Towards an Archaeology of Pastoralism: The Near East and Beyond

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Abstract: Drawing upon a variety of geographical, historical, and ethnographic observations, and using a number of variables including the degree of mobility, division of labor, and social organization, this paper defines a series of strategies for pre-modern pastoralism and then proceeds to detect the markers for these strategies using recent developments in the fields of archaezoology, archaeobiology, archaeochemistry, archeobotany, spatial analyses and settlement pattern studies.

Keywords: Pastoralism, Near East, Transhumance, Nomadism, Human Ecology

Introduction

Pastoralism – in its various forms, scales, and degrees of mobility – has been an integral part of human society and economy since the process of domestication of herd ungulates began in several different locations around the world starting with the Near East some twelve thousand years ago (cf. Clutton-Brock 1989, 1999; Clutton-Brock and Grigson 1984). In fact, a herd of domestic herd ungulates (and hence some form of pastoralism) was part of almost every human landscape in the Old World (and in the New World after European contact) until fairly recently when the industrial revolution introduced drastic changes to human socioeconomic and settlement configuration, detaching pastoralism from other daily activities and gradually transforming it into an increasingly commercialized industry (cf. Galaty and Johnson 1990; Chang and Koster 1994; FAO 2001).

Despite many social, economic, and political pressures however, there are still several major traditional pastoralist complexes around the world, each practicing a certain degree of mobility (Fig. 1). One can think of at least six major examples in the Old World: cattle pastoralists of Africa (cf. Smith 1992), camel bedouins of the Arabian and Saharan deserts (cf. Bulliet 1975; Köhler-Rollefson 1993; Bonte 2004), horse nomads of the Inner Asian steppes (cf. Basilov 1989), yak herders of the Tibetan highlands (cf. Goldstein and Beall 1989), reindeer herders of the arctic (cf. Levin and Potapov 1964; Paine 1994), and the primary subject-matter of this paper, caprine (sheep and goat) pastoralists of the Near East. To this list, one can add a number of smaller caprine pastoralist groups in Europe, especially in the Pyrenees and the Alps (Rinschede 1979; Rendu 2003) and the Indo-Pakistani borderlands (cf. Husain 1998). The camelid herders of the Andean highlands are an example of a long-standing pastoralist complex in the New World (cf. Murra 1965; Webster 1973; Flores Ochoa 1979; Flannery, Marcus, and Raynolds 1989; Browman 1990; Bonavia 1996; Aldenderfer 2001).

This paper is primarily concerned with the archaeology of early pastoralism in the Near East, but we will draw upon empirical, methodological, and theoretical developments pertaining to early and pre-modern forms of pastoralism in other parts of the world. This is to contribute to the existing database, to design more effective frames of reference essential in comparative studies of pastoralism, and to develop archaeological techniques of more efficiency in detecting and studying prehistoric strategies for pastoralism around the globe.

Definition and Terminology

In its broadest sense, pastoralism may be defined as dependence on domestic herd ungulates held and bred as a basis of subsistence of economy (Chang and Koster 1986). Unlike hunter-gatherer systems, in pastoralist systems, herd animals are accumulated wealth and represent the live resources of individuals and groups (Ingold 1980). In this paper, a number of terms are used more specifically as follows:

Pastoralism is a mode of production concerned with the exploitation of domestic animals. Pastoralism occurs in a continuum from sedentary (village-based herding) to highly mobile (nomadic) pastoralism (Fig. 2).

Mobile pastoralism is a form of pastoralism that involves movement of the herd beyond the immediate

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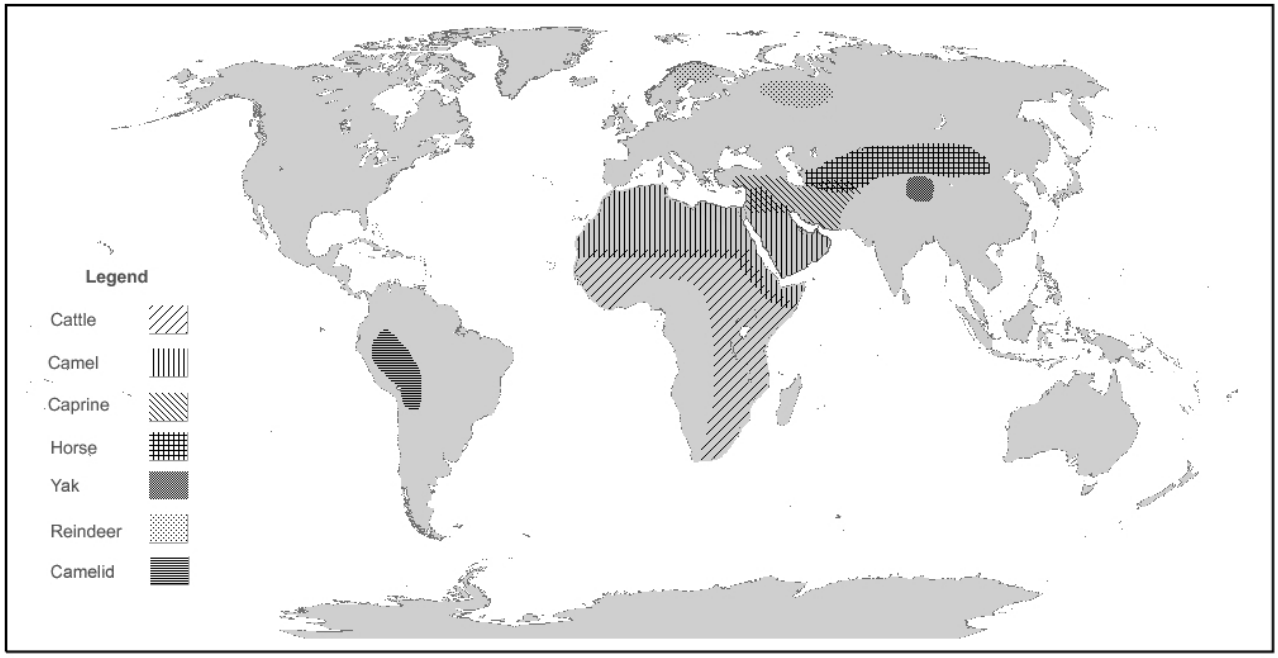

Fig. 1. Major traditional pastoralist complexes around the world.

surrounding of the sedentary settlement, usually more than one day's walk.

Nomadic pastoralism is a mode of subsistence (i.e., a way of living) primarily relying on pastoralism, involving high seasonal mobility and changing dwellings throughout the year by an entire social group, living in a succession of campsites along vertical or horizontal routes.

Key Factors in Pastoralism

Pastoralism entails human-animal interaction in a particular environmental context. Therefore, these three factors should be brought into consideration in any study of pastoralism. An environment amenable to pastoralism should be able to provide relatively easy access to pasture and sources of water. Sometimes, this can be achieved horizontally by moving the herd across a landscape from one pasture and water-hole to another, but sometimes pastoralists use vertical differences in floral coverage on a seasonal basis to achieve the same goal. Initiating pastoralism requires knowledge of the landscape and its resources by humans, but more importantly a fairly detailed understanding of animal ethology, especially their social structure, reproductive cycle, nursing behavior, and grazing habits.

One can argue that the most important factor in pastoralism is the existence of some 'key' animals to become the subject of pastoralist activities. A number of ecological conditions and cultural ideals determine the key animal(s) in a regional pastoral economy. Key animals must meet the following three criteria (Barfield 1993: 10-11):

1. The key animal(s) must be well adapted to the regional ecological conditions, so that large numbers can be supported without too much cost or effort.

2. The key animal(s) must be a necessary component of everyone's herd. An animal cannot become the cultural focus of a pastoral society if its ownership is restricted only to a small group of the society.

3. The key animal's pastoral requirements take precedence over other animals. The herd composition and pattern of migration is limited by which species is considered most important. When there is a mix of animals, the requirements of the key animal often determine the composition of the herd as a whole.

Pastoralism: Means of Production vs. Mode of Subsistence

Pastoralism can then be described as both a means of production and a mode of subsistence. **Means of production** is the act of production based on animals; **mode of subsistence** is the integration of productive strategies and social relations allowing the exploitation of natural resources and reproduction of the social groups involved (Cribb 1984). Therefore, a society may practice both pastoral means of production and agricultural means of production (see 'village based pastoralism' below), or a pastoral mode of subsistence may co-exist with an agricultural mode of subsistence, such as the co-existence of nomadic pastoralists and sedentary agriculturalists in an area, each using land and animals according to different systems, but both integrated into a wider regional economy (cf. Barth 1956, 1964; Swidler 1973).

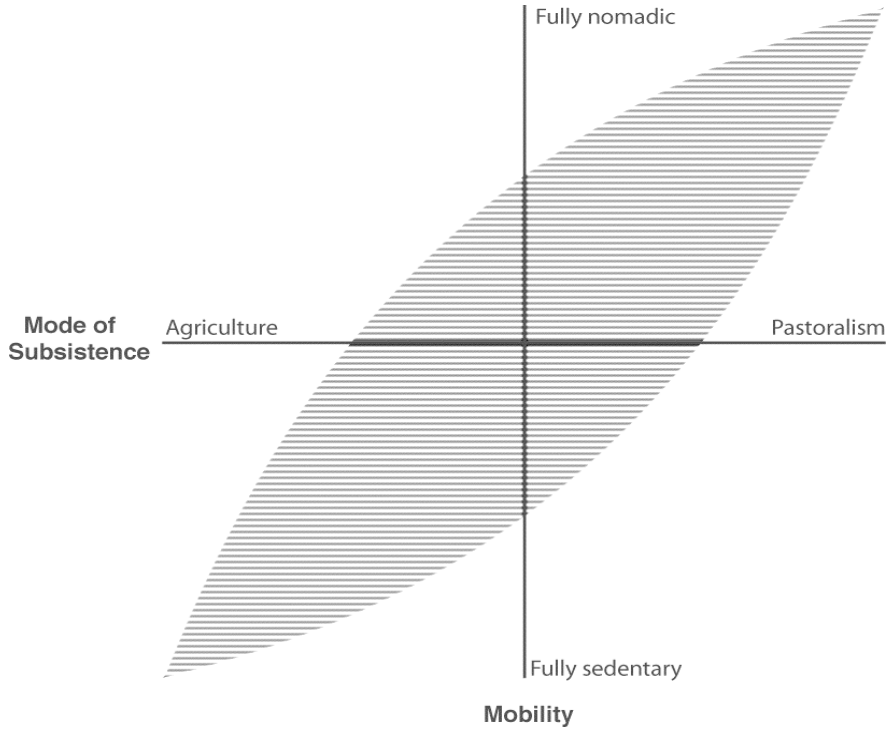

Figure 2. The relationship between mobility and the mode of subsistence (after Cribb 1994: Fig. 2.1, with some modifications)

We can therefore place social groups along an agricultural-pastoral continuum (Fig. 2) based on various factors such as the degree of dependence on pastoral production or to the extent their income is provided through pastoralism as opposed to other means of production (Cribb 1991a: 18). For example, village agriculturalists may keep a small herd without necessarily adopting all the elements of a pastoral mode of subsistence (cf. Dahl and Hjort 1976). But, with increasing emphasis on pastoral production, along with growing size and number of the herd comes increasing mobility (Salzman 1971) and specialized forms of herd management (Huntington 1972; Swidler 1972; Redding 1981), and changes in social organization (Marx 1977; Tapper 1979). The full manifestation of such a propensity towards pastoralism will ultimately involve a shift in logistics and social network leading to a new mode of subsistence characterized as 'nomadic' (Spooner 1971; Cribb 1991a).

Pastoralism in the Near East

Pastoralism has played an important and diverse social and economic role in the Near East since the domestication and widespread adoption of the primary herd ungulates – sheep and goat – in the Epipalaeoloithic to the Early Neolithic period. In some times or places the dominant economic pursuit and in other times and places a less significant aspect of production system, pastoralism has nonetheless always been an integral part of Near Eastern society and economy (Adams 1974; Bar-Yosef and Khazanov 1992; Bernbeck 1993; Cribb 1991a; Digard 1981; Flannery 1969; Marx 1977; Potts 2014; Salzman and Sadala 1980; Spooner 1973; Tapper 1979, 1998; Vardiman 1977). Especially in highlands of the Near East, such as the Zagros and Taurus Mountains, pastoralism was the dominant economic pursuit until the introduction of modern agricultural techniques less than a century ago (Amanollahi-Baharvand 1975, 1989, 1992; Barth 1961; Beck 1990, 2003; Black-Michaud 1974, 1986; Bradburd 1996; Lambton 1953; Marsden 1978; Oberling 1974; Stauffer 1965), providing pastoralists with an adaptive strategy to make more efficient use of the limited and dispersed resources of the highlands.

Apart from the dog, apparently the earliest animal to reach an understanding with humans (cf. Dayan 1994), the majority of contemporary Near Eastern pastoralists raise six or fewer species: sheep, goats, cow, horses, donkeys, and camels. Of these species, horse, donkey, and camel are more recent domesticates, used primarily as beasts of burden and do not concern us in this study. Pig, one of the earliest ungulate to be domesticated in the Near East (Kusatman 1991; Rosenberg *et al*. 1998; Peters *et al*. 1999; Albarella *et al*. 2006), is a good example of a species that failed to carve a niche for itself in Near Eastern pastoralism because it was not compatible with Near Eastern strategies of pastoralism, especially those that involve high mobility, as pigs do not readily form manageable herds, have

omnivorous feeding habits best met in forests or villages, require a moist environment, and have short legs that are not well adapted for walking long distances (Flannery 1983; Villa and Dallix 2004).

Although the Near East seems to be one of the main areas where cattle was first domesticated (Grigson 1989; Bradley and Magee 2006), cattle pastoralism too does not play a significant role in the Near East. Cattle is valued in the Near East for its higher production of milk compared to both sheep and goat, not to mention its manure and its use in agricultural activities such as plowing and threshing, as well as transportation (Sherrat 1981), but it is primarily a docile animal suitable for strategies of pastoralism with low to medium mobility, such as the one practiced in Africa (cf. Herskovits 1926; Marshall 1990; McDonald 1998).

Semi-arid environment and strong seasonality in rainfall make the Near East, especially its highlands, best suited for herding of small stock, particularly caprines. Complementary patterns of selective grazing by sheep and indiscriminant browsing by goats (Johnson 1969: 9; Spooner 1972: 122; Nyerges 1980) make this combination of species a useful one both in terms of productivity and stock management (Redding 1981). The species-specific tendency towards flocking among sheep (Garrard 1984) is exploited by pastoralists to concentrate animals in manageable groups, while the higher mobility of goats make them useful as flock leaders (Dahl and Hjort 1976: 250; Nyerges 1980). The choice of sheep or goats, or some combination of the two, may also be guided by economic factors. Goats, with their higher milk yields and shorter life cycle, are more suited to household subsistence needs, while sheep and sheep products tend to be of higher demand and value (Spooner 1972: 123; Stauffer 1965: 292; Redding 1984).

Trends in the Archaeology of Pastoralism in the Near East

Archaeological research on the early history of pastoralism in the Near East generally tend to focus on two pivotal turning points: (1) the domestication of basic herd animals (sheep and goat) in the Epipaelolithic to Early Neolithic periods (*ca*. 11,000-9,000 B.P.); and (2) the emergence of nomadic pastoralism, presumably sometime between the Middle Chalcolithic period and the Early Bronze Age (*ca*. 6500-5500 B.P.)

Archaeological research since the 1950s has furnished us with much information on the origins of food producing economies in the Near East, including the domestication of herd animals and early forms of pastoralism (cf. Braidwood 1952; Reed 1961; Flannery 1969; Hesse 1982, 1984; Blumler and Byrne 1991; Cowan and Watson 1992; Digard 1999; Hole 1989, 1996; Vigne *et al*. 2004; Zeder 1999, 2001, 2003; Zeder and Hesse 2000; Zeder *et al*. 2006). It is now more or less clear that the emergence of a food-producing economy consisted of two forms of economic activities: agriculture and animal husbandry. Recent research shows that early domestication of plants reached a turning point by sometime around 12,000 B.P. in the Levant (Bar-Yosef and Belfer-Cohen 1989; McCorriston and Hole 1991) and from there gradually expanded to the rest of the Near East through the so-called 'Levantine corridor.' Within a millennium or so, agricultural communities were established in the foothills and mid-elevations of the Zagros-Taurus Mountains where, in addition to early agriculture, gathering of wild plant resources and hunting of wild animals continued for several millennia. Once sedentary villages were established, the faunal evidence from many sites indicates a rather sudden increase in the percent of caprines by 9500 B.P. (Helmer 1989; Zeder 1994; Legge 1996) indicating domestication of sheep and goat and the emergence of village-based pastoralism (Bar-Yosef and Meadow 1995).

It seems that in the Near East food production developed out of greater exploitation of plant resources that increased in geographic range and density with the end of the Ice Age, as well as ungulates that were also dependent on these resources. Our understanding of the timing and tempo of this process is still far from perfect, so it is not entirely clear whether pastoralism developed after agriculture was established, as seems to be the case in the southern Levant (Horwitz *et al*. 1999; Köhler-Rollefson 1988, 1992) or whether pastoralism developed about the same time as agriculture, as in the northern Levant (Peters *et al*. 1999; Rosen 1992), southern Anatolia (Vigne *et al*. 1999), and probably the Zagros foothills (Hole 1989, 1996; Zeder 1999) or perhaps even independently of agriculture in some parts of the Near East, including the higher elevations of the Zagros (Bernbeck 2001).

The other major development in the early history of pastoralism in the Near East is the emergence of nomadic pastoralism. It seems that nomadic pastoralism developed independently in several different locations in the Near East, including The Arabia (Lancaster and Lancaster 1988; MacDonald 1991) the southern Levant (cf. Köhler-Rollefson 1992; Martin 1999), the Zagros (Henrickson 1985; Abdi 2003), and the Sistan basin (cf. Schiffer 1972). But the date when nomadic pastoralism emerged and became an established way of life is still subject to debate. For example, while there is a consensus among archaeologists that the Zagros Mountains was one of several regions where nomadic pastoralism first developed, estimates on the date when this shift took place range from the Neolithic period (Mortensen 1972; Zagarell 1989; Hole 1978) to the Late Chalcolithic period (Henrickson 1985) and the Early Bronze Age (Abdi 2003).

Not surprisingly, the economic and military significance attached to nomadic pastoralism has led to considerable

research on the origins of nomadism and its contribution to the course of Near Eastern history (Irons and Dyson-Hudson 1972; Nelson 1973; Castillo 1981; Gilbert 1983; Henrickson 1985; Cribb 1991a; Scholz 1995; Zagarell, 1989; Bar-Yosef and Khazanov 1992; Barfield 1993; Khazanov 1994; Potts 2014). As a new socio-economic formation, nomadic pastoralism came to play a significant role in shaping the course of ancient Near Eastern civilization (cf. Adams 1974; Rowton 1973a, 1973b, 1974), as well as more recent Near Eastern history (cf. de Planhol 1968; Khoury and Kostiner 1990).

Perhaps the most influential model on the origins of nomadic pastoralism, also applied to the Near East, is the one proposed by Lees and Bates (1974). According to this model, an initial pattern of mixed dry-farming and subsistence pastoralism was gradually replaced by a more specialized form of cultivation based on canal irrigation. The new system supported a growing population, but, since it is labor-intensive, problems occurred in scheduling agricultural and pastoral activities. As a consequence, pastoralism became confined to more marginal steppe and mountain regions where seasonal migrations of greater distance became necessary. However, the demand for specialized pastoral products from more densely populated areas assured the prospects of mobile pastoralism. Gradually, the distinct populations associated with each mode of subsistence developed their own sociopolitical configuration, one becoming nomadic pastoralist and the other sedentary agriculturalists.

Slightly different variations on the Lees and Bates model have been put forward by Spooner (1972: 126), Adams (1974), and Wright (1977: 388). According to these, the intensification of irrigation agriculture led those who were unable to successfully cope with the impending change to fall back on their pastoral resources, either temporarily until new agricultural opportunities arose or permanently as specialized pastoralism became a viable strategy. Another variant of the Lees and Bates model has been proposed by Irons (1975) and endorsed by Gilbert (1983), arguing that the growth of towns in the Near East created an increasing demand for pastoral products, leading to a portion of the population to shift to transhumant pastoralism and ultimately to nomadic pastoralism.

Strategies for Pastoralism

In general, relatively little is known about the early phases of pastoralism in the Near East between the establishment of village life in the tenth millennium B.P. and around 4500 B.P., when written texts begin to provide some information on the practice of pastoralism (cf. Edzard 1981; Szarzynska 2002). In the absence of such testimonies before 5000 B.P., we have to base our hypotheses on studies of various forms of pastoralism by historians, ethnographers, and geographers, to be tested against the relevant archaeological evidence.

There is no generally accepted typology for traditional pastoralism. Some anthropologists even express doubts that there is an advantage in having any typology at all (cf. N. Dyson-Hudson 1972; R. Dyson-Hudson 1972). Such doubts are somewhat supported by the great variation in pastoral activities due to environmental and social variables. But a classification of basic forms of pastoralism is useful in highlighting the main characteristics of a given society and to seek distinct signatures for each general type in the archaeological record. It has to be stressed, however, that these are 'ideal-types' (*sensu* Weber) to assist us in isolating the key dimensions of pastoralism and detecting their archaeological signatures.

For the purpose of this study, the factors used to define variations in pastoralism include the degree of mobility, division of labor, and social organization.

Village-Based Pastoralism

This is perhaps the most basic strategy for pastoralism, still practiced in many rural parts of the world, including the Near East (Dahl and Hjort 1976). In fact, village-based pastoralism is of particular interest to students of the ancient and modern Near East, as it has usually been taken as the archetype of settlement and land-use characterizing the Near East from the emergence of early farming communities in the early Neolithic period to the present.

Based on the distance covered by the herd and herders, one can divide village-based pastoralism into 'proximate' and 'distant' forms. In proximate village-based pastoralism (Fig. 3), during the warmer months of the year, the herds graze in pastures and fallow fields adjacent to permanent settlement and usually return to their pens every evening. During the colder months of the year, the herds are kept in pens and fed with fodder collected and stored during the harvest season or procured otherwise. This form of pastoralism is, however, not the basic foundation of the subsistence economy, but supplemental to agricultural production. As a result, the size of the herd is small and management is usually entrusted to younger members of the household whose presence is not absolutely necessary during the more important agricultural activities.

The organization of proximate village-based pastoralism in time and space is closely connected to agricultural needs and dependent on seasonal availability of fodder for the herd. For example, in order to avoid damage it is imperative that the herd must be kept away from cultivated areas when the crops are growing. However, more often than not, there are insufficient grazing grounds near villages. Further, productivity, as well as accessibility, of different pastures vary during the year, which leads to the necessity of periodic movement of the herd through pastures at various

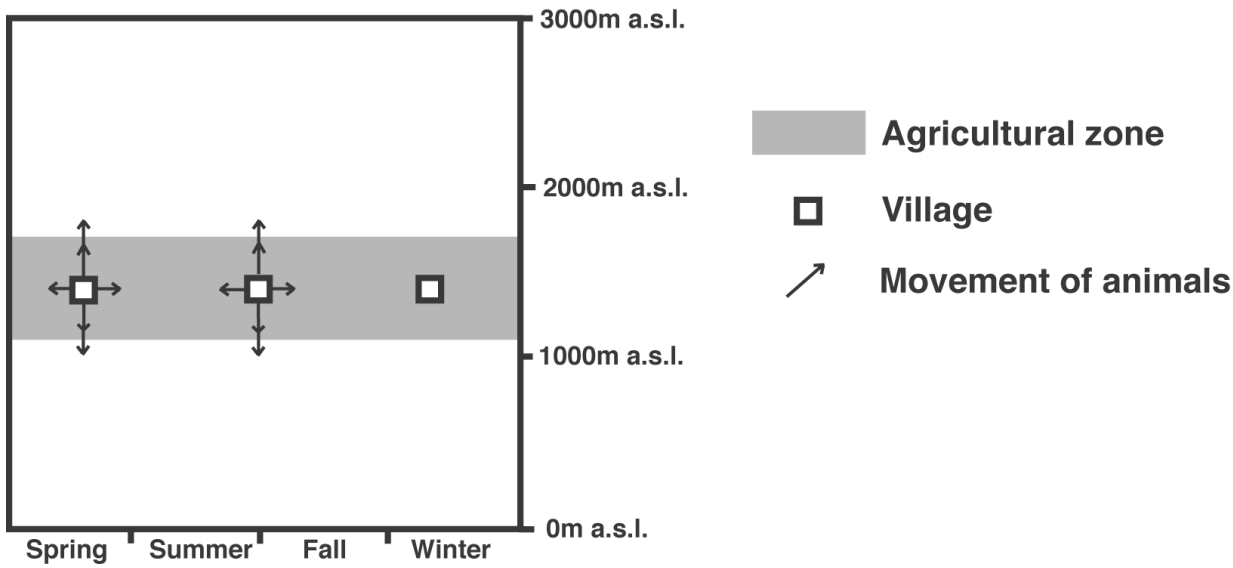

Figure 3. Schematic diagram of proximate village-based herding in the Zagros.

elevations to allow the animals access to diverse fodder resources. Longer travel to access pastures leads to another strategy, i.e., distant village-based pastoralism.

Distant village-based pastoralism (Fig. 4) describes a strategy in which the distance traveled by the herd to pastures is greater than one day's travel, so the herd remains in pasture for a longer period of time, usually not exceeding more than a few days, before returning to the village or camp to be milked for example. Longer travel is required when a greater portion of the agricultural zone is brought under cultivation, thereby increasing the distance that must be traveled to reach pastureland. In forms of distant village-based pastoralism that involve not too much travel, the herd may still be trusted to one or two members of the household, usually young adults, who are capable of caring for themselves and the herd. In this strategy, the majority of the population still continues to lead a sedentary life in the village, occupied for the most part with agricultural activities.

One can argue that a new strategy of pastoralism, transhumance, has emerged when the herd, or more often part of it, is maintained for a longer period of time – anywhere from a few days to most of the year – on pastures, sometimes quite far from the settlement, tended not by young adults, but by herdsmen specifically assigned to this task.

Transhumant Pastoralism

Transhumant pastoralism is a specialized form of pastoralism that allows people occupied with agriculture in specific ecological zones, especially in mountainous regions (Price 1981; Grötzbach 1982; Grötzbach and Stadl 1997), to use other areas as seasonal pastures when they are at their most productive time. In this strategy, the herd is kept on mountain pastures during warmer parts of the year and driven back to lower zones during colder seasons.

Described about a century ago as a regional pastoral practice in southern France, *transhumance* has come to acquire global application and many different connotations in recent decades. Sometimes it is used interchangeably, and erroneously, one might add, with nomadic pastoralism, and sometimes it is used to describe pastoral practices linked to certain ethnic groups (Vidal de la Blache 1922; Jettmar 1960; Martin and Sanz 1998; Ponz 1988; Rinschede 1979, 1984, 1988; Husain 1998).

Transhumance involves seasonal migration of the herds between summer pastures in the mountains and winter pastures in the lowlands. But, apart from its higher mobility, and more importantly, it is the organization of labor that sets transhumant pastoralism apart from other forms of pastoralism. Due to difficulties and perils of moving a herd over a long distance along varied terrains, the shepherds engaged in transhumance are not adolescents or younger adults from households owning the herd (contra 'Village-based Pastoralism' above). Neither are they necessarily closely related to each other to form a group of relatives managing their common property (contra 'Nomadic Pastoralism' below). In contemporary examples of transhumant pastoralism, shepherds are often wage laborers hired by the herd owners (Beck 1980). In southern France (Provence), for example, only a small part of shepherds originate from the native region of transhumance. Usually they are recruited from other regions of the same

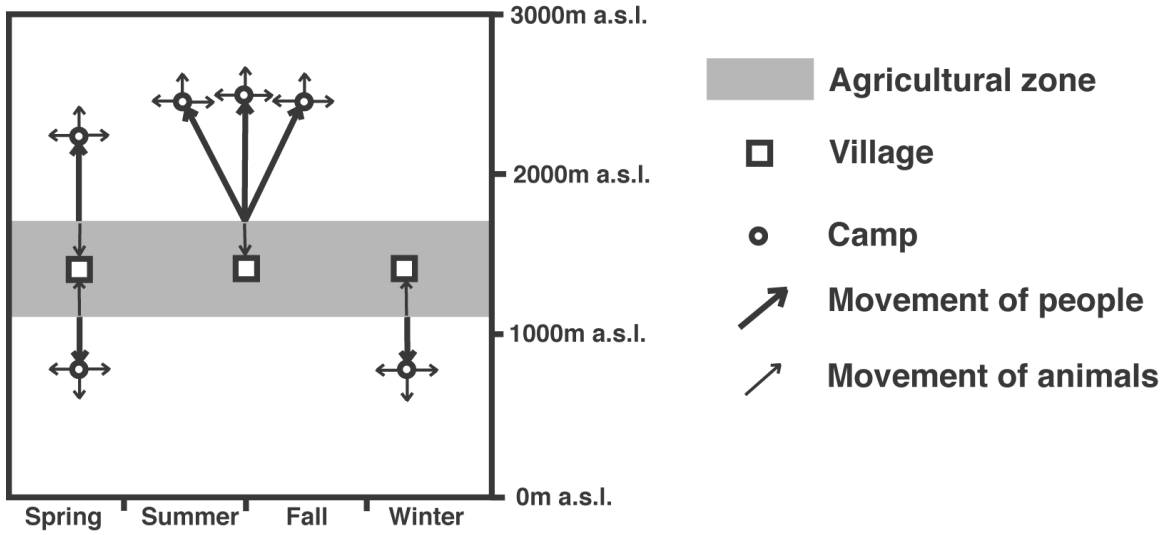

Figure 4. Schematic diagram of distant village-based herding in the Zagros Mountains.

country, from other southern European countries, and from North Africa. A demographic study (Rinschede 1979) of shepherds by nationality in the Provence from the early 1970s showed that 57% were Italian, 35% French, 3% Spaniard, 2% Portuguese, and 2% Moroccan. In the French Pyrenees and in Andorra the shepherds are predominantly of Spanish nationality. In the Spanish Pyrenees many shepherds are from the interior provinces of Spain. For more than a century in the American West, shepherds of Basque origin were the backbone of the sheep industry. With their knowledge of Spanish transhumance and the experiences they had gathered in the South American Pampa, they were especially qualified to practice transhumance between summer ranges in the mountains and winter ranges in adjacent steppes and deserts (Rinschede 1984). As a rule, hired shepherds are neither related to herd owners, nor do they have livestock of their own. Herd owners, on the other hand, can be farmers or non-agrarian entrepreneurs. In terms of management, the year-round migration between different grazing grounds is independent of other economic activities of the herd owners. If they are farmers, their farm management and agricultural activities are not related to their livestock. However, herd owners sometimes provide shelter and grazing on their fields after harvest or on meadows. Common-property pastures are usually utilized in the mountains (Price 1981), while customary rights or contracts with residents in the lowlands establish the winter grazing conditions (Jettmar 1960).

The use of hired shepherds as wage laborers observed in contemporary examples of transhumance is a possibility with monetization and wage systems. In a non-market situation, such as prehistoric cases, the same effect can be achieved through kin and pseudo-kin links. In other words, members of an extended household may be selected for carrying out transhumant activities.

A major marker of transhumance is its patterns of movement and settlement. Based on the number of stations one can distinguish two major types of transhumance (Fig. 5): uni-stationed and dual-stationed (Rinschede 1988). From the viewpoint of the starting area and the location of the base ranch, uni-stationed transhumance has only one permanent operation station in the plains, in the foothills, or in the mountains. Ascending transhumance (i.e., transhumance from the lowland settlement) has its base ranch and winter ranges in the plains or foothills, and uses summer ranges in the mountains. Descending transhumance (i.e., transhumance from the mountain settlement), on the other hand, send out the livestock from the higher elevation summer ranges close to the base ranch to spend the winter in temperate lowlands. Intermediate stationed transhumance has a base ranch in the region of transitional ranges in the foothills and has to partly cover equally long distance to summer ranges in mountains and winter ranges in lowlands.

In contrast to the uni-stationed form with only one permanent operation station, dual stationed transhumance has two equivalent permanent stations (base ranches) in the mountain and in the lowlands, i.e., one livestock station at each end of the seasonal movements. This form derives mostly from ascending and descending transhumance by using a second, usually abandoned ranch close to seasonal range.

Transhumant pastoralism is connected with environmental conditions. The most important factor is the natural contrast of climate and vegetation between agricultural zone, lowland, and mountain regions.

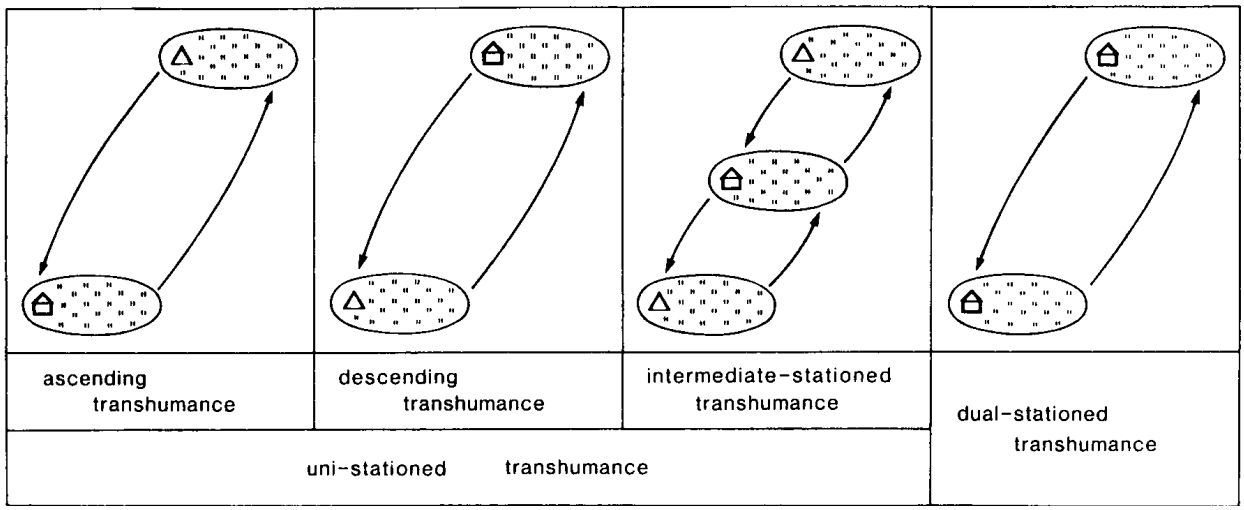

Figure 5 Schematic diagram of different modes of transhumant pastoralism (after Rinschede 1988: Fig. 7.1).

This applies to transhumance in all climatic zones, for transhumance is a global phenomenon and is to be found in all continents between the equator and the fiftieth parallel north and south. Accordingly, one can distinguish between tropical and extra-tropical (mainly Mediterranean) transhumance (Beurmann 1967).

In tropical transhumance, the wet seasons are important for the change of seasonal pastures. With nearly constant temperatures, the droughts and the rains determine the start of the herd movement. There are regions where the herd may stay in the savanna during the rains and ascend in winter to the humid mountain regions. In other regions, the herd, forced by heavy rainfall and flooding, leave the lowlands for higher and dryer regions until they descend again when the flooding recedes in winter. Tropical transhumance is now can be found in Colombia, in the Andes below 27°, southern Ethiopia, Kenya, and Rwanda (Rinschede 1988).

In extra-tropical transhumance, that shows more variation, the seasonal movements occur primarily according to the thermal rhythm of the year. Low and high temperatures and a different distribution of precipitation determine the patterns of movements of livestock. The lowlands are mostly humid in winter, nearly snow-free, and mostly dry in summers. The mountain regions, on the other hand, are cold in winters, snow-covered, as well as humid and snow-free in summers. Because of summer droughts, especially in the subtropics, ascending transhumance moves from lowlands to the mountains and returns from the mountain ranges before the first snowfall. Descending transhumance is especially connected to climatic and orographic conditions, as it keeps more livestock than it is able to feed during winter in the mountains.

Besides these natural factors, transhumance of the extra-tropics owes its existence to a number of agro-economic factors. These are especially important in ascending transhumance, for the intensive cultivation on the base ranch allows no grazing during the main vegetation period. Owners of herds, therefore, entrust the livestock to the hired men to herd on the mountain range, while they themselves and their household are engaged in agricultural activities.

Extra-tropic transhumance is to be found in nearly all regions of the young folded mountain belt of Eurasia and North Africa: the Atlas, Pyrenees, mountains of Spain and Portugal (Cordillera Cantabrica, Sierra Nevada, etc.), French, Italian, and Swiss Alps, Dinara Plania, Carpathians, Balkan Mountains, Pindhos Oros, Pontic and Taurus, Zagros, Hindukush, Kashmir, Himalaya, and Tien Shan (cf. Beurmann 1967; Jettmar 1960; Husain 1998; Martin and Sanz 1998). On the North American continent, where transhumant pastoralism was introduced more recently, it is now can be found in nearly all mountains of the West, especially the Rocky Mountains, in the Sierra Nevada, on the Colorado Plateau, in the Cascade Range, and in the Great Basin (Rinschede 1984). In the South American Andes, it is widespread in the Argentinean province of Neuquen and in the Chilean province of Cautin (Rinschede 1988). Transhumance-related forms of migratory livestock rearing are also to be found in Drakensburg in South Africa (Quinlan and Morris 1994), Great Dividing Range in Australia (Davidson 1994), and in the New Zealand Alps (Hatch 1992).

Semi-Nomadic Pastoralism

Semi-nomadic pastoralism marks the shift from an agriculturally-oriented economy to one based more on pastoralism. Semi-nomadic pastoralism is characterized by extensive herding and a periodic change of pastures

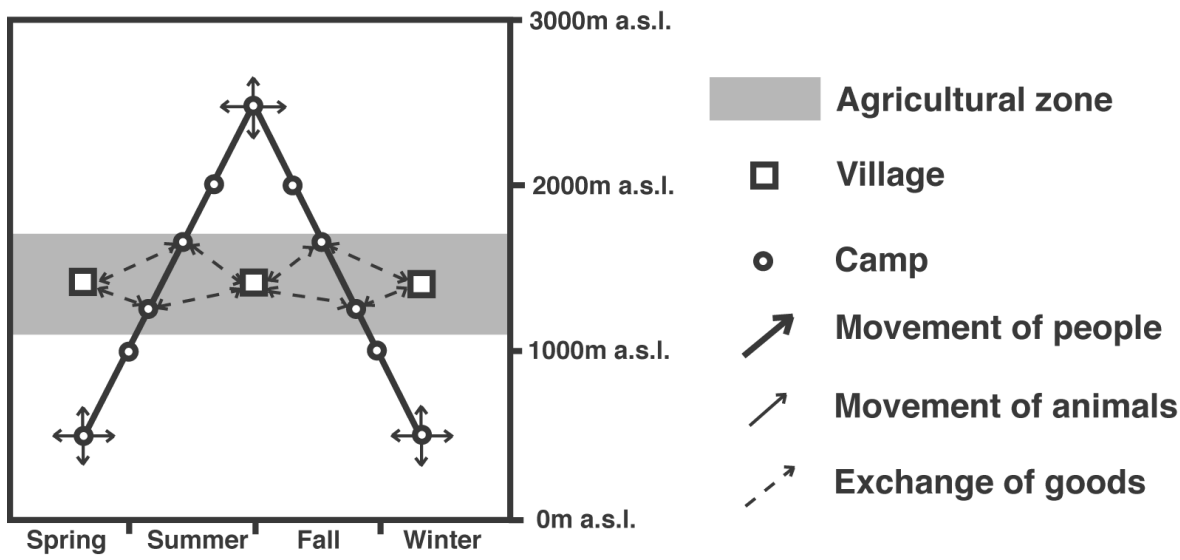

Figure 6. Schematic diagram of nomadic pastoralism in the Central Zagros Mountains.

during the course of the entire or greater part of the year (Johnson 1969). In this strategy, although pastoralism is the predominant activity, there is also agriculture in a secondary and supplementary capacity (Vincze 1980). The following seem to be the most important and common variants of semi-nomadic pastoralism: (1) the entire group is occupied with both agriculture and pastoralism; and (2) within a society, there are groups who devote their time primarily, or sometimes exclusively to pastoralism, alongside groups who are primarily occupied with agriculture. In the latter variant, the men usually move with the herd and the women remain in one place, occupied with agriculture (Beck 1998).

From an economic point of view, semi-nomadic pastoralism and full-fledged nomadic pastoralism are closely connected and often interdependent, forming many transitional states that depend on local, historical, and environmental conditions (Barth 1956). In some situations, semi-nomadic pastoralism can be a relatively stable economic system and therefore function for a long time in a more or less immutable form (Amanollahi-Bavarvand 1992). But, in other situations, semi-nomadic pastoralism can be a transitional stage between nomadic pastoralism and a mixed economy or vice versa.

Nomadic Pastoralism

This strategy for pastoralism is characterized by high mobility and an almost complete absence of agriculture, even in a supplementary capacity. There are only a few ethnographically attested examples of full-fledged nomadic pastoralism, especially in regions with little or no agricultural potential, including northern Eurasia (Vainshtein 1980) and High Inner Asia (Ekvall 1968). However, even in those areas, nomadic pastoralism occurs with other forms of subsistence, including agriculture in more productive areas, and semi-nomadic pastoralism (Krader 1959; Dyson-Hudson and Dyson-Hudson 1980). In fact, what is usually being described as nomadic pastoralism in the literature is a semi-nomadic strategy with greater emphasis on pastoralism than on agriculture with labor activities predominantly based on animal husbandry.

What is important in nomadic pastoralism is the fact that the whole group, tied by strong kinship relations (Marx 1977; Digard 1987), covers considerable distances during their seasonal migration between suitable and accessible pastures (Fig. 6). As a rule, they distinguish themselves from their neighbors and business partners as a social group (Horowitz 1972). Nomads use pasture for which they claim rights of access based on customary law (Bates 1972). When grazing on private lands, however, the owner of the land is compensated for its use. In addition, barter trade with farmers provides other goods, especially grain, which still provides most of the nomad diet. Nomads traditionally engage in a number of side activities beyond animal husbandry, such as transportation, trade, or other services, such as work as guards, guides, or mercenaries. The absence of permanent settlements and village lands results in a mobile society in which moveable property, characterized by a portable black tent (Feilberg 1944; Edelberg 1966-67; Faegre 1979), provides shelter in grazing grounds.

Seasonal movement is perhaps the primary defining characteristics of pastoral nomadism. The factors influencing seasonal migrations are varied. Although scholars agree on the ecological need as the fundamental

factor in movement, different scholars stress a range of different factors. On one level, the need for migration among nomadic pastoralist groups is related to seasonal availability of pasture and water, factors affecting such crucial aspects of the migration cycle as timing of migrations, ultimate destinations and length of stay, group structure during different seasons, and travel routes are far more complex. To a degree these can be classified as either ecological or socio-economic.

Using patterns of movement based to large extent on ethnographies of the Ruwalla of Arabia (Musil 1927, 1928) and the Basseri of Iran (Barth 1961), Johnson (1969, 1978) has proposed two basic types of nomadism: horizontal and vertical. Horizontal nomadism involves the exploitation of vast, ecologically relatively undifferentiated tracts, requiring long-distance migration to provide adequate pasture. Vertical nomadism, on the other hand, is the exploitation of ecological differences caused by variation in altitude. Physical geographical features, such as natural passes, also play a role in this typology.

Socio-economic factors play an important role in determining the migratory pattern. Bates (1973: 130-3) has noted that Yörük migrations are scheduled to: (1) exploit field stubble, (2) minimize conflict with farmers, and, perhaps as a byproduct (3) manure fields. Benkhe (1980: 117-168; see also Johnson 1973: Figure 9) has demonstrated that although migrations are essentially vertical in Cyrenaica, they are really restricted by vertical tribal territorial borders, running more-of-less parallel to one another. Black-Michaud (1986: 181-192) has emphasized the variability in migrating patterns caused by external economic pressure and politics.

Nomadic traditions have changed tremendously in recent decades. Pre-planned and forced sedentarization of nomads by states, the introduction of permanent winter camps, agrarian reforms, and socio-economic changes have resulted in adjusted and comparatively confined migration cycles (for an example among the Qashqai of Iran see Beck 2003, for Maasai of Tanzania see McCabe *et al*. 1992). These factors have contributed to a controlled mobility with features of permanency such as houses and stables in community settlements. The expansion of crop cultivation and village lands, the reduction of available space and the progression of bureaucracy have limited the territory and pastures available for nomads. Territorial, political, and private delineation of boundaries increased the phenomenon of 'closed frontier nomadism' (Shahrani 1979).

How Can Prehistoric Pastoralism Be Detected?

The various forms of pastoralism outlined above are primarily based on geographic studies, ethnographic observations, and historical records. Using these sources as a basis, we can devise a set of signatures to identify different strategies for pastoralism in the archaeological record. These signatures can be divided into five general categories: archaeozoology, archaeobiology, archaeochemistry, archaeobotany, and spatial patterns and site distribution. Only archaeozoology can offer us direct evidence for pastoralist activities, whereas the evidence furnished by other approaches is indirect but can nonetheless be used in making inferences about prehistoric strategies of pastoralism.

Archaeozoology

Archaeozoology is the most direct approach for the study of ancient patterns of pastoralism. Some more detailed commentary on archaeozoological methodology is therefore warranted.

In the past fifty years, archaeozoology has come a long way from basic identification of animal remains from archaeological excavations to an elaborate set of techniques with a sophisticated theoretical and methodological framework (Grayson 1973; Klein and Cruz-Uribe 1984; Reitz and Wing 1999; O'Conner 2000). By studying animal remains from archaeological contexts, archaeozoologists hope to develop an impression of how humans interfered in the life cycle of animals and incorporated them into their subsistence and culture.

Obviously, as animal remains go through the long transition from being part of a living organism to making their way into an archaeological context and then to an archaeozoologist's lab, they undergo a wide variety of changes. It is often the case that the remains deteriorate in quality and quantity, sometimes disappearing completely.

Let us consider the example of a domestic goat living in a small village in the Near East in the Neolithic period. At some point, the villager who raised this goat decided to kill it and make use of its meat. The goat it thus killed, skinned and butchered into smaller portions. Some of the bones were probably left where the animal was butchered while other bones were removed because they were still attached to desirable chunks of meat. After the pieces of meat were cooked and consumed, the bones were discarded one way or another depending on the degree of tidiness: perhaps they were simply thrown to the ground by the satiated villagers, or they may have been discarded in a trash pit or a midden. Once again, the bones from the live goat became more scattered. The bones left on the ground become subject to tossing and trampling by humans and other animals, gnawing from rodents and scavenging of carnivorous animals, not to mention weathering from natural elements. Eventually, the bones are covered with sediment. Then post-depositional taphonomic processes like ground moisture, soil pH, and plant roots set in and continue to change the form and composition of the

bone. The dense bones and teeth may survive relatively unscathed, but more delicate bones may be partially or completely destroyed.

Seven thousand years later, what is left of the bones of our Neolithic goat is discovered in an archaeological excavation. Depending on the excavation techniques, the kind of tools used for excavations (small vs. large pick, shovel vs. trowel), size of the screens employed, and the thoroughness of the team members, only a portion of the bones deposited in the ground will be discovered and only fragments of a certain size (depending on the experience and judiciousness of the staff archaezoologist) will actually be saved for analysis. Of course, some bones will be mislabelled, misplaced, or become more fragmented between the time they are recovered and the time they are studied in a laboratory. Therefore, out of more than two-hundred bones of a living Neolithic goat, perhaps only several small fragments would find their way to the desk of the archaeozoologist.

Not surprisingly, archaeozoologists rarely publish all the data they collect from studying the faunal remains, instead providing a commentary on general trends in the assemblage. With the prolonged process of transformation and biases involved in the recovery process, the primary objective of an archaezoologist is to identify each bone specimen recovered from a site as precisely as possible. Ideally, one could determine the species, age, and sex of each specimen, but such precise designations are rarely possible. Therefore, many specimens are assigned to more general categories. For instance, archaeozoologists often recover small fragments from the diaphysis of limb bones without any feature that would indicate the age, sex, or even the species of the animal. In such cases, the fragments are assigned to size categories based on the thickness of the bone and its general curvature. In this way, one can determine whether each fragment was part of a bone from a large or a small animal.

One of the primary concerns during the process of data collection relates to sample size. The smaller the sample, the less likely it would be representative of the assemblage as a whole. In small samples, some species are likely to be overrepresented while others might not be represented at all. Plainly, the validity of any analysis that goes beyond simple identification of specimens strongly depends on an adequate sample size. Archaeozoologists working with material from ancient settlements in Greenland have determined that after they had collected 300-400 bone specimens, the number of species and the relative significance of each species did not change, even if more specimens continued to be collected (Amarosi *et al*. 1996: 133). Hence, a sample size of 300-400 bones seems to have been adequate in assessing animal exploitation in a site in Greenland. Of course, the size of this minimum sample size most probably varies significantly between regions with different exploitation patterns and depositional environments.

Upon identifying all of the bone specimens and considering the limitations of taphonomy and sample size, archaeozoologists then conduct analyses of their primary data. Such analyses include the evaluation of relative species abundance, the construction of a mortality profile based on the age and sex ratios of the assemblage, and an assessment of the body part distribution. These indicators yield additional information about herding strategies and are particularly useful when assessing chronological change across the strata of a single site or when comparing two different archaeological sites for evidence concerning the specialization in pastoral activities (cf. Mashkour and Abdi 2002).

The relative abundance of each species can reveal information about herding decisions, potential economic specialization, and even the quality of local pasture. For example, a faunal assemblage in which cattle predominate may indicate the presence of relatively good pasture since cattle require more fodder than the caprines. Of course, the relative species abundance is also subject to a whole host of ecological, physiological, and cultural constraints. With such considerations in mind, archaeozoologists evaluate relative species abundance using a variety of methods depending on the objective of the analysis (Ringrose 1993; Lyman 1994). Two of the most common methods are described below.

The first method is the Minimum Number of Individuals (MNI) count, whereby an archaeozoologist would establish the minimum number of individuals represented by each species in the assemblage based on unique bone elements (e.g., intact crania, atlas vertebrae, and sacrum) or lateralized bone elements (e.g., left vs. right proximal or distal femur, humerus, tibia) (Uerpmann 1973; Poplin 1976, 1978-79; Grayson 1984; Cruz-Uribe 1988). As a simplified illustration, if one finds five intact goat crania (and all other unique and lateralized elements are found in equal or lesser numbers), then the MNI for goat is five. However, bones from significantly more than five goats may be present at the site, since the taphonomic processes may have destroyed their unique or lateralized bone elements (in this case, their crania). Thus, the MNI method is most useful in contexts such as a buffalo jump where a high proportion of skeletons have remained intact or even fully articulated. Conversely, the MNI is not very useful in contexts where taphonomic processes have significantly altered assemblages over time (Grayson 1973). In such cases, the MNI is not an accurate estimate of the original number of animals, and any assessment of relative species abundance is severely biased by taphonomic processes (Chase and Hagaman 1986: 75).

A second method used to evaluate the relative species abundance attempts to reconcile this shortcoming and

involves tallying the Number of Identified Specimens (NISP). Using this technique, one counts all of the bones (whether complete or fragmented) that can be identified as one specimen (such as goat) and compares that number to the number of identifiable bones from the other species present. This technique is intrinsically biased towards species with more bones in their body or skeletons that were more fragmented through butchery. However, this technique offers a useful tool for comparison between species that are relatively similar in physiology (i.e., ungulates) and have been subject to similar processes after death (i.e., butchered for meat and then bones discarded as trash). Despite certain distinct anatomical traits, it remains particularly difficult to differentiate between the bones of sheep and goat, and the NISP for these species generally represent an aggregate of both. While the NISP is only a proxy measurement for absolute abundance of each species at a site, it allows for functional comparisons between and within faunal assemblages.

The MNI method is better suited for assemblages containing nearly complete skeletons of many individuals. The number of individuals in an assemblage is only important if one is certain that there has been relatively little bone attrition. For midden deposits where the bones have been heavily processed for their meat, the NISP indicator is more appropriate. Under such conditions, one can assume that most animals present in a prehistoric farm have not left any trace at all (Amarosi *et al*. 1996: 138). The NISP is also the least mathematically transformed and therefore the most suitable for comparative statistical analysis (Amarosi *et al*. 1996: 135).

Difference in age and sex ratio yield insight into strategies of herd management. Using epiphyseal fusion and mandibular dental eruption/wear patterns to assess age and sexually dimorphic features to determine sex, archaeozoologists are capable of establishing a mortality profile that describes the broad demographic features of a faunal assemblage at the time of death (Prummel and Frisch 1986). Applying these demographic trends to address questions of herd management, one can determine whether a faunal assemblage represents animals killed during hunting forays or animals culled from a domestic herd.

Under a hunting strategy, one assumes that humans often operated opportunistically, trying to procure the maximum amount of meat while expending the minimum amount of effort. Thus, the faunal assemblages should have a 'prime-dominated' mortality profile, in which animals in the prime years of their life (with the maximum amount of meat) are predominant, with older animals represented in moderate proportions and very few young animals. Ideally, the sexes should be represented in equal proportions.

A faunal assemblage culled from a domestic herd, on the other hand, should consist of predominantly adolescent males that are ideal because they can be culled without affecting the overall stability of the domestic herd. For caprines, these adolescents should be aged anywhere from nine months to four years, depending on the particular site and the trade off between meat yield and forage investment (Zeder 1994: 107).

Once it is established that the bones represent members of domestic herd, one can discern more information about the nature of the herd. If the adolescent animals were culled at the earlier end of the spectrum, this implies a strategy of herd management that emphasizes meat production. Conversely, if the adolescents are culled towards the latter end of the spectrum, then this is an indication of herd management that placed greater emphasis on secondary products. Again, mortality profiles should also be regarded with scrutiny since they are subject to variations caused by natural ethology of the animal in question, as well as potentially selective human behavioral patterns and the discrepancies of archaeological accumulation (Hesse 1982: 414).

It has been noted that elements of the caprine post-cranial skeleton demonstrate a proportional relationship according to sex, providing a criterion with which to separate an assemblage into male and female sub-populations (Zeder and Hesse 2000). Aging these bone elements based on the status of their epiphyseal fusion, one can then establish profile for both the male and female sub-populations. With a domestic herd, one can expect the mortality profiles of the sexes will be dissimilar since the males are generally killed at a much younger age than the females. Therefore, by comparing these two mortality profiles, one can most accurately assess strategies of herd management. However, in a faunal assemblage that may contain goat, sheep, and gazelle, proportional relationships may be indicative of differences between the species rather than differences between the sexes. Therefore, this technique is best utilized on bones that can reliably be identified to species level. However, it is often difficult to distinguish between sheep and goat (Clutton-Brock *et al*. 1990; Helmer 2000; Halstead *et al*. 2002) and it is certainly challenging to establish a proportional relationship that is valid for a given local population without first establishing an extensive local reference collection. Both of these factors limit the practical application of this technique.

In recent years, archaeozoology has witnessed major empirical, methodological, and theoretical developments in the study of prehistoric patterns of pastoralism. Apart from significant advances in the past ten years in the study of the process of domestication (cf. Vigne *et al*. 2004; Zeder *et al*. 2006), in the past few years, archaezoology has experienced yet another quantum leap, developing several new avenues of research. More recent archaeozoological studies have pushed the envelope beyond mere subsistence studies, beginning to explore the health and diet of ancient

herds (cf. Davies *et al*. 2005), and to study the roles the animals may have played in broader cultural aspects of ancient societies (cf. O'Day *et al*. 2006). Not surprisingly, man's best friend, long considered to be the earliest domesticate, has been a focus of much research (cf. Serpell 1995; Snyder and Moore 2006).

Perhaps the most important development in recent years in studying the mobile strategies of ancient pastoralism is made by a team affiliated with CNRS (cf. Bocherens *et al*. 2001; Richards *et al*. 2003; Mashkour *et al*. 2005). By developing a model for isotopic values of the caprine teeth from contemporary nomadic communities in the Near East (especially among the Bakhtiari) and comparing that with samples from archaeological contexts in the Iranian Zagros, Marjan Mashkour has been able to determine an isotopic variation in caprine teeth, with emphasis on ^{13}C and ^{18}O, that point to patterns of vertical transhumance (cf. Mashkour 2004). The premise for this observation is that the floral coverage and water consumed by herds in the lowlands vs. the highlands has a different isotopic signature hat can detected in animal bone, especially in its teeth crown. Once this isotopic pattern is identified in the archaeological sample it can be compared with the modern dataset to establish a pattern of vertical movement.

As new research topics in archaeozoology begin to emerge, progress is also being made in already established topics such as aging and sexing (Ruscillo 2005), taphonomy (O'Conner 2005), and studies of secondary animal products such as fat, oil, milk and diary products (Mulville and Outram 2006; Balasse 2002, 2003; Balasse and Ambrose 2005a-b; Balasse and Tresset 2002; Balasse *et al*. 2000, 2002, 2003, 2005). The latter avenue of research has been picked up by archaeologists other than archaeozoologists, especially by those concerned with chemical analysis of archaeological material, especially ceramics, with considerable degree of success. Some of these developments are discussed further below under 'Archaechemistry'.

Archaeobiology

Archaeobiology is the study of biological aspects of human behavior from the perspective of human remains from archaeological contexts (cf. Larsen 2015). Human remains can provide much information on demography, diet, nutrition, mechanical stress, health and diseases of ancient population. While most archaeobiological studies are concerned with short-term effects in human remains, some can be used to study long-term changes that may result from transitions in subsistence economy that in turn alter patterns of human activity and diet (cf. Larsen 1995).

The emergence and spread of farming – agriculture and pastoralism – is a celebrated benchmark in human history, described as one of the most important research topics in archaeology (cf. Smith 2001). With more work input farming is typically capable of producing more food-stuff than foraging. Further, it indirectly allows shorter birth intervals (Buikstra *et al*. 1986). A combination of these two factors – i.e., higher birth rate and more food – created a momentum for population increase as farming spread around the world, paving the way for settlements to grow in size, ultimately leading to the emergence of cities and allowing people to live in high densities in tight spaces, a hospitable environment for all sorts of diseases to thrive. Less celebrated is the fact that the emergence and spread of farming introduced many detrimental effects into human communities: compared to their forager ancestors, farmers were smaller in stature (which, depending on one's subsistence activities, may in fact be an advantageous change), experienced shorter life expectancy (considered by many to be a disadvantage), and suffered from many deficiencies and occupational stresses such as strain injuries, fractures, and arthritis caused by grueling farming tasks (definitely a disadvantage).

An important side-effect of domestication of animals has been the introduction of many zoonoses (diseases contracted by humans from animals) (cf. Cohen and Armelagos 1984; Karlen 1996; Barrett *et al.* 1998; Ewald 1994, 1999). To name but a few zoonoses, one can think of several different kinds of viral poxes, tuberculosis, and measles that came from the cattle, pertussis (whooping cough) and influenza from the pig, and rhinoviruses from the horse. Apart from herd animals, humans contracted many diseases from pet animals, including pertussis from the dog, cat scratch fever from the kittens, and tularemia from rabbits. To this list one can add all sorts of other enteric diseases, usually bacterial or parasitic in origin, e.g., rabies, salmonella, cryptosporidium, girdalia, treponematosis (syphilis, pinta, and yaws), and leprosy.

Some ten thousand years later, diseases contracted by humans from animals show no sign of abating. Most recently, humans contracted HIV from the sooty mangaby monkey, lyme disease from deer ticks, and food and mouth disease from the cattle. Recent avian and sw flu pandemics, has already raised fears of a global flu epidemic capable of killing hundreds of thousands, if not millions.

There are however two problems with identifying diseases contracted from animals by humans: first, infection by a pathogen does not always result in disease. The progress from infection to disease depends on pathogenicity of the agent, method of transmission, and the nature and strength of the response by the host (Inhorn and Brown 1990; Smith and Moss 1994). Second, and perhaps more importantly in terms of archaeological identification, is the fact that many infectious diseases result in quick death that leave no skeletal trace, thus hindering an understanding of the full process of the disease including its source. Sometimes, however, the individual survives the initial

pathogenic attack long enough to protract modification in osseous tissues, especially teeth and bone (cf. Ortner and Aufderheide 1991). Archaeobiological studies have been able to detect and describe a number of skeletal indicators of infection that can help in documenting diseases that humans may have contracted from domesticated animals.

An example of a zoonoose that can be identified in human remains is tuberculosis (cf. Buikstra 1981; Mays 2005). This disease is caused by bacillus *Mycobacterium tuberculosis*, primarily transmitted through breathing into respiratory system, causing primary infection in lung tissues and secondary infection in hilar lymph nodes (Hopewell 1994). Over the years, the bacilli spread to skeletal tissues through the circulatory system and begin to destroy bones, especially hematopoietic marrow and cancellous bones. For example, the ribs, vertebrae, sternum and long bone metaphyses (especially in subadults) are favored targets for secondary infection because of rich blood supply and scarcity of phagocytic cells (cf. Thijn and Steensma 1990). The process results in extensive damage to cancellous bones, causing lesion and bone loss.

Effects of tuberculosis have been identified in mortuary populations from around the world, including the Near East (cf. Ortner 1979; Spigelman and Lemma 1993), Egypt (cf. Buikstra *et al*. 1993), Nubia (cf. Armelagos 1969; Baker 1997), Greece (Angel 1984), Italy (Formicola *et al*. 1987), Denmark (Bennike 1985), England (Manchester 1991), and Japan (Suzuki 1991). Most early scholars believed that tuberculosis did not exist in the New World prior to the arrival of the Europeans (cf. Hrdlicka 1909), but more recent studies show cases of tuberculosis throughout the New World (cf. Buikstra 1981) usually attributed to the emergence of food production and settlement in villages and towns.

Another important contribution by archaeobiology to archaeological studies of pastoralism is the study of diet and nutrition, including studies of differences in the diet and dietary habits of foragers vs. farmers (cf. Wing and Brown 1979; Larsen 1995; Goodman *et al*. 2000). It is now more or less established that nutritional deficiency was another consequence of farming that disrupted fairly balanced diet of foragers (Smith and Smith 1999), leading to over-dependence on starchy food-stuff like cereals that are rich in carbohydrate, but lack some proteins and vitamins causing many deficiencies and diseases including lower bone density, diabetes, and heart disease (Cohen 1989).

For example, some studies have tried to correlate patterns in teeth wear and changes in diet, as humans make the transition from foraging to farming. In general, there seems to be a considerable increase in dental microwear from forager to farmer communities due to a shift in the texture of the food. In general, trends in dental micorwear indicate higher prevalence of finer scratches in forager and early farmers, while microwear features become coarser in more intensive farmers. Many examples supporting this pattern come from North America, e.g., Lower Mississippi River Valley (Rose *et al*. 1991), Portugal (Lubell *et al*. 1994), northern Syria (Molleson *et al*. 1993), and Japan (Inoue *et al*. 1986).

While it is fairly easy to distinguish forager vs. farmer diet based on human remains from archaeological contexts, telling apart an agriculturalist vs. a pastoralist diet is more difficult, as they both rely heavily on plant foods. However, ethnographic observations on the diet of pastoralist people show some disparities with that of the agriculturalists. Pastoralists continue to consume much plant food, some wild and some domestic procured from farming communities, but, perhaps the most important aspect that makes pastoralist diet stand out compared to that of agriculturalists is higher consumption of milk and milk products (Galvin *et al*. 2000). For example, studies conducted in the 1980s show that milk provides a big part of annual dietary intake of east African pastoralist diet: %55 among the Borana (Cossins and Upton 1987), %62 among the Turkana (Galvin 1992), %64 among the Maasai (Nestel 1986), %66 among the Ariaal (Fratkin 1991), and as high as %75 among the Rendille (Field and Simpkin 1985).

Milk is a fantastic source of high quality proteins with balanced amino acid profiles that cannot be found in plant proteins. The higher milk consumption of milk among pastoralist people seems to remedy for some of the shortcomings of plant diet characteristic of agriculturalists and lead to overall better health and physical condition of the pastoralists. An example of the role of milk in diet can be observed among Khoisan people of southern Africa. Historical and biological evidence suggest that cultural and biological characteristics of contemporary Khoisan people may have developed as a result of transition from foraging to mobile pastoralism about two-thousand years ago. When first encountered by Europeans, the Khoisan people were described as consisting of two distinctive groups: the San, who were relatively smaller in body size and followed an exclusively foraging lifeway, and the Khoi, who were taller and more robust and followed a pastoralist lifeway based on cattle. The origins of Khoi pastoralism are unclear, but the consensus is that the Khoi adopted this economic system from pastoralists groups to the north. But, there is little agreement on the source and mechanisms through which pastoralism spread through the Khoi region (for discussion see Hausman 1984). It has been suggested that the larger body size observed among the Khoi is a result of their consumption of milk products (Hausman 1984: 268). In contrast, the San do not have access to milk products and seem to be subject to more food stress than the Khoi, which has a negative effect on childhood growth, hence resulting in smaller adult stature.

Another impact of higher milk consumption has been observed in patterns of iodine deficiency and endemic

goiter amongst several central and west African people. A number of cattle pastoralist groups in this region, e.g., the Bororos of Mali, Niger, North Cameroun and Central African Republic, show less abnormality in thyroid function compared to sedentary agriculturalists of the same region. This has been linked to higher consumption of milk and milk products by the Bororos compared to the sedentary population whose diet consists primarily of vegetal material (Biassoni *et al*. 1998).

The key animals in traditional pastoralist economies mentioned at the beginning of this paper (i.e., sheep, goat, cattle, camel, yak, and horse) are all capable of producing various amounts of milk (FAO 1990) that either raw or processed forms an important component of pastoralist diet. Cows, in particular, can produce more milk than early sheep and goats, and after a millennium or more of giving milk to human babies whose mothers had little milk of their own, the digestive system of humans must have developed the ability to process lactose at least as semi-processed yogurt or cheese. If so, our domestic bacteria that make cheese and yogurt must have come soon after the appearance of cows.

But, how can one detect milk and milk products in the archaeological record and by inference, make assumptions about pastoralist activities in the past. Interestingly enough, in recent decades, major advances have been made in chemical analyses of residues (including residues of dairy products) from archaeological contexts. We will discuss some of these breakthroughs below.

Archaeochemistry

Archaeochemistry is the analyses of chemical residues from archaeological contexts, especially those recovered from ceramic vessels and sherds from excavations (Evershed *et al*. 1991; Heron and Evershed 1995; Dudd and Evershed 1999; Charters *et al*. 1993; Copley *et al*. 2005a-c; Stern *et al*. 200).

Fatty acids extracted from pottery through successive applications of organic solvents (such as chloroform or diachloromethane) are separated from one another using gas chromatography (GC), and their relative abundances are measured and compared against modern reference samples associated with particular foodstuffs (Evershed *et al*. 1990; Heron *et al*. 1991). Abundances and distributions of major classifications of lipids (free fatty acids, monacylglycerols, diacylglycerols, and triacylglycerols) can be diagnostic of specific animal fats or vegetable oils, although these are often altered by microbial degradation during deposition. Animal fats are identified through the presence of small amounts of cholesterol in addition to high abundances of *n*-hexadecanoic ($C_{16:0}$) and *n*-octadecanoic ($C_{18:0}$) fatty acids (Heron *et al*. 1991). High abundances of $C_{16:0}$ and $C_{18:0}$ fatty acids can indicate the presence of animal fats and vegetable oils in archaeological ceramics, but fatty acid distributions alone have little diagnostic value in differentiating between the two major classifications of mammalian fats – those from subcutaneous adipose tissue and residues of dairy products. Modern milk fats contain high abundances of short-chain saturated fatty acids in the C_4 - C_{14} carbon number range, and may be distinguishable from adipose fats of the same animal (Evershed *et al*. 2002). The relative abundance and distribution of fatty acids can be greatly affected by the varying degrees of water solubility of each of the compounds, and microbial degradation during deposition over long periods of time. Unsaturated fatty acids are depleted at a quicker rate than saturated fatty acids (Heron and Evershed 1995), and the 'signature' short-chain fatty acids in dairy products do not appear to survive, unlike the longer-chain lipid species (Dudd and Evershed 1998; Copley *et al*. 2003).

A new criterion for the identification of animal fats preserved in archaeological ceramics was established in 1997 by a British team (Evershed *et al*. 1997). In a landmark study, employing gas chromatography and combustion isotope ratio mass spectrometry (GC-C-IRMS) as analytical techniques, Evershed and his colleagues demonstrated that it was not only possible to distinguish the isotopic signatures of animal fats from ruminant and non-ruminant domesticated species, but also to assign $\partial^{13}C$ values of the major n-alkanoic acids directly to specific types of ceramic vessels (Evershed *et al*. 1997). In the following years, Evershed and colleagues used this method of measuring stable carbon isotope ratios for individual compounds to determine the different $\partial^{13}C$ values of dairy lipids and adipose fats of milk-producing species that had been grazing on C3 pasturelands, and which had been preserved in archaeological ceramics (see also Dudd *et al*. 1999; Craig 2003; Craig and Collins 2000). Differential routing of dietary carbon and fatty acids during the synthesis of adipose and dairy fats produces different $\partial^{13}C$ signatures in ruminant species. The mammary glands of dairy animals are unable to synthesize $C_{18:0}$ (one of the principal components of all animal fats) and must obtain it from the unsaturated fatty acids ($C_{18:1}$ $C_{18:2}$ and $C_{18:3}$) of the plants they consume which are partially hydrogenated by bacteria in their rumen (Copley *et al*. 2003). The Evershed group has recently used the $\partial^{13}C$ signatures of this differential routing to demonstrate that the primary function of Neolithic ceramics in Britain was for the processing or consumption of dairy foods, and that dairying was well-developed agricultural practice when farming was introduced from mainland Europe (Copley *et al*. 2003). GC-C-IRMS has revolutionized the study of both meat and milk molecules, and has quickly become the standard for:

1. Identifying the isotopic signatures of photosynthetic pathways in organic residues and living organisms (Copley *et al*. 2003).

2. Demonstrating the role of dairy foods and meat products in prehistoric agricultural economies (Dudd and Evershed 1998; Copley *et al*. 2003; Craig *et al*. 2003);

3. Determining patterns of animal exploitation as they can be interpreted from different ceramic traditions (Evershed *et al*. 1997; Dudd *et al*. 1999).

Coupled with more conventional gas chromatography and mass spectrometry techniques that identify carbon double bond positions and distribution of triacylglycerols, $\partial^{13}C$ values can also be used to assign saturated fatty acid compositions to specific domesticated animals (Mottram *et al*. 1999; Copley *et al*. 2003).

Another British researcher, Oliver Craig, has adopted the GC-C-IRMS technique developed by the Evershed group, and discovered that pottery fragments from three early Neolithic sites in Hungary contained major fatty acids with $\partial^{13}C$ values consistent with milk from ruminant species (cf. Craig and Collins 2000; Craig *et al*. 2000, 2003). Craig concludes that dairy foods were an integral component of a mixed agricultural economy of the Danube basin circa 7800 B.P., but cautions against interpreting the absence of ruminant dairy fats in ceramics from the late Neolithic period sites (such as those from Çatalhöyük which have been analyzed by the Evershed group), as indicating the origins of dairy food production were in southeastern Europe. Craig suggests that many more Near Eastern sites need to be assessed before rushing to such a conclusion (Craig *et al*. 2003). High abundances of $C_{16:0}$ and $C_{18:0}$ fatty acids have been noted in pottery fragments recovered from the late Neolithic period site at Tell el-Kherk in Syria (Shimoyama and Ichikawa 2000) and the Chalcolithic period settlement at Yarikkaya in central Anatolia (Sauter, Pushinger, and Schoop 2003). These authors argue that these fatty acid ratios indicate that the pottery they examined was used in the production of dairy foods. Work is also underway by Michael Gregg on samples from elsewhere in the Near East. Gregg has found high abundances of $C_{16:0}$ and $C_{18:0}$ in fragments from Çayonu, Tappeh Sarab, and Wadi Ziqlab, and he has obtained soil samples from nearby these sites for isotopic comparison of the $\partial^{13}C$ values of major n-alkanoic acids in order to securely identify these organic residues (Gregg and Slater 2010).

Archaeobotany

It has long been recognized that humans have had a profound impact on their surrounding environment. Unfortunately, more often than not, this impact has been detrimental. In fact, a host of recent publications (cf. Krech 1999; Redman 1999; Redman *et al*. 2004; Goudie 2013) demonstrate that the notion of an environmentally-savvy ancient human whose behavior towards nature and its resources was always one of harmony, respect, and foresight is another myth propagated by quasi-scholarship of modern times. But, most studies of human impact on ancient environments tend to focus on sedentary populations and their activities, whereas the impact of mobile groups, including mobile pastoralists with their herd of animals grazing through the landscape, can be equally destructive and extensive. While sedentary people may leave their mark on the landscape with such activities as land modification or deforestation (cf. Miller 1985) pastoralists leave a more subtle impact on the environment in the form of (over)grazing (cf. Gilles and Jamtgaard 1981; Homewood and Rodgers 1987).

It appears that light grazing (browsing) with frequent movement of the herd does little damage to the floral coverage. For example, cattle pastoralists of east Africa were for a long time able to maintain a steady relationship with their surrounding pastures by devising a balanced pattern of movement (cf. Dyson-Hudson and Dyson-Hudson 1980; Netting 1981; Anderson and Broch-Due 1999). This balance is, however, being offset in recent decades due to population growth and political restrictions on their movement (cf. McCabe *et al*. 1992).

In many other parts of the world, grazing has left a degenerating effect on the landscape (Rifkin 1992). For example, in western United States cattle has done major damage to the landscape by grazing on their favorite fodder, willow and cottonwood shoots, causing massive erosion to streambeds once held together by these plants (cf. Gillis 1991). In the Near East, in particular, evidence suggests that overgrazing has done much damage to the landscape over the course of the past several thousands of years (Köhler-Rollefson 1988; Harlan 1992).

Pastoralist impact on the landscape can be detected using studies of botanical remains from archaeological excavations. These remains can be either macrobotanical or microbotanical. Macrobotanical remains are often charred, mineralized, dry or waterlogged parts of plants. Less frequently, botanical remains may be preserved in furnishings (e.g., matt) or construction material (e.g. hay mixed with clay in mudbrick). Very much like faunal remains discussed earlier, only a small percentage of the floral remains that were used by ancient humans are recovered and analyzed (Pearsall 2000).

An important approach in detecting pastoralist activities with the help of botanical remains is the study of dung remains from archaeological contexts. Dung has been and continues to be an important fuel in the Near East, especially in its rural areas. Discovery of plant remains in dung can tell us about the kinds of plants animals were grazing on and therefore shed some light on their patterns of movement. The idea that charred seeds may have come from dung fuel was first put forward by Naomi Miller of the University of Pennsylvania during her analysis of floral remains from Malyan in southern Iran (Miller 1984). Miller identified seeds of cultigens, primarily wheat and

barley in dung remains, suggesting that they were fed to animals as fodder, but she also identified seeds of wild plants that suggest grazing beyond the agricultural zone (e.g., distance village-based pastoralism, transhmance, or nomadic pastoralism discussed above). Critiques of the 'dung theory' (cf. Hillman *et al*. 1997) point out that some animals avoid certain plants (e.g., wild rue [*Peganum harmala*] or camel thorn [*Alhagi camelorum*]) when they are fresh, but don't mind eating them in their dried form (Miller 1999: 21), but more importantly, ethnographic observations suggests that dung does not necessarily have to be procured from pens or stables, but people are observed following animals in pastures and picking up dung after them (Hillamn *et al*. 1997: 525).

Microbotanical studies, especially phytolith analyses and palynology (Pearsall 2000), can also furnish us with insight into ancient strategies for pastoralism. Phytoliths are plant crystals that form in epidermal and other plant tissues and preserve in a variety of contexts, including dung, indirectly providing evidence for pastoralist activities (cf. Rosen 1997). Palynology is the study of microbotanical plant remains such as stomata, spores, and especially fossil and subfossil pollen from archaeological or geoarchaeological contexts, especially pollen cores taken from lake-beds that can be used in tracking changes in floral coverage of the region surrounding the location from which the pollen sample was taken. Analyses of pollen, especially from cores, offer a view on changes in pollen over time and can help us track environmental changes in the region and provide glimpses into conditions under which pastoralism may have developed.

One such study has been attempted vis-à-vis intermediate stages of pastoralism in the Zagros Mountains (Abdi 2003: 409-411). The pollen diagrams from Lake Zeribar in the central Zagros (van Zeist 1967; van Zeist and Bottema 1977) provide some clues on floral changes in the area from the colder, drier early Holocene to the warmer, wetter middle Holocene. The complex floral changes observed in this period can probably be related to climatic change. Of the pollen diagrams published for Lake Zeribar (van Zeist and Bottema 1977, fig. 24), Zones 5b, 5c, and 6 from pollen core I and II can be attributed to the Middle Neolithic to the Middle Chalcolithic periods. In Zone 5b, one can see an increase in oak pollen, while later, in Zone 5c, there is a sharp drop to half the previous level, while pistachio and ash (both quality woods suitable for making bows and arrows and other tools) increase. Later in Zone 6, oak increases to 3 to 4 times more than its level in earlier Zone 5c. What stands out in terms of differences in vegetation related to pastoralism in Zones 5b/c and 6 is the genus used for fodder and the genus indicating overgrazing. Most importantly, in Zone 5c one can see a radical increase in *Rumex*, a common fodder, while with Zone 6 there is a sudden increase in *Sanguisorba* minor, a common indicator of over-grazing. Another indication of over-grazing in Zone 6 is the fairly frequent occurrence of Rheum and *Anisosciadium*. These tragacanthic plants enter various Artemisia and even segetal habitats, indicating the lack of competition resulting from over-grazing (Zohary 1973: 491). In summary, conditions for grazing seem to have been excellent during much of the Middle Chalcolithic Period, but at the end of this period, there is evidence for general deterioration of the climate (van Zeist and Bottema 1982, 1991) and overgrazing that corroborates other lines of evidence suggesting increasing mobile pastoralist activities in the region (Abdi 2003).

Spatial Patterns and Site Distribution

Different pastoralist strategies can also be detected using archaeological data, from intrasite spatial distribution of material culture to changes in distribution of archaeological sites.

Village-based pastoralism is hard to identify positively, because if one has a village with sheep and goat remains from a range of age-sex categories but no evidence of camps, by default one infers village-based pastoralism. But direct evidence is not easy to find archaeologically. Since the distance traveled between the village and the pasture is short and the herd usually returns to the village before nightfall, there is little or no need to build temporary shelters or campsites at the pasture. In terms of material culture, what the village-based shepherds usually carry with them in these short journeys is a modest amount of food (usually wrapped in a piece of cloth) and a container made from leather or pottery for beverage, usually water, or occasionally milk or buttermilk. The need for a container may be eliminated if a source of water is known in the pasture. In the most optimistic scenario, if the shepherds do in fact take a pottery jar with them, and the jar does break, our chances of finding a few pieces of surface sherds after millennia seem low. Of course, there is a minor chance of documenting such sherds in a careful pedestrian survey, but we are not yet in a position to differentiate between a herder's lunch and a farmer's lunch.

Perhaps one can best detect village-based pastoralism in the village itself. The discovery of pens or corrals next to residential quarters can be taken as an indication of keeping herds. As discussed above, chemical analyses of pottery vessels for residues of dairy products and sampling of archaeological deposits for archaeobotanical remains can provide clues on pastoral activities.

Transhumant pastoralism leaves behind a more detectable spatial signature. One can expect to find transhumant sites between the limits of the agricultural zone and the boundary of vegetal growth on highland. The need to reside at the pasture for an extended period of time would prompt the herders to build some sort of temporary

dwelling in a campsite (Gamble 1991). This dwelling may show itself in the archaeological record as stone footing. Not far from the campsite one can also expect to find evidence for ancient pens or corrals, depending on the size of the herd (Cribb 1991b; Banning and Köhler-Rollefson 1992). Transhumant pastoralists may also use natural features such as caves and rock-shelters as their temporary dwellings or animal pens (Straus 1997).

Transhumant pastoralism leaves a distinct signature in the material culture (Caracotche 2001). Whether as members of extended household or as wage laborers, herders travel alone or in small groups depending on the size of the herd, but they do not form an independent social group. Therefore, one can expect to see a general pattern in transhumant sites that the material culture does not show the full range of household activities, but only artifacts that represent a limited range of activities associated with herding (e.g., stone tools for sawing wood and cutting fodder, pots for preparation of small amounts of food and storage of food for a short period of time). Further, if herders were members of an extended household, one could expect to see a sub-group of the regional assemblage represented in a transhumant site. In the case of hired herders, since they may come from different communities, one can expect to see material culture characteristic of their respective communities of origin. This may show itself in microstylistic analysis of a regional pottery tradition (if herders come from different villages in the same region), or examples of different pottery traditions (if herders come from different regions) (cf. Calderón 2002). In any case, transhumant pastoralists, whether members of an extended household or hired shepherds, occasionally stop by villages where the owner of the herd resides to exchange goods and receive payment. Therefore, one can expect to see examples of the material culture from permanent settlements finding their way into transhumant sites (for further exploration of this observation see Abdi *et al*. 2002).

Camps, whether of semi-nomads or full-fledged nomads, leave the most characteristic signature in the archaeological record (Edelberg 1966-67; Gamble and Boismier 1991; Cribb 1991b). As Hole (1978, 1979, 1980, 2004) has suggested, there are several important factors that should be brought into consideration while searching for nomadic campsites:

1. Nomadic campsites should be located with respect to seasonal pastures and to migration routes without regard to arable lands or concern with close major sources of water like rivers. This is usually beyond the limits of agricultural zones and in peripheral areas where nomads can pitch their tents and graze their herd without interference and potential problems with sedentary villagers, but close enough so they could carry out their exchange of goods without having to travel a distance that may be detrimental to some perishable material such as dairy products.

2. Nomadic campsites should provide evidence of repetitive seasonal occupation (see also: Dandekar 2003; Dever 1992; Cohen 1992).

3. Nomadic campsites should show evidence for small groups of temporary dwellings built with minimum investment of time and labor.

4. Material culture from nomadic campsites should represent a range of activities associated with a self-sufficient household. This should include a whole range of artifacts associated with procurement, processing, and storage of food, as well as domestic production (e.g., textile weaving and basket making), and personal belongings including ornaments.

Moreover, the bulk of the pottery from a nomadic campsite should be handmade and coarse, of the kinds that can easily be made without elaborate firing installations. One can, however, expect to find examples of fine pottery characteristic of the region or other regions along the migratory route, either as social gifts from sedentary people, or as luxurious tableware procured from pottery workshops in villages or towns that may have been used by nomads for guests as a gesture of hospitality. Chipped stone from nomadic sites should also be traceable to sources along the migration route. However, in some cases, some chipped stone may find its way to a nomadic assemblage through exchange with sedentary villagers. There is also the possibility that raw material for chipped stone may have been supplied to villagers by nomads.

Conclusion: Emerging Trends in the Archaeology of Pastoralism

While ongoing archaeological fieldwork and studies in archaeozoology, archaeobiology, archaeochemistry, and archaeobotany are making major empirical and methodological progress pertaining to the studies of the early forms of pastoralism, archaeology of pastoralism is also beginning to show signs of growth, by moving beyond the subsistence basis of pastoralism and looking at organizational aspects and adaptive capacity of pastoralism, two important changes taken up by some communities, and not by others, due to a combination of environmental and social factors. Recent studies try to break down the linear development inherent in early models from sedentism to nomadism to several stages with stressing on such factors as logistics of distance to be traveled and changing organization of pastoralist activities.

More recent studies begin with the basic observations that prehistoric economic systems predominantly depend on agricultural, which is a risky business with considerable uncertainty in crop yields due to frost, drought, excess precipitation, salinization of the fields due to inefficient water-management, pests, disease, intercommunity conflict, and other factors that could seriously jeopardize a

community exclusively dependent on agriculture. Further, a prehistoric agricultural strategy based solely on one or two staple crops and some use of wild foods may not have been capable of producing sufficient foodstuff even under optimal conditions. A growing population may thus demand foodstuffs beyond the potentials of the production system. Under such circumstances, some groups, either sedentary or mobile, may begin to exploit adjacent production zones through temporary settlements. Over time, temporary settlements became permanent in order to reduce the energy expended in movement. Gradually, social contact between the new settlements and the original settlement decreases, and an autonomous settlement based on a specialized strategy emerges. Each community develops its own characteristics while still participating in the regional cultural tradition.

A common response to the risk involved in a single-strategy economy is diversification, enabling producers to reduce risk in the face of environmental and social factors. In the case of early village economies, diversification can take a number of forms, including diversification of staple crop production, and diversification of the production system by placing more emphasis on pastoralism.

Different production strategies pose different challenges in coordination of effort in space and time. In early agriculture, with the occasional exception of the communal maintenance of irrigation systems, most tasks could have been managed within the household. Even in some mixed economies (like village-based pastoralism) factors related to timing and movement could still be administered within the household. Pastoralism, on the other hand, involves the coordination of complex movements of people and animals, necessitating communal institutions for scheduling and integration. With the increasing size of the herd and numbers of herders, the control mechanism that processes information concerning the distribution of resources, allocation of tasks, scheduling of movement, coordination of demands, and resolution of conflicts must, in turn, expand (Johnson 1983).

With lands surrounding the villages coming increasingly under cultivation, village-based herders faced the problem of having to travel farther to take the flocks out of the agricultural zone. Initially, the distance traveled was more or less a day's walk, so that younger people, whose presence was not required for more essential agricultural activities, could have been entrusted with the task. But as the distance became greater and many small household herds were aggregated into a few large collective herds, mature individuals had to be sent out who were capable of managing and protecting the herd.

These herders were still members of the village community, but they had diminishing involvement with their home village, instead spending long portions of the year traveling from pasture to pasture at various elevations. Realizing the benefits of pastoralism, especially the demands of growing settlements for animal products, some herders may have started their own flock. These herders only occasionally returned to their home village, perhaps to exchange goods and to socialize. With more time in the wild and less time in their home village, some herders may have invited their households to accompany them on their trips. As years passed, as parents died, and brothers and sisters grew up and formed their own family, social bonds that tied pastoralist and agriculturalist families began to fade away. Within a few generations, any memory the mobile pastoralists may have had of their ancestral links with the village may have been lost. They considered themselves a different social group: nomads, who, as far as they could remember, had always wandered the land.

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References

Abdi, K.,
2003 The Early Development of Pastoralism in the Central Zagros Mountains. *Journal of World Prehistory* 17, 395-448.

Abdi, K., G. Nokandeh, A. Azadi, F. Biglari, S. Heydari, D. Farmani, A. Rezaii, and M. Mashkour,
2002 Tuwah Khoshkeh: A Middle Chalcolithic Pastoralist Camp-site in the Islamabad Plain, West Central Zagros Mountains, Iran. *Iran* 40, 43-74.

Adams, R. McC.,
1974 The Mesopotamian Social Landscape: A View from the Frontier. In: Moore, C. (ed.), *Reconstructing Complex Societies*, Supplement to the Bulletin of American Schools of Oriental Research 20, pp. 1-12.

Alberalla, U., K. Dobney, P. Rowley-Conwy,
2006 The Domestication of Pig (Susa scrofa): New Challenges and Approaches. In: Zeder, M., Emshwiller, E., Bradley, D. & Smith, B. (Eds.), *Documenting Domestication: New Genetic and Archaeological Paradigms*. University of California Press, Berkeley and Los Angeles, pp. 209-227

Aldenderfer, M.,
2001 Andean Pastoral Origins and Evolution: The Role of Ethnoarchaeology. In: Kuznar, L. A. (ed.), *Ethnoarchaeology of Andean South America: Contributions to Archaeological Method and Theory*. Prehistory Press, Ann Arbor, pp. 19-30.

Amanollahi-Baharvand, S.,
1975 *The Baharvand, Former Pastoralists of Iran*. Ph.D. dissertation, Department of Anthropology, Rice University.

1989 *Pastoral Nomadism in Iran*. Āgāh Publishers, Tehran (in Persian).

1992 *The Lurs: A Research on the Ethnic Continuity and Geographical Distribution of Lurs in Iran*. Āgāh Publishers, Tehran (in Persian).

Amarosi, T., J. Woollett, S. Perdikaris and T. McGovern,
1996 Regional zooarchaeology and global change: problems and potentials. *World Archaeology* 28, 126-157.

Angle, J. L.,
1984 Health as a crucial factor in the change from hunting to developed farming in the eastern Mediterranean. In: Cohen, M. N. & Armelagos, G. J. (Eds.), *Paleopathology at the Origins of Agriculture*. Academic Press, Orlando, pp. 51-73.

Armelagos, G. J.,
1969 Disease in ancient Nubia. *Science* 163, 255-259.

Baker, B. J.,
1997 Contributions of biological anthropology to the understanding of ancient Nubians and Nubian society. In Lustig, J. (ed), *Anthropology and Egyptology*. Monographs in Mediterranean Archaeology 8, Sheffield University Press, Sheffield.

Balasse M.,
2002 Reconstructing dietary and environmental history from enamel isotopic analysis: time resolution of intra-tooth sequential sampling. *International Journal of Osteoarchaeology* 12, 155-165.

2003 Keeping the young alive to stimulate milk production? Differences between cattle and small stock. *Anthropozoologica* 37, 3-10.

Balasse M. and S. H. Ambrose,
2005a Mobilité altitudinale des pasteurs néolithiques dans la vallée du Rift (Kenya) : premiers indices de l'analyse du d13C de l'émail dentaire du cheptel domestique. *Anthropozoologica* 40, 147-166.

2005b Distinguishing sheep and goats using dental morphology and stable carbon isotopes in C4 grassland environments. *Journal of Archaeological Science* 32, 691-702.

Balasse M. and A. Tresset,
2002 Early weaning of Neolithic domestic cattle (Bercy, France) revealed by intra-tooth variation in nitrogen isotope ratios. *Journal of Archaeological Science* 29, 853-859.

Balasse, M., S. H. Ambrose, A. B. Smith, and T. Douglas Price,
2002 The Seasonal mobility for prehistoric herders in south-western cape of south-western Africa assessed by isotopic analysis of sheep tooth enamel. *Journal of Archaeological Science* 29, 917-932.

Balasse M., A. B. Smith, S. H. Ambrose et S. R. Leigh,
2003 Determining sheep birth seasonality by analysis of tooth enamel oxygen isotope ratios: the Late Stone Age site of Kasteelberg (South Africa). *Journal of Archaeological Science* 30, 205-015.

Balasse M., A. Tresset, K. Dobney and S. H. Ambrose,
2005 The use of isotope ratios to test for seaweed eating in sheep. *Journal of Zoology* 266, 283-291.

Balasse M., A. Tresset, H. Bocherens, A. Mariotti et J-D. Vigne,
2000 Un abattage "post-lactation" sur des bovins domestiques néolithiques. Etude isotopique des restes osseux du site de Bercy (Paris, France). *Anthropozoologica* 31, 39-48.

Banning, E. B. and I. Köhler-Rollefson,
1992 Ethnographic Lessons for the Pastoral Past: Camp Locations and Material Remains near Beidha, Southern Jordan. In: Bar-Yosef, O. & Khazanov, A. (Eds.), *Pastoralism in the Levant*. Prehistory Press, Madison, pp. 181-204.

Barfield, T. J.,
1993 *The Nomadic Alternative*. Prentice Hall, Englewood Cliffs NJ.

Barrett, R., C. W. Kuzawa, T. McDade, and G. J. Armelagos,
1998 Emerging and Re-Emerging Infectious Diseases: The Third Epidemiologic Transition. *Annual Review of Anthropology* 27, 247-271.

Barth, F.,
1956 *Indus and Swat Kohistan: An Ethnographic Survey*. Forenede Trykerrier, Oslo.

1961 *Nomads of South Persia: The Basseri Tribe of the Khamseh Confederacy*. Allen and Unwin, London.

1964 Capital, Investment and the Social Structure of a pastoral Nomad Group in South Persia. In: Firth, R. & Yamey, B. S. (Eds.), *Capital, Saving and Credit in Peasant Societies*, Aldine, Chicago, pp. 69-81.

Bar-Yosef, O. and A. Belfer-Cohen,
1989 The Origins of Sedentism and Farming Communities in the Levant. *Journal of World Prehistory* 3, 447-498.

Bar-Yosef, O. and A. Khazanov (eds.),
1992 *Pastoralism in the Levant: Archaeological Materials in Anthropological Perspectives*. Monographs in World Archaeology 10. Prehistory Press, Madison.

Bar-Yosef, O. and R. H. Meadow,
1995. The Origins of Agriculture in the Near East. In: Price, T. D. & Gebauer, A. B. (Eds.), *Last Hunters-First Farmers: New Perspectives on the Prehistoric Transition to Agriculture*. School of American Research, Santa Fe, pp. 39-94.

Basilov, B. (ed.),
1989 *Nomads of Eurasia*. University of Washington Press, Seattle.

Bates, D. G.,
1972 Differential Access to Pasture in A Nomadic Society: The Yörük of South Eastern Turkey. In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 48-59.

1973 *Nomads and Farmers: A study of the Yörük of south east Turkey*. Anthropological Papers, University of Michigan Museum of Anthropology, Ann Arbor.

Beck, L.,
1980 Herd Owners and their Hired Shepherds: The Qashqa'i of Iran. *Ethnology* 19, 327-52.

1990 *Nomad: A Year in the Life of a Qashqa'i Tribesman in Iran*. University of California Press, Berkeley and Los Angeles.

1998 Use of Land by Nomadic Pastoralists in Iran, 1970-1988. *Yale School of Forestry and Environmental Studies Bulletin Series* 103, 58-80.

2003 Qashqa'i Nomadic Pastoralists and Their Use of Land. In: Miller, N. F., & Abdi, K. (Eds.), *Yeki Bud, Yeki Nabud: Essays on the Archaeology of Iran in Honor of William M. Sumner*. Cotsen Institute of Archaeology of the UCLA Monograph 48, Los Angeles, pp. 289-304.

Bennike, P.,
1985 *Paleopathology of Danish Skeletons: A coparative study of demography, disease and injury*. Akademisk Forlag, Copenhagen.

Bernbeck, R.,
1993 *Steppe als Kulturlandschaft*. D. Reimer Verlag, Berlin.

2001 Forschungsperspektiven für das Iranische Neolithikum. *Archaäologische Mitteilungen aus Iran und Turan* 33, 1-18.

Beurmann, A.,
1967 *Fernweidewirtschaft in Südeuropa*. Barunschweig.

Biassoni, P., G. Ravera, J. Bertocchi, F. Schenone, and P. Bourdoux,
1998 Influence of dietary habits on thyroid status of a nomadic people, the Bororo shepherds, roaming a central African region affected by severe iodine deficiency. *European Journal of Endocrinology* 138, 681-685.

Black-Michaud, J.,
1974 An Ethnographic and Ecological Survey of Luristan, Western Persia. *Middle Eastern Studies* 10, 210-228.

1986 *Sheep and Land: The Economies of Power in a Tribal Society*. Cambridge University Press, Cambridge.

Blumler, M. A. and R. Byrne,
1991 The Ecological Genetics of Domestication and the Origins of Agriculture. *Current Anthropology* 32, 23-54.

Bocherens, H., M. Mashkour, D. Billiou, E. Pellé, and A. Mariotti,
2001 A New Approach for Studying Prehistoric Herd Management

in Arid Areas: Intra-tooth Isotopic Analyses of Archaeological Caprines from Iran. *Comptes Rendus de l'Académie des Sciences* 332, 67-74.

Bonavia, D.,
1996 *Los camélidos sudamericanos: una introducción a su estudio*. IFEA, Lima.

Bonte, P.,
2004 *Les derniers nomads*. Solar, Paris.

Bradburd, D. A.,
1996 Toward an Understanding of the Economics of Pastoralism: The Balance of Exchange Between Pastoralists and Nonpastoralists in Western Iran, 1815-1975. *Human Ecology* 24, 1-38.

Bradley, D. and D. Magee,
2006 Genetics and the Origins of Domestic Cattle. In: Zeder, M., Emshwiller, E., Bradley, D. & Smith, B. (Eds.), *Documenting Domestication: New Genetic and Archaeological Paradigms*. University of California Press, Berkeley and Los Angeles, pp. 317-328

Braidwood, R. J.,
1952 *The Near East and the Foundations for Civilization*. Condon Lectures. Oregon State System of Higher Education, Eugene.

Browman, D. L.,
1990 High Altitude Camelid Pastoralism of the Andes. In: Galaty, J. G. & Johnson, D. L. (Eds.), *World of Pastoralism: Herding Systems in Comparative Perspective*, Guilford Press. New York, pp. 323-352.

Buikstra, J. E. (ed.),
1981 *Prehistoric Tuberculosis in the America*. Scientific Papers 5, Center for American Archaeology,

Buikstra. J. E., B. J. Baker, D. C. Cook,
1993 What diseases plagued ancient Egyptians? A Century of Controversy Considered. In: Davies, W. V. & Walker, R. (Eds.), *Biological Anthropology and the Study of Ancient Egypt*, British Museum Press, London, pp. 24-53.

Buikstra, J. E., L. W. Konigsber, and J. Bullington,
1986 Fertility and the Development of Agriculture in the Prehistoric Midwest. *American Antiquity* 51, 528-546.

Bulliet, R.,
1975 *The Camel and the Wheel*. Harvard University Press, Cambridge MA.

Calderón, R.,
2002 Genetic structure of the Basque herders of northern Spain. In: W. R. Leonard & Crawford, M. H. (Eds.), *Human Biology of Pastoral Populations*, Cambridge University Press, Cambridge, pp. 50-63.

Caracotche, M. S.,
2001 The invisibility of time: an ethnoarchaeological study of the temporary sites of herders of the southern Puna. In: Kuznar, L. A. (ed.), *Ethnoarchaeology of Andean South America: Contributions to Archaeological method and Theory*. Prehistory Press, Ann Arbor, pp. 97-115.

Castillo, J. S. (ed.),
1981 *Nomads and Sedentary Peoples*. El Colegio de Mexico, Mexico City.

Chang, C. and H. A. Koster,
1986 Beyond Bones: Toward an Archaeology of Pastoralism. In: Schiffer, M. J. (ed.), *Advances in Archaeological method and Theory* 9, Academic Press, New York, pp. 97-148.

Chang, C. and H. A. Koster (eds.),
1994 *Pastoralists at the Periphery: Herders in a Capitalist World*. University of Arizona Press, Tuscon.

Charters, S., R. P. Evershed, L. J. Goad, A. Leyden, P. W. Blinkhorn, and V. Denham,
1993 Quantification and distribution of lipids in archaeological ceramics. *Archaeometry* 35, 211-223.

Chase, P. G. and R. M. Hagaman,
1986 Minimum Number of Individuals and its Alternative: A Probability Theory Perspective. OSSA 13, 75-86.

Clutton-Brock, J. (ed.),
1989 *The Walking Larder: Patterns of Domestication, Pastoralism, and Predation*. Unwin Hyman, London.

1999 *A Natural History of Domesticated Mammals*. Second Edition, Cambridge University Press, Cambridge and New York.

Clutton-Brock, J. and C. Grigson (eds.),
1984 *Animals and Archaeology 3: Early Herders and Their Flocks*. BAR International Series, 202, Oxford.

Clutton-Brock, J., Dennis-Bryan, P. L. Armitage, and P. A. Jewell,
1990 Osteology of the Soay sheep. *Bulletin of British Museum of Natural History* 56, 1-56.

Cohen, M. N.,
1989 *Health and the rise of civilization*. Yale University Press, New Haven.

Cohen, R.,
1992 The Nomadic or Semi-Nomadic Middle Bronze Age I Settlements in the Central Negev. In: Bar-Yosef, O. & Khazanov, A. (Eds.), *Pastoralism in the Levant*, Prehistory Press, Madison, pp. 105-132.

Copley. M.S., R. Berstan, S. N. Dudd, G. Docherty, A. J. Mukherjee, V. Straker, S. Payne, R. P. Evershed,
2005a Direct chemical evidence for widespread dairying in prehistoric Britain. *Proceedings of the National Academy of Sciences* 100, 1524-1529.

Copley, M. S., R. Berstan, V. Straker, S. Payne, and R. P. Evershed,
2005b Dairying in antiquity II. Evidence from absorbed lipid residues dating to the British Bronze Age. *Journal of Archaeological Science* 32, 505-521.

Copley, M.S., R. Berstan, A. J. Mukherjee, S. N. Dudd, S. Straker, V. Payne, and R. P. Evershed,
2005c Dairying in antiquity III. Evidence from absorbed lipid residues dating to the British Neolithic. *Journal of Archaeological Science* 32, 523-546.

Cossins, N. J. and M. Upton,
1987 The Boranan Pastoral system of southern Ethiopia. *Agricultural Systems* 25, 199-218.

Cowan, C. W. and P. J. Watson (eds.),
1992 *The Origins of Agriculture: An International Perspective*. Smithsonian Institution Press, Washington D.C.

Craig, O. E.,
2003 Dairying, dairy products and milk residues: potential studies in European prehistory. In: Parker Pearson, M. (ed.), *Food, Culture and Identity in the Neolithic and Early Bronze Age*. BAR International Series 1117, Archaeopress, Oxford, pp. 89-96.

Craig O.E., M. J. Collins,
2000 An Improved Method for the Immunological Detection of Mineral Bound Protein using Hydrofluoric Acid and Direct Capture. *Journal of Immunological Methods* 236, 89-97.

Craig O. E., J. Mulville, M. Parker Pearson, R. Sokol, K. Gelsthorpe, R. Stacey, M. J. Collins,
2000 Detecting Milk Proteins in Ancient Pots. *Nature* 408, 312.

Craig, O.E., J. Chapman, C. P. Heron,L. H. Willis, L. Bartosiewicz, G. Taylor, A. Whittle, M. J. Collins,
2003 Did Europe's First Farmers Produce Dairy Foods? *Proceedings of the Royal Society of London*

Cribb, R. L. D.,
1984 Computer Simulation of Herding Systems as an Interpretative and Heuristic Device in the Study of Kill-off Strategies. In: Clutton-Brock, J. & Grigson, C. (Eds.), *Animal and Archaeology 3: Early Herders and their Flocks*. BAR International Series, 202, Oxford, pp. 161-170.

1987 The Logic of the Herd: A Computer Simulation of Archaeological Herd Structure. *Journal of Anthropological Archaeology* 6, 376-415.

1991a *Nomads and Archaeology*. Cambridge University Press, Cambridge.

1991b Mobile Villagers: The Structure and Organisation of Nomadic Campsites in the Near East. In: Gamble, C. S. & Boismier, W. (Eds.), *Ethnoarchaeological Approaches to Mobile Campsites: Hunter Gatherer and Pastoralist Case Studies*, International Monographs in Prehistory, Ethnoarchaeological Series 1, Ann Arbor, pp. 371-393.

Cruz-Uribe, K.,
1988 The use and meaning of species diversity and richness in archaeological faunas. *Journal of Archaeological Science* 15, 179-196.

Dahl, G. and A. Hjort,
1976 *Having Herds: Pastoral Herd Growth and Household Economy*. Stockholm Studies in Anthropology 2. University of Stockholm Department of Social Anthropology, Stockholm.

Dandekar, A.,
2003 In the name of pastoralism: The early medieval Maharashtra. In: Heredia, R. C. & Ratnagar, S. F. (Eds.), *Mobile and Marginalized Peoples: Perspectives from the Past*. Manohar Publishers, New Delhi, pp. 65-88.

Davidson, B. R.,
1994 The Development of the Pastoral Industry in Australia during the Nineteenth Century. In: Chang, C. & Koster, H. A. (Eds.), *Pastoralists at the Periphery: Herders in a Capitalist World*. University of Arizona Press, Tuscon, pp. 79-102.

Dayan, T.,
1994 Early domesticated dogs of the Near East. *Journal of Archaeological Science* 21, 633-640.

Dever, William G.,
1992 Pastoralism and the End of the Urban Early Bronze Age Palestine. In: Bar-Yosef, O. & Khazanov, A. (Eds.), *Pastoralism in the Levant*, Prehistory Press, Madison, pp. 83-92.

Digard, J.-P.,
1981 *Techniques des nomades Bakhtiari*. Cambridge University Press and Éditions de la Maison des Sciences de l'Homme, Cambridge and Paris.

1987 Jeux de structure: segmentarité et pouvoir chez les nomades Baxtyari d'Iran. *L'Homme* 27, 12-53.

1999 Premières domestications proche-orientales: le regard d'un ethnologue. *Paléorient* 25, 81-85.

Dudd, S.N. and R. P. Evershed,
1998 Direct Demonstration of Milk as an Element of Archaeological Economies. *Science* 282, 1478-1481.

1999 Evidence for Varying Patterns of Exploitation of Animal Products in Different Prehistoric Pottery Traditions based on Lipids in Surface and Absorbed Residues. *Journal of Archaeological Science* 26, 1473-1482.

Dudd, S. N., R. P. Evershed, and A. M. Gibson,
1999 Evidence for varying patterns of exploitation of animal products in different prehistoric pottery traditions based on lipids preserved in surface and absorbed residues. *Journal of Archaeological Science* 26: 1473-1482.

Dyson-Hudson, N.,
1972 The Study of Nomads. In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 2-29.

Dyson-Hudson, R.,
1972 Pastoralism: Self Image and Behavioral Reality. In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 30-47.

Dyson-Hudson, R. and N. Dyson-Hudson,
1980 Nomadic Pastoralism. *Annual Review of Anthropology* 9, 15-61.

Edelberg, L.,
1966-67. Seasonal Dwellings of Farmers in North-Western Luristan. *Folk* 8-9: 373-401.

Edzard, D. O.,
1981 Mesopotamian Nomads in the Third Millennium B.C. In: Castillo, J. S. (ed.), *Nomads and Sedentary Peoples*. El Colegio de Mexico, Mexico City, pp. 37-45.

Ekvall, R. B.,
1968 *Fields on the Hoof: Nexus of Tibetan Nomadic Pastoralism*. Holt, Reinehart and Winston, New York.

Evershed, R.P., C. Heron, and J. Goad,
1990 Analysis of Organic Residues of Archaeological Origin by High-temperature Gas Chromatography-Mass Spectrometry, *Analyst* 115, 1339-1342.

1991 Epicuticular wax components preserved in potsherds as chemical indicators of leafy vegetables in ancient diets. *Antiquity* 65, 540- 544.

Evershed, R. P., C. Heron, S. Charters, and L. J. Goad,
1992 The survival of food residues: new methods of analysis, interpretation and application. *Proceedings of the British Academy* 77, 187-208.

Evershed, R.P., H. R. Mottram, S. N. Dudd, S. Charters, A. W. Stott, G. J. Lawrence, A. M. Gibson, A. Conner, P. W. Blinkhorn, and H. R. Reeves,
1997 New criteria for the identification of animal fats preserved in archaeological pottery. *Naturwissenschaften* 84: 402–406.

Ewald, P. W.,
1994 *Evolution of Infectious Disease*. Oxford University Press, Oxford.

1999 Using Evolution as a Tool for Controlling Infectious Diseases. In: Trevathan, W. R., Smith, E. O., & McKenna, J. J. (Eds.), *Evolutionary Medicine*, Oxford University Press, Oxford, pp. 245-270.

Faegre, T.,
1979 *Tents: Architecture of the Nomads*. John Murray, London.

FAO (Food and Agriculture Organization of the United Nations),
1990 *The technology of traditional milk products in developing countries*. Fao, Rome.

FAO (Food and Agriculture Organization of the United Nations),
2001 *Pastoralism in the new millennium*. Fao, Rome.

Feilberg, C. G.,
1944 *La tente noire*. Ethnografisk Rakke II, Nationalmusteets Skrifter, Copenhagen.

Field, C. R. and S. P. Simpkin,
1985 *The Importance of Camels to Subsistence Pastoralists in Kenya*. Integrated Project in Arid Lands Technical Report E-7, UNESCO, Nairobi.

Flannery, K. V.,
1969 Origins and Ecological Effects of Early Domestication in Iran and the Near East. In: Ucko, P.J. & Dimbleby, P.W. (Eds.), *The Domestication and Exploitation of Plants and Animals*, Duckworth, London, pp. 73-100.

1983 Early pig domestication in the Fertile Crescent, a retrospective look. In: Young, T. C., Smith, P. E. L., & Mortensen, P. (Eds.), *The Hilly Flanks and Beyond: Essays on the Prehistory of Southwestern Asia in Honor of Robert J. Braidwood*, The Oriental Institute, Chicago, pp. 163-188.

Flannery, K. V., J. Marcus, and R. G. Reynolds,
1989 *The Flocks of Wamani: A study of llama herders on the punas of Ayacucho, Peru*. Academic Press, San Diego.

Flores Ochoa, J.,
1979 *Pastoralists of the Andes: The Alpaca Herders of Paratía*. Translated by R. Bolton. Institute for the Study of Human Issues, Philadelphia.

Formicola, V., Q. Milanesi, and C. Scasini,
1987 Evidence of spinal tuberculosis at the beginning of the fourth millennium B.C. from Arene Candide Cave (Liguria, Italy). *American Journal of Physical Anthropology* 72: 1-6.

Fratkin, E.,
1991 *Surviving drought and development: Ariaal pastoralist of Northern Kenya*. Westview Press, Boulder.

Galaty, J. G. and D. L. Johnson (Eds.),
1990 *World of Pastoralism: Herding Systems in Comparative Perspective*. Guilford Press, New York.

Galvin, K. A.,
1992 Nutritional ecology of pastoralists in dry tropical Africa. *American Journal of Human Biology* 4: 209-221.

Galvin, K. A., D. L. Coppock, and P. W. Leslie,
2000 Diet, Nutrition, and the Pastoral Strategy. In: Goodman, A. H., Dufour, D. L., & Pelto, G. H. (Eds.), *Nutritional Anthropology: Biocultural Perspectives on Food and Nutrition*, Mayfield Publishing Co., Mountain View CA., pp. 86-96.

Gamble, C.,
1991 An Introduction to the Living Spaces of Mobile Peoples. In: Gamble, C. S. & Boismier, W. (Eds.), *Ethnoarchaeological Approaches to Mobile Campsites: Hunter Gatherer and Pastoralist Case Studies*, International Monographs in Prehistory, Ethnoarchaeological Series 1, Ann Arbor, pp. 1-23.

Gamble, C. S. and W. Boismier (eds.),
1991 *Approaches to Mobile Campsites: Hunter-Gatherer and Pastoralist Case Studies*. International Monographs in Prehistory, Ethnoarchaeological Series 1. Ann Arbor.

Garrard, A. N.,
1984 The Selection of South-West Asian Animal Domesticates In: Clutton-Brock, J. & Grigson, C. (Eds.), *Animal and Archaeology 3: Early Herders and their Flocks*. BAR International Series, 202, Oxford, pp. 117-132.

Gilbert, A. S.,
1975 Modern Nomads and Prehistoric Pastoralists: The Limits of Analogy. *The Journal of the Ancient Near Eastern Society of Columbia University* 7, 53-71.

1983 On the Origins of Specialized Nomadic Pastoralism in Western Iran. *World Archaeology* 15,105-119.

Gilles, J. L. and K. Jamtgaard,
1981 Overgrazing in pastoral areas. *Sociologia Ruralis* 21/ 2, 129-141

Gillis, A. M.,
1991 Should cows chew cheatgrass on commonlands? *BioScience* 41, 668-675.

Goldstein, M. and C. Beall,
1989 *Nomads of Western Tibet: The Survival of a way of life*. University of California Press, Berkeley and Los Angeles.

Goodman, A. H., D. L. Dufour, and G. H. Pelto (eds.),
2000 *Nutritional Anthropology: Biocultural Perspectives on Food and Nutrition*. Mayfield Publishing Co., Mountain View CA.

Goudie, A. S.,
2013 *The Human Impact on the natural environment: Past, Present and Future*. John Wiley & Sons, New York.

Grayson, D. K.,
1973 On the methodology of faunal analysis. *American Antiquity* 38, 432-439.

1984 *Quantitative Zooarchaeology*. Academic Press, Orlando.

Gregg, M. W. and G. F. Slater
2010 A New Method for Extraction, Isolation and Transesterification of Free Fatty Acids from Archaeological Pottery *Archaeometry* 52/ 5, 833-854

Grigson, C.,
1989 Size and sex: evidence for the domestication of cattle in the Near East. In: Milles, A., Williams, D., & Gardner, N. (Eds.), *The Beginning of Agriculture*. BAR 496, Oxford, pp. 77-109.

Grötzbach, E.,
1982 *Das Hochgebirge als menschlicher Lebensraum*. Eichstätter Hochschulreden 33, Munich.

Grötzbach, E. and C. Stadl,
1997 Mountain Peoples and Cultures. In: Messerli, B. & Ives, J. (Eds.), *Mountains of the World: A Global Priority*, Parthenon Publishing Group, London, pp. 17-38.

Halstead, P., P. Collins, and V. Isaakidoub,
2002 Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult Ovis and Capra. *Journal of Archaeological Science* 29, 545-553.

Harlan, J. R.,
1992 *Crops and Man*. American Society of Agronomy and Crop Science Society of America, Madison.

Hatch, E.,
1992 *Respectable Lives: Social Standing in Rural New Zealand*. University of California Press, Berkeley.

Hausman, A. J.,
1984 Holocen human evolution in southern Africa. In: Clark, J. D. & Brandt, S. A. (Eds.), *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa*. University of California Press, Berkeley, pp. 261-271.

Helmer, D.,
1989 Le développement de la domestication au Proche-Orient de 9500 à 7500 B.P.: Les nouvelles données d'El Kown et de Ras Shamra. *Paléorient* 15: 111-121.

Helmer, D.,
2000 Discrimination des genres Ovis et Capra à l'aide des prémolaires inférieures 3 et 4 et interprétation des âges d'abattage: l'exemple de Dikili Tash (Grèce). *Journal of Mountain Ecology & Anthropozooologica*, 5: 29-38.

Henrickson, E. F.,
1985 The Early Development of Pastoralism in the Central Zagros Highlands (Luristan). *Iranica Antiqua*, 20: 1-42.

Heron, C.P. and R. P. Evershed,
1995 The Analysis of Organic Residues and the Study of Pottery Use. In: Schiffer, M. B. (Ed.), *Archaeological Method and Theory 5*, University of Arizona Press, Tuscon, pp. 247-283.

Heron, C.P., R. P. Evershed, L. J. Goad, V. Denham,
1991 New Approaches to the Analysis of Organic Residues from Archaeological Remains. In: Budd, P., Chapman, B., Jackson, C., Janaway, R., & Ottaway, B. (Eds.), *Archaeological Sciences 1989*, Oxbow Monograph 9, Oxford, pp. 332-339.

Herskovits, M. J.,
1926 The Cattle Complex in East Africa. *American Anthropologist* 28, 230-272, 361-388, 494-528.

Hesse, B.,
1982 Slaughter Patterns and Domestication: The Beginning of Pastoralism in Western Iran. *Man* 17, 403-417.

1984 These are Our Goats: The Origins of Herding in West Central Iran. In: Clutton-Brock, J. & Grigson, C. (Eds.), *Animal and Archaeology 3: Early Herders and their Flocks*. BAR International Series, 202, Oxford, pp. 243-264.

Hillman, G. C., A. J. Legge, and P. A. Rowley-Conwy,
1997 On the charred seeds from epipalaeolithic Abu Hureyra: Food or fuel? *Current Anthropology* 38, 651-659.

Hole, F.,
1978. Pastoral Nomadism in Western Iran. In: Gould, R. A. (Ed.), *Explorations in Ethnoarchaeology*, University of New Mexico Press, Albuquerque, pp. 127-167.

1979 Rediscovering the Past in the Present: Ethnoarchaeology in Luristan, Iran. In: Kramer, C. (Ed.), *Ethnoarchaeology: Implications of Ethnography for Archaeology*, Columbia University Press, New York, pp.192-218.

1980 The Prehistory of Herding: Some Suggestions from Ethnography. In: Barrelet, M. T. (Ed.), *L'Archéologie de l'Iraq du début de l'époque Néolitique à 333 avant notre ère*, Éditions de la Centre National de la Recherche Scientifique, Paris, Pp. 119-130.

1989 A Two-Part, Two Stage Model of Domestication. In: Clutton-Brock, J. (Ed.), *The Walking Larder: Patterns of Domestication, Pastoralism, and Predation*, Unwin Hyman, London, pp. 97-104. .

1996 The Context of Caprine Domestication in the Zagros Region. In: Harris, D. R. (Ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, Smithsonian Institution Press, Washington D.C., pp. 263-281.

2004 Campsites of the Seasonally Mobile in Western Iran. In: Folsach, K. von, Thrane, H. & Thuesen, I. (Eds.), *From Handaxe to Khan: Essay presented to Peder Mortensen on the Occasion of his 70th Birthday*, Aarhus University Press, Aarhus, pp. 67-86.

Homewood, K. and W. A. Rodgers,
1987 Pastoralism, Conservation and the Overgrazing Controversy. In: Anderson, D & Grove, R. (Eds), *Conservation in Africa: People, Policies and Practice*. Cambridge University Press, pp. 111-127

Hopewell, P.C.,
1994 Overview of clinical tuberculosis. In: Bloom, B. R. (Ed.), *Tuberculosis: pathogenesis, Protection, and Control*, American Society for Microbiology Press, Washington, D.C., pp. 25-46.

Horrowitz, M. M.,
1972 Ethnic Boundary Maintenance Among Pastoralists and Farmers in the Western Sudan (Niger). In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 105-114.

Horwitz, L. K., E. Tchernov, P. Ducos, C. Becker, A. Von Den Driesch, L. Martin, and A. Garrard,
1999 Animal Domestication in the Southern Levant. *Paléorient* 25, 63-80.

Hrdlicka, A.,
1909 *Tuberculosis among certain Indian Tribes of the United States*. Bulletin 42, Bureau of America Ethnology, Washington, D.C.

Huntington, H. G.,
1972 The Rate of Return from the Basseri's Livestock Investment. *Man* 7, 476-479.

Husain, M.,
1998 *Geography of Jammu and Kashmir: Some Aspects*. Rajesh Publications, New Delhi.

Ingold, T.,
1980 *Hunters, Pastoralist and Ranchers*. Cambridge University Press, Cambridge.

Inhorn, M. C. and P. J. Brown,
1990 The Anthropology of Infectious disease. *Annual Review of Anthropology* 19, 89-117.

Inoue, N. Ito, G., and T. Kamegai,
1986 Dental pathology of hunter-gatherers and early farmers in Prehistoric Japan. In: Akazawa, T. & Aikens, C. M. (Eds.), *Prehistoric Hunter-Gatherers in Japan: New Research Methods*, Bulletin 27, University of Tokyo Museum, Tokyo, pp. 163-198.

Irons, W.,
1975 *The Yomut Turkmen: A Study of Social Organization Among a Central Asian Turkic Speaking Population*. Anthropological Papers 58, University of Michigan Museum of Anthropology, Ann Arbor.

Irons, W. and N. Dyson-Hudson (Eds.),
1972 *Perspectives on Nomadism*. E. J. Brill, Leiden.

Jettmar, K.,
1960 Soziale und wirtschaftliche Dynamik bei asiatischen Gebirgsbauren. *Sociologus* 10, 120-138.

Johnson, D. L.,
1969 *The Nature of Nomadism* University of Chicago Department of Geography Research Paper 118, Chicago.

Johnson, G. A.,
1983 Decision-Making Organization and Pastoral Nomad Campsite. *Human Ecology* 11, 175-99.

Karlen, A.,
1996 *Man and microbes: disease and plagues in history and modern times*. Simon & Schuster, New York.

Khazanov, A. M.,
1994 *Nomads and the Outside World*. University of Wisconsin Press, Madison.

Khoury, P. S. and J. Kostiner (eds.),
1990 *Tribes and State Formation in the Middle East*. University of California Press, Berkeley.

Klein, R. and K. Cruz-Uribe,
1984 *The Analysis of Animal Bones from Archaeological Sites*. University of Chicago Press, Chicago.

Köhler-Rollefson, I.,
1988 The Aftermath of the Levantine Neolithic Revolution in the Ligt of Ecologic and Ethnographic Evidence. *Paléorien* 14/1, 87-93.

1992 A Model for the Development of Nomadic Pastoralism on the Transjordanian Plateau. In: Bar-Yosef, O. & Khazanov, A. (Eds.), *Pastoralism in the Levant*, Prehistory Press, Madison, pp. 11-18.

1993 Camels and Camel Pastoralism in Arabia. *Biblical Archaeologist* 56/4, 180-188.

Krader, L.,
1959 The Ecology of Nomadic Pastoralism. *International Social Science Journal* 11: 499-510.

Krech, S.,
1999 *The Ecological Indian: Myth and History*. W. W. Norton & Co., New York.

Kusatman, B.,
1991 *The origins of pig domestication with particular reference to the Near East*. Ph.D. dissertation, Institute of Archaeology, University of London.

Lambton, A. K. S.,
1953 *Landlord and Peasant in Persia*. Oxford University Press, Oxford.

Lancaster, W. and F. Lancaster,
1988 Thoughts on the Bedouinisation of Arabia. *Proceedings of the Seminar for Arabian Studies* 21, 51-62.

Larsen, C. S.,
1995 Biological Changes in Human Populations with Agriculture. *Annual Review of Anthropology* 24, 185-213.

2015 *Bioarchaeology: Interpreting behavior from the human skeleton*. Cambridge University Press, Cambridge.

Lees, S. H. and D. G. Bates,
1974 The Origins of Specialized Nomadic Pastoralism: A Systemic Model. *American Antiquity* 39, 187-193.

Legge, T.,
1996 The Beginning of Caprine Domestication in Southwest Asia. In: Harris, D. R. (Ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, Smithsonian Institution Press, Washington D.C., pp. 238-262

Levin, M.G. and L. P. Potapov,
1964 *The Peoples of Siberia*. University of Chicago Press, Chicago.

Lubell, D., M. Jackes, H. Schwartz, M. Knyf, and C. Meiklejohn,
1994 The Mesolithic-Neolithic transition in Portugal: isotopic and dental evidence of diet. *Journal of Archaeological Science* 21, 201-216.

Lyman, R. L.,
1994 Quantitative units and terminology in Zooarachaeology. *American Antiquity* 59, 36-71.

MacDonald, M. C. A.,
1991 Was the Nabataean Kingdom a "Bedouin State"? *Zeitschrift des Deutschen Palästina Vereins* 107, 102-119.

McDonald, M. M. A.,
1998 Early African Pastoralism: view from Dakhleh Oasis (South Central Egypt). *Journal of Anthropological Archaeology* 17/2, 124-142.

Manchester, K.,
1991 Tubercolosis and leprosy: evidence for interaction of disease. In: Ortner, D. J. & Aufderhide, A. C. (Eds.), *Human Paleolpathology: Current Syntheses and Future Options*. Smithsonian Institution Press, Washington, D.C., pp. 23-35.

Marsden, D. J.,
1978 *The Qashqa'i Tribe and Tribal Identity*, Occasional Paper 6, Center for Development Studies, University of Swansea.

Marshall, F.,
1990 Origins of Specialized Pastoral Production in East Africa. *American Anthropologist* 92/4, 873-894.

Martin, L.,
1999 Mammal Remains from the eastern Jordanian Neolithic, and the nature of caprine herding in the steppe. *Paléorient* 25/2, 87-104.

Martin, F. R. and A. G. Sanz (Eds.),
1998 *Mesta, transhumancia y lana en la España moderna*, Grijalbo Mondodori, Barcelona.

Marx, E.,
1977 The Tribe as a Unit of Subsistence: Nomadic Pastoralism in the Near East. *American Anthropologist* 79, 343-363.

Mashkour, M.,
2004 Tracing Ancient 'Nomads': Isotopic Research on the Origins of Vertical 'Transhumance' in the Zagros Region. *Nomadic People* 7, 36-47.

Mashkour, M. and K. Abdi,
2002 Archaeozoology and the Question of Pastoralist Campsites: The Case of Tuwah Khoshkeh. In: Buitenhuis, H., Choyke, A. M., Mashkour, M. & Al-Shiyab, A. H. (Eds.), *Archaeozoology of the Near East* V, ARC Publication, Groningen, pp. 211-227.

Mashkour, M., H. Bocherens, and I. Moussa,
2005 Long distance movement of sheep and goats of Bakhtiari nomads tracked with intra-tooth variations of stable isotope (13C and 18O). In: Davies, J., Fabis, M., Mainland, I., Richards, M., & Thomas, R., (Eds.), *Diet and health in past animal populations: current research and future directions*, Oxbow Books, Oxford, pp. 113-124.

Mays, S. A.,
2005 Tuberculosis as a zoonotic disease in antiquity. In: Davies, J., Fabis, M., Mainland, I., Richards, M., & Thomas, R., (Eds.), *Diet and health in past animal populations: current research and future directions*, Oxbow Books, Oxford, pp. 125-.

McCabe, J., S. P. Terrence, and Schofield, C.,
1992 Can conservation and development be coupled among pastoral people? An examination of the Maasai of the Ngorngoro Conservation Area, Tanzania. *Human Organization* 51, 353-366.

McCorriston, J. and F. Hole,
1991 The Ecology of Seasonal Stress and the Origin of Agriculture in the Near East. *American Anthropologist* 93, 46-69.

Miller, N. F.,
1984 The use of dung as fuel: an ethnographic model and an archaeological example. *Paléorient* 10, 71-79.

1985 Paleoethnobotanical Evidence for deforestation in ancient Iran: A case study of urban Malyan. *Journal of Ethnobiology* 5, 1-19.

1996 Seed Eaters of the Ancient Near East: Human or Herbivore? *Current Anthropology* 37, 521-528.

1999 Interpreting ancient environment and patterns of land use: seeds, charcoal and archaeological context. *Turkish Academy of Sciences Journal of Archaeology* 2: 15-29.

Molleson, T., K. Jones, and S. Jones,
1993 Dietary change and the effects of food preparation on micorowear patterns in the Late Neolithic of Abu Hurayra, northern Syria. *Journal of Human Evolution* 24, 455-468.

Mortensen, P.,
1972 Seasonal Camps and Early Villages in the Zagros. In: Ucko, P., Tringham, R. & Dimbleby, G.W. (Eds.), *Man, Settlement and Urbanism*, Duckworth, London, Pp. 293-297.

Mottram, H.R., S. R. Dudd, G. J. Lawrence, A. W. Stott, and R. P. Evershed,
1999 New chromatographic, mass spectrometric and stable isotope approaches to the classification of degraded animal fats preserved in archaeological pottery. *Journal of Chromatography* 833, 209-221.

Mulville, J. and A. Outram (Eds.),
2006 *The zooarchaeology of fats, oils, milk and dairying*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002. Oxbow Books, Oxford.

Murra, J. V.,
1965 Herds and Herders in the Inca State. In: Leeds, A., & Vayda, A. P. (Eds.), *Man, Culture, and Animals: The Role of Animals in Human Ecological Adjustments*, Publications of the American Association for the Advancement of Science, 78. Washington, D. C.: American Association for the Advancement of Science. pp. 185-216.

Musil, A.,
1927 *Arabia Deserta: A topographical itinerary*. Oriental Explorations and Studies 2. American Geographical Society, Mew York.

1928 *The manners and customs of the Rwala Bedouin*. Oriental Explorations and Studies 6. American Geographical Society, Mew York.

Nelson, C. (Ed.),
1973 *The Desert and the Sown: Nomads in Wider Society*. Research Series No. 21, University of California Institute of International Studies, Berkeley.

Nestel, P.,
1986 A society in transition: developmental and seasonal influences on the nutrition of Maasai women and children. *Food Nutrition Bulletin* 8, 2-18.

Netting, R.,
1981 *Balancing on an Alp*. Cambridge University Press, Cambridge.

Nyerges, E.,
1980 Traditional Pastoralism in Environmental Perspective. *Expedition* 22, 36-41.

Oberling, P.,
1974 *The Qashqa'i Nomads of Fars*. Mouton, The Hague.

O'Conner, T.,
2000 *The Archaeology of Animal Bones*. Texas A&M University, College Station.

O'Conner, T., (ed.),
2005 *Biosphere to lithosphere: New studies in vertebrate taphonomy*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002. Oxbow Books, Oxford.

O'Day, S. J., W. Van Neer, and A. Ervynck (eds.),
2005 *Behavior behind Bones: the zooarchaeology of ritual, religion, status, and identity*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002. Oxbow Books, Oxford.

Ortner, D. J.,
1979 Disease and Mortality in the Early Bronze Age people of Bab edh-Dhra, Jordan. *American Journal of Physical Anthropology* 51, 139-156.

Ortner, D. J. and A. C. Aufderhide (eds.),
1991 *Human Paleolpathology: Current Syntheses and Future Options*. Smithsonian Institution Press, Washington, D.C.

Paine, R.,
1994 *Herds of the tundra: A portrait of Saami reindeer pastoralism*. Smithsonian Institution Press, Washington, D.C.

Pearsall, D. M.,
2000 *Paleoethnobotany: A handbook of procedures*. Revised edition. Academic Press, San Diego.

Peters, J., D. Helmer, A. Von Den Driesch, and M. Saña Segui,
1999 Early Animal Husbandry in the Northern Levant. *Paléorient* 25/2, 27-48de Planhol, X. (1968). Les fondements géographiques de l'histoire de l'Islam. Flammarion, Paris.

Ponz, H.,
1988 The Importance, Status and Structure of Almwirtschaft in the Alps. In: Allan, N. J. R., Knapp, G. W. & Stadel, C. (Eds.), *Human Impact on Mountains*, Rowman and Littlefield, Totowa NJ, pp. 109-115.

Poplin, F.,
1976 A propos du nombre de restes et du nombre d'individus dans les échantillons d'ossements. *Cahiers de la Centre Recherches Préhistorique* 5, 61-74.

1978-79 Essai d'ostéologie quantitative sur l'estimation du nombre d'individus. *Kölner Jahrbuch für vor-und frühgeschichte* 16, 153-164.

Potts, D. T.,
2014 *Nomadism in Iran*. Oxford University Press, Oxford.

Price, L. W.,
1981 *Mountains and Man: A Study of Process and Environment*. University of California Press, Berkeley.

Prummel, W. and H. J. Frisch,
1986 A Guide for distinction of species, sex, and body side in bones of sheep and goat. *Journal of Archaeological Science* 13, 567-577.

Quinlan, T and C. D. Morris,
1994 Implications of changes to the transhumance system for conservation of the mountain catchments in eastern Lesotho. *African Journal of Range & Forage Science*, 11/ 3, 76-81.

Redding, R. W.,
1981 *Decision Making in Subsistence Herding of Sheep and Goats in the Middle East*. Ph.D. Dissertation, Department of Anthropology, University of Michigan.

1984 Theoretical Determinants of a Herder's Decisions: Modeling Variation in the Sheep/Goat Ratio. In: Clutton-Brock, J. & Grigson, C. (Eds.), *Animal and Archaeology 3: Early Herders and their Flocks*. BAR International Series, 202, Oxford, pp. 161-170.

Redman, C. L.,
1999 *Human Impact on Ancient Environments*. University of Arizona Press, Tucson.

Redman, C. L., S.R. James, P. R. Fish, and J. D. Rogers (Eds.),
2004 *The archaeology of global change: The impact of humans on their environment*. Smithsonian Institution Press, Washington, D. C.

Reed, C. A.,
1961 Osteological Evidences for Prehistoric Domestication in Southwestern Asia. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 75, 31-38.

Reitz, E. and E. Wing,
1999 *Zoorachaeology*. Cambridge University Press, Cambridge.

Rendu, C.,
2003 *La montagne d'Einveig: Une estive pyrénéenne dan la longue durée*. Editions Trabucaire, Perpignan.

Rifkin, J.,
1992 *Beyond Beef: The rise and fall of the cattle culture*. Dutton, New York.

Ringrose, T. J.,
1993 Bone counts and statistics: a critique. *Journal of Archaeological Science* 20, 121-157.

Rinschede, G.,
1979 *Die Transhumance in den französischen Alpen und in den Pyrenäen*. Westfälische Geographische Studien 32, Münster.

1984 Wanderviehwirtschaft im Vergleich: Alpen/Pyrenaen-Hochgebirge der westlichen USA. In: Grötzbach, E. & Rinschede, G. (Eds.), *Beitrage zur vergleichenden Kutlturgeographie der Hochgebirge*, Eichastaetter Beitrage 12, Verlag Pustet, Regensburg, pp. 285-304.

1988 Transhumance in European and American Mountains. In: Allan, N. J. R., Knapp, G. W. & Stadel, C. (Eds.), *Human Impact on Mountains*, Rowman and Littlefield, Totowa NJ, pp. 96-108.

Rose, J. C., M. K. Marks, and L. L. Tieszen,
1991 Bioarchaeology and Subsistence in the central and lower portions of the Mississippi Valley. In: Powell, M. L, Bridges, P. S., & Mires, A. M. W. (Eds.), *What Means these Bones? Studies in Southeastern Bioarchaeology*. University of Alabama Press, Tuscaloosa, pp. 7-21.

Rosen, S. A.,
1992 The Case for Seasonal Movement of Pastoral Nomads in the Late Byzantine/Early Arabic Period in the South Central Negev. In: Bar-Yosef, O. & Khazanov, A. (Eds.), *Pastoralism in the Levant*, Prehistory Press, Madison, pp. 153-164.

Rosen, A. M.,
1997 The geoarchaeology of Holocene environments and land use at Kazane Höyük, S.E. Turkey. *Geoarchaeology* 12, 395-416.

Rosenberg, M., R. Nesbitt, R. W. Redding, and B. L. Peasnall,
1998 Hallan Cemi, pig husbandry, and post-pleistocene adaptations along the Taurus-Zagros arc (Turkey). *Paléorient* 24, 25-41.

Rowton, M. B.,
1973a Autonomy and Nomadism in Western Asia. *Orientalia* 42, 247-258.

1973b Urban Autonomy in a Nomadic Environment. *Journal of Near Eastern Studies* 32, 201-215.

1974 Enclosed Nomadism. *Journal of the Economic and Social History of the Orient* 17, 1-30.

Ruscillo, D. (ed.),
2006 *Recent advances in ageing and sexing animal bones*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002Oxbow Books, Oxford.

Salzman, P. C.,
1971 Movement and Resource Extraction Among Pastoral Nomads: The Case of the Shah Nawazi Baluch. *Anthropological Quarterly* 44, 185-197.

Salzman, P. C. and E. Sadala (eds.),
1980 *When Nomads Settle: Processes of Sedentarization as Adaptation and Response*. Praeger, New York.

Sauter, F., L. Puchinger, and U.D. Schoop,
2003 Fat analysis sheds light on everyday life in prehistoric Anatolia: traces of lipids identified in chalcolithic potsherds excavated near Boazkale, Central Turkey. *Studies in Organic Archaeometry* (online journal) 6: http://www.arkatusa.org/ark/journal/2003/I15_General/03-799F/799F.asp

Schiffer, J. G.,
1972 *Prehistoric Baluchistan: A Systematic Approach*. Ph.D. dissertation, Department of Anthropology, University of Wisconsin.

Scholz, F.,
1995 *Nomadismus: Theorie und Wandel einer sozio-ökologischen Kulturweise*. Erdkundliches Wissen 118, Franz Steiner Verlag, Stuttgat.

Serpell, J. (ed.),
1996 *The domestic dog: Its evolution, behaviour, and interactions with people*. Cambridge University Press, Cambridge.

Shahrani, M. N. M.,
1979 *The Kirghiz and Wakhi of Afghanistan: Adaptation to Closed Frontier.* University of Washington Press, Seattle.

Sherratt, A.,
1981 Plough and Pastoralism: Aspects of Secondary Products Revolution. In: I. Hodder, I., Isaac, G., & Hammond, N. (Eds.), *Patterns of the Past: Studies in Honour of David Clarke*, Cambridge University Press, Cambridge, pp. 261-305.

Shimoyama, A. and A. Ichikawa,
2000 Fatty acid analysis of pottery samples from Tel-el Kerkh. *Bulletin of the Oriental Museum of Tokyo* 21, 33-36.

1992 *Pastoralism in Africa: Origins and Development Ecology*. Ohio University Press, Athens.

Smith, B. D.,
2001 The Transition to Food Production. In: Feinman, G., & Price, T. D. (Eds.), *Archaeology at the Millennium: A Sourcebook*. Kluwer Academic/Plenum Publishers, New York, pp. 199-229.

Smith, P. G. and A. R. Moss,
1994 Epidemiology of tuberculosis. In: Bloom, B. R., (Ed.), *Tuberculosis: Pathogenesis, Protection, and Control*, American Society for Microbiology Press, Washington, pp. 47-59.

Smith, P. A. and R. M. Smith,
1999 Diets in Transition: Hunter-gatherers to station diet and stations diet to self-select store diet. *Human Ecology* 27, 115-133.

Snyder, L. and E. Moore (eds.),
2006 *Dogs and People in Social, working, economic or symbolic interaction*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002. Oxbow Books, Oxford.

Spigelman, M. and E. Lemma,
1993 The use of polymerase chain reaction (PCR) to detect Mycobaterium tuberculosis in ancient skeletons. *International Journal of Osteoarchaeology* 3, 137-144.

Spooner, B.,
1971 Towards a Generative Model of Nomadism. *Anthropological Quarterly* 44, 198-210.

1972 The Status of Nomadism as a Cultural Phenomenon in the Middle East. In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 122-132.

Spooner, B.,
1973 *The Cultural Ecology of Pastoral Nomads*. Addison-Wesley Module in Anthropology 45.

Stauffer, T. R.,
1965 The Economics of Nomadism in Iran. *The Middle East Journal* 19, 284-302.

Stern, B., C. Heron, M. Serpico, and J. Bourriau,
2000 A comparison of methods for establishing fatty acid concentration gradient across potsherds: a case study using late Bronze Age amphorae. *Archaeometry* 42, 399-414.

Straus, L. G.,
1997 Convenient Cavities: Some Human Uses of Caves and Rockshelters. In: Bonsall, C. & Tolan-Smith, C. (Eds.), *The Human Use of Caves*, BAR International Series 667, Oxford, pp. 1-8.

Swidler, W. W.,
1972 Some Demographic Factors Regulating the Formation of Flocks and Camps Among the Brahui of Baluchistan. In: Irons, W. & Dyson-Hudson, N. (Eds.), *Perspectives on Nomadism*, E. J. Brill, Leiden, pp. 69-75

1973 Adaptive Processes Regulating Nomadic-Sedentary Interaction in the Middle East. In: Nelson, C. (Ed.), *The Desert and the Sown: Nomads in Wider Society*, Research Series 21, University of California Institute of International Studies, Berkeley, pp. 23-41.

Szarzynska, K.,
2002 *Sheep Husbandry and Production of Wool, Garments and Cloths in Archaic Summer*. Agade. Warsaw.

Suzuki, T.,
1991 Paleopathological study on infectious diseases in Japan. In: Ortner, D. J. and Aufderhide, A. C. (Eds), *Human Paleolpathology: Current Syntheses and Future Options*, Smithsonian Institution Press, Washington, D.C., pp. 128-138.

Tapper, R. L.,
1979 *Pasture and Politics: Economics, Conflict and Ritual among Shahsevan Nomads of N.W. Iran*. Academic Press, London.

1998 *Frontier Nomads of Iran: A Political and Social History of the Shahsevan*. Cambridge University Press, Cambridge.

Thijn, C. J. P. and J. T. Steensma,
1990 *Tuberculosis of the Sekeleton: Focus on radiology.* Springer Verlag, Berlin.

Uerpmann, H. P.,
1987 *The Ancient Distribution of Ungulate Mammals in the Middle East*. Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe A27, Dr. Ludwig Reichert Verlag, Wiesbaden.

Vainshtein, S. I.,
1980 *Nomads of South Siberia: The Pastoral Economics of Tuva*. Cambridge University Press, Cambridge.

Vardiman, E. E.,
1977 *Nomaden: Schöpfer einer neuen Kultur im Vorderen Orient*, Economische Verlag, Düsseldorf.

Vidal de la Blache, P.,
1922 *Principes de géographie humaine*. A. Colin, Paris.

Vigne, J.-D., and H. Buitenhuis,
1999 Les premiers pas de la domestications animale à l'Ouest de l"Euphrate: Chypre et l'Anatolie centrale. *Paléorient* 25, 49-62.

Vigne, J.-D, J. Peters, and D. Helmer (eds.),
2004 *The first steps of animal domestication: new archaeozoological techniques*. Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002Oxbow Books, Oxford.

Villa, E. and A. S. Dallix,
2004 Food and ideology: The role of the wild boar and pig in the BA on the Levantine coast. *Anthropozoologica* 39, 219-236.

Vincze, L.,
1980 Peasant Animal Husbandry: A Dialectical Model of Techno-Environmental Integration in Agro-Pastoral Societies. *Ethnology* 19, 387-403.

Webster, S. S.,
1973 Native Pastoralism in the South Andes. *Ethnology* 12, 115-133.

Wing, E. S. and A. B. Brown,
1979 *Paleonutrition: Method and Theory in Prehistoric Foodways*. Academic Press, New York.

Wright, H. T.,
1977 Recent research on the origin of the state. *Annual Review of Anthropology* 6, 379-397.

Zagarell, A.,
1989 Pastoralism and the Early State in Greater Mesopotamia. In: Lamberg-Karlovsky, C. C. (Ed.), *Archaeological Thought in America*, Cambridge University Press, Cambridge and New York, pp. 280-301.

Zeder, M. A.,
1994 After the Revolution: Post-Neolithic Subsistence in Northern Mesopotamia. *American Anthropologist* 96, 97-126.

1999 Animal Domestication in the Zagros: A review of Past and Current Research. *Paléorient* 25, 11-26.

2001 A Metrical Analysis of a Collection of Modern Goats (Capra hircus aegagrus and C. h. hircus) from Iran and Iraq: Implications for the Study of Caprine Domestication. *Journal of Archaeological Science* 28, 61-79.

2003 Hiding in Plain Sight: The Value of Museum Collections in the study of the origins of animal domestication. In: Grupe, G. & Peters, J. (Eds.), *Documenta Archaeobiologiae: Decyphering Ancient Bones: The Research Potential of Bioarchaeological Collections*, Rahden, Verlag Marie Leidorf, pp. 125-138.

Zeder, M. A. and B. Hesse,
2000 The Initial Domestication of Goats (Capra hircus) in the Zagros Mountains 10,000 Years Ago. *Science* 287, 2254-2257.

Zeder, M., E. Emshwiller, D. Bradley, and B. Smith (eds.),
2006 *Documenting Domestication: New Genetic and Archaeological Paradigms*. University of California Press, Berkeley and Los Angeles.

van Zeist, W.,
1967 Late Quaternary Vegetation History of Western Iran. *Review of Paleobotany and Palynology* 2, 301-311.

van Zeist, W. and S. Bottema,
1977 Palynological Investigations in Western Iran. *Paleohistoria* 19, 19-95.

1982 Vegetational History of the Eastern Mediterranean and the Near East during the Last, 20,000 Years. In: Bintliff J. L. & van Zeist, W. (Eds.), *Palaeoclimates, Palaeoenvironments and Human Communities in the Eastern Mediterranean Region in Later Prehistory*, BAR International 133, Oxford, pp. 277-321.

1991 *Late Quaternary Vegetation of the Near East*. Tübinger Atlas des Vorderen Orients Reihe A, Nr. 18, Dr. Ludwig Reichert Verlag, Wiesbaden.

Zohary, M.,
1973 *Geobotanical Foundations of the Middle East*. G. Fischer, Stuttgart.