archaeological signature, such as the 'House of the Tapir', whose size, sophistication, and clean floor could easily be misinterpreted.
7. Prey scarcity, variable meat yields, predictability of movements, and bodyweight — the definitive criteria of cost–benefit analyses — all retain the potential to influence the decision to avoid the exploitation of a given animal. Nevertheless, in light of the above — where each one of these criteria has been negated by Nukak experience — such potential causes need to be demonstrated on a case by case basis, not assumed to be generally true.

Some twenty years ago Jones (1977, 196) showed that at a specific point in time (between 3800 and 3500 BP) prehistoric Tasmanian hunter-gatherers made a conscious decision not to eat fish, despite its ready availability, the fact that it had been a major food resource for four thousand years, and that it constituted a net loss of food (Jones 1978, 45). This event appears to have had nothing to do with environmental change. As Jones pointed out, an intellectual event caused a contraction in ecological space (1978, 44). The force of this economically maladaptive, ideological, decision was such that it still adhered three thousand years later at the time of European contact. Among Amazonian rainforest societies also, the widespread occurrence of food taboos suggests a long tradition for this cultural practice (Reichel-Dolmatoff 1975; 1976; 1978; Ross 1978), and an equally intellectual dimension to its implementation and maintenance.

A recent assessment of intraspecific prey choice by the Amazonian Piró concluded that particular prey species were not actively conserved by choosing age and sex to minimize impact on prey populations (Alvard 1995, 802). However, the conclusion that optimal foraging hypotheses more accurately predicted hunters' decisions or provided a model against which the archaeological record could be compared, also ignored the role of ideology. As Raymond Hames, in his comments on Alvard's article noted: '. . . the widespread existence of game taboos in Amazonia . . . is a nagging problem for the rational-choice models . . .' (Hames 1995, 805). Not surprisingly, we believe that the significance of taboo extends far beyond the chimaera of 'problems' which arise only or mainly from efforts to straitjacket Amerindian behaviour into western modes.

Animal-food proscriptions, like any taboos, are acts of denial — the sacrifice of things which might be had for reasons which make eminent sense to the society concerned, but which might only be dimly perceived by outsiders. For tropical rainforest hunting and gathering societies, such taboos are culturally variable ideological imperatives whose symbolic complexities must be acknowledged if interpretations of the archaeological record are to reflect indigenous realities rather than western assumptions.

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Notes

1. A large amount of original data has been obtained during the wider project and part has already been published: (Politis 1992; 1996a,b; 1998; 1999; Politis & Rodríguez 1994). The seven field seasons during which data used in this paper was collected comprised 185 days. GP led these field seasons and was accompanied by Julián Rodriguez (Universidad Nacional, Colombia), Dairon Cárdenas (Instituto SINCHI, Colombia), and Gustavo Martínez (CONICET-Universidad Nacional del Centro de la Pcia. de Buenos Aires, Argentina). Additional information was obtained through interviews with various Nukak who were temporarily in Santafé de Bogotá for medical reasons and were in the care of missionaries of the 'New Tribes Association of Colombia'. Two of the association's missionaries, M. Conduff and I. Gualteros, were fluent Nukak speakers and co-operated with translation during the interviews. Finally, field data was contrasted and elaborated with that which had been collected by the missionaries over more than ten years of permanent contact with Nukak bands living in the east of the territory.
2. The rainforest habitat of the Nukak is part of northwest Amazonia where annual rainfall varies from 2500 mm to 3000 mm (Domínguez 1985). The region lies at an altitude of 200–300 m above sea level and forms part of the watershed between the Amazon and Orinoco drainage systems. Although dominated by heavy rainfall, the climate is tempered by high mean daily temperatures (24°–27°C), and there is a short dry season which begins in the second half of November and lasts until March. The abundant precipitation, which peaks in July and August with more than 400 mm per month, compensates for the three-month-long dry season and allows for the development of continuous forest with medium-height forest canopy.
3. In summer, Nukak move longer distances ($\bar{x}$ = 8.05 km, n = 18) and stay less time in each residential camp ($\bar{x}$ = 2.6 days, n = 20), while in winter, shorter distances are covered ($\bar{x}$ = 3.85 km, n = 12) and stays are longer ($\bar{x}$ = 4.8 days, n = 13).
4. Following Politis & Martínez (1996), vertebrates are classified thus: up to 10 kg = 'small', between 10 and 50 kg = 'medium', greater than 50 kg = 'large'. In this way the main vertebrates inhabiting the region can be grouped as follows:
   Small: all monkeys, tortoises, armadillos, agouti and smaller rodents and birds.
   Medium-size: white-lipped peccary, collared peccary, deer, spectacled caiman.
   Large: jaguar, tapir.
5. Other animals, probably less important, but still clan ancestors, which inhabit the 'House of the Tapir' and which rise to the surface at night are paca, anteater, and the *perro de agua.*

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Conclusion

Eating for Calories or for Company? Concluding Remarks on Consuming Passions

Martin Jones

The legacy of 'New Archaeology'

In the late 1960s and early 1970s, what had been rather barren prehistoric landscapes were being revitalized by output from the rapidly growing field of bio-archaeology. Ancient animal populations came to life, exhibiting complex behaviour. The ecosystems of which they were part acquired colour, texture and seasonality. Several of the ideas lending this field momentum came from those with direct experience of animal exploitation, people like Eric Higgs, once a sheep farmer, and Lewis Binford, who had followed caribou with the Nunamiut. From within a materialist ecological tradition, they pressed a generation of researchers to consider the harsh realities and adaptive pressures that shaped the relationship between people and the living species upon which they preyed. Environment, seasonality and behaviour were ecological realities to which prehistoric communities were forced to adapt. Our task as archaeologists was to chart and rationalize the many facets of that adaptive process.

The approach was very fruitful in that it encouraged new ways of thinking about the past, and a considerable diversification of bio-archaeological method. Many more projects incorporated a bio-archaeological element, and the range of data gathered expanded from simple taxonomic lists to information on life-tables, taphonomy, and the physical manipulation of biological resources. Food-processing sequences were identified and given a spatial context across the site and the landscape. With the assistance of ethnographic parallels, all could be woven together as part of the prehistoric community's grand adaptive strategy. Binford brought as teaching aids to one of his more memorable classes a fresh animal carcass and a set of stone tools. While taking the carcass apart in front of the students, he explained how a whole series of attributes, butchery marks, breakage patterns, skeletal element numbers, served as archaeological markers of that past adaptive mechanism, from which only bones and tools survived. Much of the emphasis placed by Binford, Higgs and others, on the constraints of environment and animal behaviour still hold as critical elements of our analysis of human palaeo-ecology. That act of butchering the carcass, however, also signifies a transition in the place of ecological adaptation in human action.

From production to consumption: an explosion of choice?

The behavioural and ecological constraints upon how a living animal or plant can be coaxed to become food are often severe. The same is not true of the culled or harvested prey, which is entirely at our mercy. There is no one way to turn an animal carcass, or a cereal ear, into food. In fact there is a vast constellation of ways, of cultural options, in which that transformation is achieved. By exploring those different options, the preparers and sharers of food do two things. They both reflect the society of which they are part, and they reconstitute it through the ritual of the shared meal.

In his contribution to this volume, Finbar McCormick refers to an eighth-century tale of 'MacDatho's pig'. The tale relates how the carving and distribution of a banquet pig is contested, and the argument that ensues is concerned with the relative status and power of those gathered together at the banquet to share food. He who carved the pig and distributed the joints acted not so much in an ecological landscape of minimum calorific costs and maximum returns, as in a social landscape of roles and relationships. The papers in this volume are all in some way or another exploring what of those social landscapes is retrievable from the bio-archaeological record. To a large extent, the kinds of bio-archaeological data examined are precisely those that had been brought into play within the materialist ecology of Binford, Higgs and others, for example age-sex data, element distributions, butchery and taphonomy. A point made by various contributors is that such data often relate more directly to preparation and consumption of food than the ecology of living species. This, in principle, would suit them better to elucidating the social landscape of the prepared meal than the living ecology of the 'walking larder'. In different ways, the papers in this volume pick up on the possibilities of doing that, and in this final paper I shall reflect on the concepts that have been brought into play, and the kinds of data used to explore them.

Community, feast and meal

Implicit in all contributions, and explicit in some, is the concept of 'community', of a group of people, present in body or symbolically, that is witnessing and engaged in the preparation and sharing of food. The scale of that community varies considerably. At one end is Montón's intimate family group, delineated by gender and age. At the other end is Grant's vast population of the Roman Empire, and even those beyond its fringes aspiring to Roman culture, and the Amazonian Nukak's global community, the subject of the paper by Politis and Saunders, which extends into the realm of ancestors and animal spirits. At the small scale, the preparation of food is deeply embedded in social relationships, typified by the mother feeding her child. Montón takes an example from Senegal, of a switch from one cereal to another, a fairly commonplace event in prehistory, being framed by the radical renegotiation of gender and internal family relationships. At the global scale, one could almost argue the reverse, that social relationships were embedded in the preparation of food. Certainly in Grant's example of food status in the Classical world, such things as material culture and cuisine may have been the principal means of recognition of a shared *Romanitas*. A plausible comparison can be made between Petronius' send-up in the *Satyricon* of Trimalchio's feast in the heart of the Empire, and what contemporary social climbers were depositing in the archaeological record of the distant northwestern provinces (Fig. 11.1). This in itself demonstrates how pervasive the meaning of status consumption was, even among people that were unlikely to have shared a common language.

In between these two extremes, some contributions allude to intermediate positions on the community scale. Each individual recognizes 'community' on a variety of different scales, and acknowledges each of those communities at different occasions of sharing food. McCormick discusses a community of feasters in medieval Ireland, larger than the family, but who probably know each other's names. The Nukak recognize five dimensions of 'territory', each corresponding to some articulation of 'community', with the intimate and the mythical at opposite ends of the scale. A number of the contributions leave the issue of community scale open, more often than not because the archaeological evidence is not there, at least from a single site. A couple of the contributions, though not specifying scale, draw a contrast between two different scales of consumption, the smaller-scale domestic 'meal' and the larger-scale ceremonial 'feast'. By implication, the meal is seen as a daily occurrence, following certain norms of practicality, non-wastage and good 'housekeeping'. The feast is seen as being less frequent, taken outside the home base at some significant location, and following its own distinctive rules in relation to such matters as food choice, 'practicality' and wastage. In this volume, the most explicit theorization of feasting comes with Miracle's use of the work of Hayden (1996). He explores a materialist explanation, consistent with a classical view of culture as an extra-somatic means of adaptation, and feasting seen as a means of exchanging people, items and information.

'Community' and the divisions within it relate to the structure of society, and 'feast/meal' to the process of constituting it through the sharing of food. Within 'community' different contributions explore such delineating elements as gender and age (Montón) and wealth, status and power (Grant, McCormick). Around 'feast/meal', contributors explore such elements of process as cuisine (Miracle), ceremony (Albarella and Serjeantson), gesture and ritual (Miracle). These are all concerned with some kind of collective activity that simultaneously establishes identity shared and identity bounded. Politis and Saunders explore another element of process that also does these things, the avoidance of particular food-types, to which the term 'taboo' is sometimes attached. Their example of the Nukak illustrates how the avoidance of perfectly palatable foods delineates the shared lineage of particular groups and situates them within a wider cosmology of nature. Within those lineages, practices of food avoidance further delineate divisions of gender and different stages of life.

Trimalchio's menu (adapted from the Satyricon)	First-century changes in the bio-archaeology of southern Britain
peahens' eggs	
beef, pork, African figs, lobsters, geese	figs, oyster shells, and an increase in remains of cattle and pig
wild boar, hung with Syrian dates and stuffed with thrushes, grapes	dates, and an increase in pig remains grapes
more pig, stuffed with sausages and black puddings	more pig
pastries, apples, grapes	grapes
capon	increase in chicken bones and eggs
nuts, raisons, quinces	grapes
more pork , and all washed down with copious wine	increase in pig remains, more amphorae

Figure 11.1. *A comparison between two records of consumption in the first century* AD*: Petronius' parody of a* nouveau riche *feast, and the bioarchaeological record of a northwest province.*

Making rules and breaking them

Alongside these concepts relating to structure and process, we might ask about those relating to agency and deviation. Such concepts feature much less in the contributions to this volume, perhaps because of the difficulty of tracing them archaeologically. If reconstructing social norms from archaeological evidence is a challenge in itself, than tracking particular deviations from those norms is that much more of challenge, however important they may be in reaching that prime archaeological target of understanding change through time. Not surprisingly, those comments on agency and deviation that are made relate to ethnographic rather than archaeological examples. As it happens, they also relate to material economic drivers. Montón's Senegalese example and Forbes' discussion of storage and peasant decisions in postwar Greece both fall within this category. Politis and Saunders tangentially hint at agency and change, by emphasizing the relativity and context specific nature of food avoidance among Amazonian communities.

Perhaps another dimension of agency and deviation is evident in a more subtle manner, the way in which cultures in real life fail to neatly fit our *post-hoc* observational categories. One example of this is our hunter-gatherer/farmer dichotomy, which is often clearer in our analytical minds than in the societies we study. Such is the case with the Nukak 'hunter-gatherers'. Politis and Saunders argue '*they should remain in this politico-economic category despite not being "pure" hunter-gatherers*', their lack of 'purity' deriving from their simultaneously being cultivators. The Durrington Walls Neolithic community also clearly crossed that boundary in some quite interesting ways. The neat partitioning between wild and domestic animals that had first been suggested for the site was overturned by the reanalyses of Albarella and Serjeantson. Milner's discussions of Ertebølle sites brings us to a third culture that did not follow our rules of the transition to farming, and a succession of scholars have moulded explanations that retrospectively bring them back into line.

Continuing the theme of communities that don't fit neatly into our analytical categories, Forbes' account of the Methana peasants highlights how keeping a range of options open was far more important than following a particular 'politico-economic' template. I suspect that has been true of many communities including the various ambiguous hunter-gatherer-farmers above. As with that group, post-industrial observers have often wished to overcategorize pre-industrial peasants. Are they part of urbanized monetary society or not? Are they self-sufficient or not? Is the peasant who took a full-time job with the merchant marines, any less part of the community than his neighbours who put more effort into working the land? Not only is such lack of neat fit of direct relevance to agency and change, we might expect it in many cases to be archaeologically visible.

Finding consumption in the archaeological record

The contributions to this volume offer a wealth of approaches to linking archaeological data to the concepts outlined above. As mentioned above, much of the core methodology employed follows directly from what grew out of a materialist ecology tradition.

In its application to the social dynamic of consumption, three central themes have been emphasized, the themes of variation, sequence, and scale.

Variation across space and time, across contexts, within and between sites has been the main route to seeking out patterns of difference in consumption that map onto archaeological correlates of social difference. A number of contributions point to particular animal species whose meat may be selectively consumed in 'élite' contexts, or simply a greater consumption of meat, a higher trophic position. Trace elements are mentioned in this context, but there may be greater potential to explore isotopic markers of trophic position (cf. Van de Merwe 1992). 'Exotic' foodstuffs such as Miracle's mussels, transported 20 km may also signify 'special' consumption.

The paper by Politis and Saunders explores another facet of difference, food avoidance, not just in terms of their ethnographic example, but also in terms of its potential archaeological visibility. Grant picks up the example of the avoidance of horsemeat. I am also struck by her earlier work on the rarity of wild animals on later prehistoric sites in Britain (Grant 1981). The absence of butchered deer bones on Iron Age sites that do yield utilized antler remains seems to offer a prime example of one of the correlates of avoidance suggested by Politis and Saunders. It may be productive in archaeological terms to explore food avoidance in relation to the broader categories before homing in on particular species. In much of modern western culture, we treat aquatic invertebrates as a delicacy, while their terrestrial relatives we generally find repulsive. This is by no means a universal trait, terrestrial invertebrates are recurrently an important resource for woodland dwellers, and bio-archaeology should by now be able to cast light, both on its history, and on its relationship with the changing boundaries between 'culture' and 'nature'.

The theme of sequence is emphasized by Miracle, who discusses a number of approaches taken to it. The *chaîne opératoire*, derived from lithic studies, attempts to relate a mental template and cognitive process with a series of gestures and actions shaping material culture. The study of various bio-data has generated *processing sequences*, that build a connection between the inaccessibility of food in a raw cull or fresh harvest with the human actions employed to render it accessible, through butchering a carcass or threshing a crop, for example. Both entail rebuilding a sequence, but one starting from the mental template of the subject, and the other the physiological constraints of the object. Implicit in Miracle's argument is that to shift focus from functional food to social feast, bio-archaeologists should shift emphasis from processing sequence to the *chaîne opératoire*. Two approaches that come to mind in this respect are those taken by Flannery (1986) at the cave site of Guila Naquitz, and by a human osteologists on skeletal stress.

At Guila Naquitz, Flannery brought a spatial and contextual analysis of lithics into the same frame, and treated them in a similar manner. For each of the visits to the cave he was able to suggest where people where sitting, and what they were doing in relation to the preparation and consumption of food. He went on to speculate about how these different patterns of consumption related to the divisions of age and gender within a small foraging band. Whether or not these attributions were correct, it is clear that the spatial patterning of the processing sequences did constitute some socially constructed protocol of behaviour on the domestic scale. Attribution to age and gender can be much more securely established through skeletal remains, and a recent study by Sofaer-Derevenski (2000) has illustrated how this can work. The perennial gestures and actions that formed part of the routine practice of men, women and children leave their mark on the skeleton, notably through the impact of labour on such vulnerable parts of the skeleton as the spine. Her analysis of arthritic developments on different vertebrae of medieval women could be directly related to the practice of carrying resources in a certain way, and the same methodology may be applied to such activities as digging and grinding.

Processing sequences for bio-data have often stopped at the detached meat or threshed grain. A number of contributors (Montón, Albarella and Serjeantson, Milner, Miracle) emphasize the potential of studying the final stages of preparation, cuisine and cooking. While it is certainly true that skeletal remains retain evidence of different forms of heating, this is clearly an area in which a wealth of evidence can come from the molecular and microscopic routes. Samuel (1996) has shown how microscopy of pot residues can reveal remarkable detail of ingredients and such transformations as baking and brewing. Evershed (1999) has demonstrated that lipid analysis of residues can help distinguish roasting, boiling and dairying. Montón stresses the value of seeking out the origins of cooking, through early traces of fire and burnt bone. It would be interesting to pursue this, not just in terms of the origins of different kinds of sociality, but also in terms of the origins of external digestion, which may be a critical aspect of the hominid enlargement of the brain at the expense of the gut (Aiello 1997).

If one of our prime interests in looking at past consumption is to understand the community involved and the basis on which it meets to share food, the scale in space and time of our data patterns is critical. Scale recurs in the papers in terms of the size of the cull, of the whole carcass, and the number of people who might share its meat. I would suggest that the issue of scale can be usefully taken further in these analyses. In reading about the feasting at Neolithic Durrington Walls, I wondered how widely those feasting practices would have been recognized. If they walked 25 miles to the adjacent clusters of henge monuments, would the same feasts be going on? What about those henge groups in the far north of the country — how different would their feasts have been? All these questions are in principle answerable, and the skeletal assemblages exist.

Bio-data is particularly well suited to examining temporal scales, as there is so many indications of tempo contained within the data itself. Three types of tempos of sharing food come to mind. The first is the regular tempo, annual/seasonal/diurnal that accounts for the core of food sharing. It can be picked up archaeologically through the age of young mammals, through resource species that inherently display a pronounced seasonal cycle, and through related indicators, such as storage facilities, of an agrarian cycle. The second tempo is one that much agriculture seeks to annul, but will have been a recurrent reality for hunting and gathering communities. This is the sporadic and irregular cyclicity of many prey populations. Large mammals, certain marine populations, and the fruits and nuts of several tree species are subject to repeated cycles of years of plenty and scarcity. Miracle alludes to these in relation to mollusc populations, and the possibility that prehistoric feasts might dovetail with these. The third tempo is biographic, the feasting that accompanies rites of passage. Such a tempo might be explicit from particular contexts, such as Neolithic henge monuments. The one rite of passage at an association is more clearly visible in archaeological terms is death, and funerary associations are mentioned by certain authors.

Another archaeological feature that we might relate to tempo is what has been described as 'wastage'. Copious leftovers and 'waste' has been seen as an indication of special feasts, rather than ordinary meals. The term 'waste' is obviously value-laden, and it might be more useful to emphasize the relative brevity of the processing sequence. Whereas at some ordinary contexts, a carcass is distributed through several meals, each joint of meat being boiled up a few times, and some joints dried or preserved. The food waste is then fed to animals, the bones opened for marrow or boiled for glue and so on. This might be described as a 'deep' sequence with a slow tempo, in contrast with a 'shallow' sequence in which everything from killing the animal to disposal of the debris may be contained within a few days, or even hours. The so-called 'ordinary meal' relates to a smaller scale in space, but a larger time scale. The so-called 'special feast' conversely relates to a larger scale in space and a smaller time scale. Expressed in this manner, there can be many detectable variations on a theme, reflecting the multiplicity of food sharing in a society.

Eating for calories or for company?

The distinction between biological and social feeding is drawn, sometimes tacitly, sometimes directly, throughout this volume. Two forms of food sharing are envisioned, corresponding to the domestic and public spheres (cf. Montón). In the first, an intimate group of close family members eats to survive on a daily basis, effectively exploiting their environment, balancing their diet and making the most of the resources they acquire, disposing of only the final fragments of intensive processing. In the other, a larger group gathers together at some significant location to share food in a more lavish and symbolic manner, consuming quantities of 'special' foods, and disposing of their waste quickly and without secondary processing. There may be other evidence for the 'specialness' of the feast, distinctive artefacts, or evidence of human burial, for example.

As various contributors argue, this contrast may not be the most useful one to draw, downplaying as it does both the social dimension of the daily meal, and the biological dimension of the ritual feast. There is no contradiction between reconstituting social relationships and meeting nutritional needs, and both forms of food sharing achieve both. As soon as two or more people stop and meet to eat together, then that sharing of food is immediately situated in the context of, and actively refers to, social relationships. There is an element of performance and ritual to all such acts of sharing. There are probably limits to how much we can explore the origins of the latter from the former in the archaeological record. We are by no means the only species whose members routinely share food within some kind of distinctive protocol. We assume that in other species such protocols are broadly fixed, even 'hard-wired' in behavioural terms, whereas in humans they are actively reconstituted in the context of shifting signification and meaning. The protocol of food sharing is repeatedly renegotiated and reconstituted through time, with consequences for the dynamics of social reproduction.

What might be a more productive issue to explore through archaeology is the pattern and tempo of that ongoing change. So, for example, in the case of Miracle's Pupićina fauna, a social explanation involving 'feasting' need not be in conflict with an adaptive explanation involving 'broad spectrum' risk avoidance. The adaptive and social accounts can happily co-exist. Rather than asking 'was it or wasn't it a feast?' we can ask 'how did the rituals of preparing and sharing food change in tempo and scale, and what does that apply about the changing dynamics and structure of society and its relationship with its world?' The contributions to this volume have offered a number of routes to addressing questions of this kind. The routes that stand out to me are as follows:

- a continued emphasis upon *context* and on relating that context to parallel lines of evidence;
- an increased emphasis on, and precision over, *scale* in space and time;
- a fresh look at the notion of processing *sequence*, drawing on the ideas behind the *chaîne opératoire*, and placing greater emphasis on the final stages of preparation, such as cooking.

There are new methodological avenues to be pursued, particularly those combining different methods of bio-archaeology within the same project. We need, for example, more studies integrating analyses of food remains together with isotopic and pathological studies of associated human remains. We need to interconnect the better established macro-analyses with the fast developing microscopic and molecular techniques. We also need to think a lot more about agency, deviation and change. The shift of focus from production to consumption, from the biological to the social, that underpins this volume has a considerable potential to stimulate bio-archaeological studies, in much the same way materialist ecology stimulated it a quarter of a century ago. The contributions here have taken some important steps in that direction.

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