

THE TECHNOLOGY OF NOMADIC BEDOUIN PASTORALISTS:
IMPLICATIONS FOR THE ORIGIN AND PERSISTENCE OF NOMADIC PASTORALISM

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Introduction

Nomadic pastoralism in the Near East is not well studied by the archaeological community, and is subsequently poorly understood (Chang and Koster, 1986; Barfield, 1993; Simms and Russell, 1996). Archaeologists have historically dismissed it as either just an extension of the “normal” agriculturally associated pastoralism, or as the simple result of hunter-gatherers assimilating food production but keeping their nomadic habits (Chang and Koster, 1986; Khazanov, 1994) (eg. Hole, 1978; Bonte, 1981; Gilbert, 1983). These are unsubstantiated assumptions about the evolution and succession of pastoralism in the Near East and they ignore the technological specialization and unique material culture of modern Near Eastern nomadic Bedouin pastoralists. They therefore cannot explain how or why nomadic pastoralism began in the area or why it endured. To do this, we must ask: What technology allows nomadic Bedouin pastoralists in the Near East to be nomadic and what produced this specialized lifeway and associated technology?

A Definition of Nomadic Pastoralism

Animal husbandry is the keeping and breeding of domesticated animals by humans (Uerpmann, 1996). Pastoralism is a unique form of animal husbandry. Chang and Koster (1986) define pastoralism as a dependence upon domestic herd animals held as property. This definition is differentiated from that of animal husbandry by the exclusion of non-herd animals.

The definition of pastoralism provided by Chang and Koster is clear and easy to understand; however, it is too broad to serve the purposes of this study. If we want to look at nomadic pastoralism as a specialized form of pastoralism, we must establish a good definition of nomadic pastoralism.

Although the phrase 'nomadic pastoralism' may seem self-explanatory, it has been used inconsistently throughout the literature of pastoralism. Originally, the term 'nomadic', combined with 'semi-nomadic' and 'sedentary', was part of an arbitrary classification system for pastoralists based on the extent of their seasonal migration and the extent to which they rely on their animals (Chang and Koster, 1986; Barfield, 1993; Khazanov, 1994) (eg. Awad, 1962; Coon, 1969). Also, these labels carried with them certain expectations and stigmas; a group was classified based on only a few characteristics, and then assumed to be identical to all the other groups in their subset of pastoralism. This ignored the variability among pastoralists and therefore did not accomplish much. It is, however, almost impossible to make sense of pastoralism as a subsistence strategy without being able to classify pastoral groups somehow; but, the classificatory conditions of the extent of migration and amount of reliance on herd animals are not enough.

Another view of nomadic pastoralists is the misconception of the 'pure pastoralist'—the completely self-supporting, completely independent pastoralist (Chang and Koster, 1986; Barfield, 1993). Because this type of pastoralism is not seen in the ethnographic record, it probably never existed in the first place. This term can also be applied to the romanticized orientalist notion of nomadism in

which certain moral attributes, such as stoicism, honor, and independence, are assigned to the nomad who lives solely from the products of his herd (Chang and Koster, 1986; Barfield, 1993). Although nomadic pastoralists create the majority of their subsistence base from their herd animals, they also take advantage of other resources, such as hunting available game animals, gathering available plant resources, and utilization of agricultural resources gained from other groups through trade or raiding (Baer, 1963; Barfield, 1993). It is wrong to assume that nomadic pastoralist groups would not interact with their neighbors; this assumption can only be made if the group in question were geographically isolated from outside contact. Likewise, assuming that nomadic pastoralists do not take advantage of naturally occurring plant and animal resources is also wrong.

Khazanov (1994) writes that the title 'nomads' has historically been applied both to hunter-gatherers and to pastoralists. He believes that this has caused confusion because while both are highly mobile, hunter-gatherers are governed by different conditions and implement their "nomadism" in a very different way than nomadic pastoralists. He defines pastoral nomadism as an economy of extensively mobile pastoralism causing the majority of the population to follow pastoral migrations and which is associated with the level in the development of technology characterized by the period between the Neolithic and Industrial revolutions. This definition is more complete than previous ones, but is still not sufficient as it ignores the environmental and ecological considerations of nomadic pastoralism.

I define nomadic pastoralism as a food producing strategy based on the intensive management of herd animals for their meat and for secondary products such as skin, wool or hair, milk, dung, blood, traction, and transport. Because of the variable climate and environment of the areas in which nomadic pastoralism is practiced and the ecology of their herd animals, this management includes seasonal migration of herds. Because a majority of the members of the group are in some way directly involved with herd management, the household moves with the herd. While the products of the herd animals are the most important resources, utilization of other resources is not excluded. Barfield's (1993) definition of nomadic pastoralism agrees with this, and explains that the stipulations of this definition effectively exclude other intensive pastoralists, such as large scale dairy farmers, who are not nomadic, and other nomadic groups, such as hunter-gatherers and gypsies, who are not pastoralists.

Identification of Nomadic Pastoral Sites

The main line of evidence used to determine the presence of pastoralism in a site is faunal analysis (Chang and Koster, 1986; Khazanov, 1994; Bar-Yosef, 1996; Legge, 1996; Alvard, 2001, unpublished). While it is extremely difficult to differentiate wild from domestic herbivores based only on the anatomical traits of skeletons, the frequency of animal sex and age and species diversity in the faunal record of pastoral sites is different than in hunter gatherer sites. The presence of many young males and old females of one or two species indicate pastoralism, whereas hunter-gather sites have a more random age, sex, and species distribu-

tion. Also, skeletons are more likely to be complete at pastoralist sites but only limb bones are usually represented in the faunal record of hunter-gatherer sites. This pattern stems from the different ways in which each group uses animal resources. Pastoralists want to maintain the best herd composition, which is many fertile females and only a few breeding males, and so are more likely to kill mainly young males and older females for meat. Hunter-gatherers, on the other hand, do not manage their game populations and are more opportunistic in selecting animals for meat. Also, they frequently kill game far from the campsite, and so only bring the limbs, which most meat rich portions, home. Legge (1996) makes a case for determination of domesticates from wild species based on size difference, but this may not work because the natural size variation of each type may overlap.

There are some problems to the faunal analysis method. The activity of dogs can severely affect the types of faunal remains left at a site. Bedouin dogs are not routinely fed, and usually must find food for themselves. They often drag bones far from the original or even the secondary disposal location. In Simms' (1988) study of Bedouin camp site structure, dogs deposited bones twenty meters or more away from the main campsite. This type of faunal analysis may also prove to be misleading in a situation where pastoral people were contemporaneous with hunter-gatherers. Trade or theft of pastoralist meat animals by hunter-gatherer groups produces very similar faunal assemblages at both types of sites. In this case, it is almost impossible to unmistakably distinguish a pastoral site using faunal analysis alone.

Chang and Koster (1986) make a strong case for identifying pastoral sites based on the presence of specialized animal enclosures. These enclosures are very unique to pastoral societies. No other nomadic society needs them. Coupled with this, animal enclosures are very visible in the archaeological record. Animals produce a lot of waste, and animal enclosures accumulate a lot of this waste in even short periods of time. The ground of the enclosure becomes very compacted. The accumulated animal urine and dung shows up archaeologically as changes in the soil chemistry (Chang and Koster, 1986). Chang and Koster (1986) believe that chemical analysis (eg. Phosphate level) of paleosols is the best method to identify animal enclosures. They say that we can almost be certain pastoralists occupied the site once an animal enclosure has been conclusively identified.

Another specialized structure unique to pastoralists that can be used as an identifier is the *laban* platform (Simms, 1988). This feature consists of several flat stones on the ground inside the tent. The *laban* platform is used to store goat milk *laban*, a product only pastoral people can make. Since these platforms are usually left intact upon leaving camp, they are fairly visible in the archaeological record (Simms, 1988). Simms says that this feature is “a durable material referent of animal domestication and dairying (1988)”.

Micromorphology is a very promising technique that may be used to identify pastoral sites. Goldberg and Whitbread define micromorphology as “the study of undisturbed soils and soft sediments using petrographic thin sections (1993)”. One of the main objectives of their study of an ethnographic Bedouin tent living floor (1993) was to define the micromorphological criteria needed to identify

Bedouin tent floors in the archaeological record. They believe that micromorphology is a very feasible means of at least living floor identification, but this technique can also possibly be used to identify the animal enclosures discussed above. They only suggested a few micromorphological characteristics that might show living floors (such as the amount of space in between grains, and a higher percentage of organic material in the thin section) because they feel that many more sites must be sampled to eliminate any statistical error before they can make any definite conclusions.

Antiquity of Domestication in the Near East

The earliest dates for sheep and goat domestication in the Near East are around 10,000-9000 BP (Hole, 1996; Legge, 1996; Ueberman, 1996; Bar-Yosef, 1998; Diamond, 1999). Kohler-Rollefson (1993, 1996) has determined that camels may have been domesticated and used in southern Arabia as early as 4000 BP, but clear evidence of their widespread use outside the Arabian peninsula does not occur until after 3000 BP. Horses also do not appear in the Near East until around 4000 BP (Khazanoz, 1994). The oxen is domesticated in West Asia by 8000 BP, and the domestic donkey is present after around 6000 BP (Diamond, 1999).

The Ecological Factors Associated with Nomadic Pastoralism

As noted above, the climate, environment and ecology of their herd animals significantly affects the nomadic pastoralist life pattern and, as we will discover

below, technology. The areas available to nomadic pastoralists in the Near East are usually marginal—agriculturists and agro-pastoralists usually occupy the better areas (Levy, 1983; Barfield, 1993).

The main climatic variable associated with pastoral migrations in the Near East is the scattered availability of water—through the position of wells and springs across the landscape for drinking, and through the scattered nature of rainfall, which creates pasture (Cole, 1975; Kay, 1978; Behnke, 1980; Levy, 1983; Lancaster and Lancaster, 1986; Barfield, 1993; Keohane, 1994; Khazanov, 1994; Danin, 1998). In order to meet the needs of their herd animals sufficient drinking water and pasture are always necessary. As these resources are depleted or as they change seasonally, the herd must be moved to the next source. Pasture and drinking water may be widely separated depending upon conditions.

The Near East encompasses a wide variety of environments and climatic variations and has contained the same type of variation, though in different proportions, throughout the Holocene (Danin, 1998; Goldberg, 1998). Some of the environmental factors in the Near East that nomadic pastoralists must deal with include large seasonal and daily temperature swings, drought, wind and sandstorms, and water scarceness (Katakura, 1977, Lancaster and Lancaster, 1986; Danin, 1998).

Description of the Technology of Modern Nomadic Bedouin Pastoralists

Near Eastern nomadic pastoralists have developed a unique technological assemblage in response to the aforementioned environmental variables, the ecological needs of their herd animals, and cultural conditions. This assemblage includes a variety of housing, including brush shelters, caves, and most notably, the black tent. Also included are a variety of water management tools such as skin bags and containers, and the digging and upkeep of wells. There is an assortment of food preserving and storage facilities, including milk modification technology and food hiding structures. Spinning and weaving equipment is also an important part of their technology, and the use of animals, most importantly the camel, for traction is significant as well. The following description of modern nomadic Bedouin pastoralist technology relies heavily on publications by Coon (1969), Dickson (1969), Cole (1975), Katakura (1977), Hole (1978), Ibrahim and Cole (1978), Kay (1978), Behnke (1980), Sherratt (1983), Bienkowski (1985), Chang and Koster (1986), Janzen (1986), Lancaster and Lancaster (1986), Weir (1990), Banning (1993), Barfield (1993), Kohler-Rollefson (1993), Keohane (1994), Kohler-Rollefson (1996), Simms and Russell (1996), and Ullah (1999, unpublished). The last reference is my field journal, which I wrote over three months in the summer of 1999, while participating in an archaeological dig in southern Jordan. It is not a scientific study on Bedouin technology but is the observations of a visiting archaeologist on Bedouin life; and, Because I recorded many of the aspects of Bedouin technology that I witnessed in the journal, I use it in this study.

Of the housing structures used by the Bedouin, the black tent, or *Bayt al-sha'r*, is most associated with a highly nomadic lifestyle. The tent is composed of three parts: the roof, the walls, and the poles and guy ropes. The roof is made of several (usually six to eight) linear (around 60-90 cm wide) strips of cloth sewn together lengthwise to create a large rectangle of cloth. This cloth is supported by large center poles and smaller outer poles and secured by guy ropes. A wooden socket or stick protects the point of contact between a pole and the tent roof. Also, reinforcing strips are sewn across the width of the tent roof at the lines of greatest strain where the poles are attached. V or D shaped rings are sewn to the end of these reinforcing strips to which the guy ropes are attached. The guy ropes are secured to the substrate by pegs, or by brush anchors buried in the sand. The front and back walls are pinned to the tent roof, and either the long ends of the roof hang down to make the side walls, or the back wall wraps around to cover the sides. The back and side walls can alternatively be built of stacked field stones or brush. When possible, the tent floor is usually outlined by a circle or semicircle of stones.

Goat hair is the most common tent roof material, although sheep's wool, camel hair, or any combination of the three may also be used. Also, cotton, jute, or another plant fiber cloth may be used. If these are used at all, they usually will only be used in the tent walls. The most common rope material is hemp or jute.

The Arabic name, *Bayt al-sha'r*, literally means "house of hair", and some characteristics of the tent, like its black color, are a direct consequence of the raw material it is made from. Other characteristics of the tent have to do with the

way that raw material is processed into threads, and how it is woven. Raw animal fiber is spun on a hand spindle to produce a single strand of yarn. This strand is then re-spun; making the finished yarn double stranded. The finished yarn is woven on a ground loom, which is a completely manual loom.

Caves may also serve as shelter for nomadic Bedouin pastoralists. Binkowski (1985) lists three types of cave dwellings: residential, work, and seasonal. Residential caves are extensively modified and are associated with a more sedentary lifestyle. A good example of this type of cave can be seen in Petra where the Bedul inhabit ancient Nabatean cave-houses. Work and seasonal caves are more associated with a nomadic lifestyle. Work caves are not residential; they are used for as animal pens, dairying facilities, as rest areas, and other things. These caves are generally not modified very much. Seasonal caves are basically residential caves that are not extensively modified and that are only occupied for short time periods. All of these types of caves can be used in conjunction with a black tent dwelling, or on their own.

Brush shelters may also serve as a dwelling for nomadic Bedouin pastoralists. These range from fairly complicated structures of poles and branches to simple reed or palm huts and to even simpler stacked brush shelters. Sometimes a tree will be modified to construct a shelter, and even an unmodified tree can serve as the simplest shelter of all. Other types brush constructions are built to be used in conjunction with the black tent or cave. These range from stacked brush windbreaks, walls, privacy screens, or animal enclosures to fairly elaborate sun shades over daily work areas.

Skin bags are used to store and transport water and other goods, and are important in the process of converting milk into yogurt, butter, and cheese, which keep better. Goat skin, and to a lesser extent sheep and camel skin are the most common materials for these bags, although various game animals such as gazelle may also be used. The simplest skin bag consists of an unmodified skin that is tied off securely at the ankles and the neck left as the opening. Skin can also be cut and sewn into more elaborate bags. Skin buckets are used for hauling water and troughs for watering the herd are constructed of a skin bowl suspended on a wooden frame.

The Bedouin use skin bags to convert milk into yogurt, or *laban*. The bags are reused and therefore retain the culturing bacteria necessary to make *laban*. To convert the *laban* into butter, a special skin container is used. This container is suspended from a wooden tripod and is rocked back and forth until the butter coagulates. The *laban* can also be boiled, drained, and then placed into another type of skin bag where it is kneaded until it turns into cheese.

Well building and management is another important aspect of nomadic Bedouin technology. The Bedouin construct and maintain both tube wells and artesian wells. In addition, natural springs are cleaned out and maintained. Wells are strategically spaced throughout the countryside, and are maintained at regular intervals.

The storage technology of modern Bedouin culminates in storage facilities called *masan*. Dairy products, grain and other foodstuffs as well as material items can be stored in these *masan*. While some *masan* are placed in the open,

most are carefully hidden and camouflaged. These will be constructed with natural stones to match the color of the surroundings and the *masan* will be shaped to blend in with the background. Naturally occurring niches and small caves can also be used, and these will also be camouflaged. *Masan* may also be located in remote or dangerous areas, and the items stored will be moved frequently from *masan* to *masan*.

A more specialized storage structure is the *laban* platform. It consists of several flat rocks, and is almost always located inside the habitation structure. Storage of *laban* is its only function. The rocks keep the *laban* cool by insulating it from the ground, which lengthens its storage life. Also, it provides a dirt free place to keep the *laban*.

The tractive power of domesticates can be considered part of the pastoral nomad's tool kit. Camels, donkeys, horses and oxen are the only animals available to Near Eastern pastoralists that are large enough to be effective vehicles for the traction of all the other material items during nomadic movements. Of these the camel is the most suitable for the environment, followed by donkeys and then horses. The ox is not suitable for Near Eastern nomadic pastoralism because of its high resource consumption. Khazanov (1994) writes that horses have always been rare and very expensive in the Near East, and since their arrival was probably contemporaneous with that of the camel (see above for exact dates), nomadic pastoralists probably did not use them very much for traction. Some modern Bedouin do, however, breed horses for riding.

Aspects and Discussion of Modern Nomadic Bedouin Pastoralist Technology

Parts of modern Bedouin pastoralist technology, such as the black tent, are obviously specialized for nomadic pastoralism, while other parts, such as skin bags, wells, and brush shelters, are commonly used by many other types of groups. When the entire assemblage of nomadic pastoral technology is looked at as a whole, however, it is unmistakably specialized. In order to understand this specialization, it is useful to investigate particular aspects of nomadic pastoral technology and see how they relate to one another. This section also relies heavily on publications by Coon (1969), Dickson (1969), Cole (1975), Katakura (1977), Hole (1978), Ibrahim and Cole (1978), Kay (1978), Behnke (1980), Sherratt (1983), Bienkowski (1985), Chang and Koster (1986), Janzen (1986), Lancaster and Lancaster (1986), Weir (1990), Banning (1993), Barfield (1993), Kohler-Rollefson (1993), Keohane (1994), Kohler-Rollefson (1996), Simms and Russell (1996) and Ullah (1999, unpublished).

The black tent holds many features that make it ideally suited for nomadic pastoralism. It is easily set up and taken down, can be transported fairly easily, and is constructed from a material that makes it superior to other types of habitation in an arid environment. Because the raw tent material is the hair of the Bedouin's own herd animals, the construction of the tent, and because spinning and weaving is part of the nomadic pastoralist tool kit, repair and replacement of worn tent parts is fairly easy. Although no scientific study has been done, the black color of the goat hair material is probably similar to the color of a raven's feathers—not the absence of all colors but the presence of all colors. This color is

superior at reflecting solar radiation, and therefore the tent roof does not heat as quickly as other material when exposed to direct sunlight. Also, the tent walls can be raised or taken off to take advantage of any cooling breezes. They can also serve as awnings, which can be moved during the course of the day to produce the most amount of shade. The special weave of the tent material swells when wet, and combined with the natural oils present on the fibers, this makes the tent relatively waterproof. The weave also increases the insulation value of the material. The tent walls can be secured down in cold weather or during cold desert nights and heat will be retained very well. Closing the tent walls also provides protection from sandstorms and provides privacy.

The tent is more versatile than other habitation types. While Near Eastern nomadic pastoralists do use caves, the areas in which this type of habitation is used is limited by the availability of caves. In order to make and use substantial brush shelters, enough materials must be immediately available. Large expanses of the areas of the Near East traditionally used by nomadic pastoralists lack dense patches of trees or brushy vegetation (Danin, 1998; Goldberg, 1998). The time that it would take to find and gather enough material to build a sufficient brush shelter in these areas could be longer than the group plans to stay at that camp. A good example of an area where this can be true is the *Rub' al-Khali*, the vast desert of the Arabian peninsula known as the Empty Quarter. A tent, however, can be used as a shelter in a caveless area, and because it moves with the group, can be set up quicker and more efficiently than a brush shelter.

Water management is the most important aspect of nomadic pastoral technology in terms of survival. As previously discussed, pasture and water may be widely separated but are both needed to sustain the herd animals. Because pasture is a fixed resource, nomadic pastoralists are forced to camp in close proximity to it. Water must be brought to the camp and stored, and skin bags are the easiest and most efficient way to do this. Also, strategic placement of wells allows the exploitation of potential pasturage that is too far from the nearest natural water source.

Food preserving and storage technology is also important for Near Eastern pastoral nomads because of the climatic variability of their marginal environment. Converting milk into a variety of longer keeping dairy products allows prolonged use of and intensive reliance on a resource that would otherwise be short term and less important. Storage of food items provides a backup for the season when food production is low or during years of drought. Simms and Russell (1996) find that camouflaging and hiding food storage facilities deters inter-group competition by preventing opportunistic and premeditated theft. Also, because the head of the household is in charge of storing and therefore is the only one who knows the location of all the storage sites, group members cannot hide food from each other, and intra-group competition is lessened. In a marginal environment where there are times of lessened resource availability, the ability to convert food into longer lasting forms and to effectively store it is important for survival. While other types of groups do practice these things, the food preserving and storage technology of nomadic pastoralists is highly specialized for their lifestyle.

Nomadic Bedouin pastoralists have a much larger material culture than nomadic hunter-gatherer groups. It would be very difficult if not impossible for nomadic Bedouin pastoralists to be as nomadic as they are without domesticated animals to use for traction and transport of these material culture items. Kohler-Rollefson (1993, 1996) shows that the advent of the domesticated camel around 2000-1000 BP corresponds with the dates for the earliest pastoralist archaeological remains found in the most remote areas of the Near East. She argues that the ecological characteristics of the camel, namely its extraordinary water conserving abilities and its ability to survive on the sparse and poor quality desert vegetation, allowed nomadic pastoralists to exploit areas that were previously inaccessible. Donkeys were probably used extensively by nomadic pastoralists for traction before the domestication of the camel (Khazanov, 1996). And, donkey bones were found in some nomadic pastoral archaeological sites (Sherratt, 1983; Bar-Yosef, 1996).

Implications for the Beginnings and Evolution of Nomadic Pastoralism

The technological specializations of nomadic pastoralism in the Near East preclude it from beginning as either an extension of sedentary agro-pastoralism or as the addition of pastoral food production to a preexisting hunter-gatherer lifestyle. If these were the case, we would expect to see similarity between the material culture of ancient and modern Near Eastern nomadic pastoralists and ancient nomadic hunter-gatherer or sedentary agro-pastoral technology.

We cannot, however, assume that nomadic pastoralism evolved in isolation, and any ideas about its origins must realize that original pastoralist must have changed from some other subsistence strategy (Khazanov, 1994). Domestic herd animals were first used only for meat, and the use of secondary products did not begin until around 6000 BP (Levy, 1983; Sherratt, 1983; Simms and Russell, 1996; Uerpmann, 1996; Alvard, 2001, unpublished). This date has been examined by comparison with the percent of adult hypolactasia (lactose intolerance) in the modern human world populations (Simms and Russell, 1996). The gene is autosomal dominant, and if dairying began at the same time as domestication (10,000 BP), then a selective advantage of only 1-3% accounts for the present spread. The date of 6000 BP means that a much higher selective advantage would be necessary. Because milk and dairy provides so much of modern pastoralists dietary energy, it is likely that milk drinking would have had such a high selective advantage in marginal habitats, supporting the 6000 BP date (Sherratt, 1983).

Alvard (2001, unpublished) uses advanced ecological modeling (based on prey conservation and optimal foraging theories) to show that if meat is the only resource considered, pastoralism is likely to occur if resources are less abundant, are defended, and when the cost of deferring harvest of the meat is low (i.e. the potential benefits of conservation and deferred harvest of meat outweighs the potential cost of immediately harvesting and consuming that meat). He also uses an allometric model that predicts that as the deferment cost increases, the body size of the domesticate should decrease. This is because smaller animals are smaller

meat packages and therefore an individual smaller animal cost less to conserve than individual large animals. Large animals will not be domesticated until a potential pastoralist group has enough resources to invest in larger meat packages. This prediction seems to fit the pattern of the species domestication timing seen in the Near East (see above for dates).

Herding for meat alone, however, does not provide enough resources for full time specialized nomadic pastoralism to be worthwhile. Only when the secondary animal products are also utilized can enough food energy be provided from the herd animals to make this lifestyle successful (Simms and Russell, 1996). Therefore, specialized nomadic pastoralism probably could not occur in the Near East until the secondary products revolution, an idea supported by the archaeological record (Khazanov, 1994).

Many researchers have assumed early pastoralism to be linked rather closely with early agriculture (eg. Levy, 1983, Hole, 1996). Since even modern Bedouin nomadic pastoralists highly depend upon agricultural resources, this idea is probably true. Early meat pastoralism, because it requires long term deferment and because on its own it cannot fully support a group, would have had to have been tied to a more productive economy, like agriculture. Hunter-gatherer groups could not have devoted the time and energy needed to sustain meat herds.

Assuming a relationship between early pastoralism and early agriculture, however, does not mean that *nomadic* pastoralism began as merely an extension of agriculture. Instead, Nomadic pastoralism probably dually evolved with agri-

culture (Levy, 1983). Levy (1983) believes that improvements in the technology of agriculture in the Chalcolithic allowed agriculturists to move to more marginal lands. After the secondary products revolution, herd animals became an indispensable part of the subsistence base of these agriculturists. Because agriculture in the more arid lands was more difficult than in richer areas, the need to keep herd animals away from the fields increased. Nomadic pastoralism began because a specialized component of the society was needed to herd animals away from the agricultural areas. Trade between the two groups allowed them both to exploit agricultural and animal products.

Lightfoot (1983) postulates that nomadic pastoralism is a response to a marginal environment. In order to gain enough resources in a marginal environment, Lightfoot believes that either resource intensification, migration, or both must occur. Bar-Yosef (1996) believes that the growing populations in the early Chalcolithic states of the more temperate regions of the Near East pushed the more subsistence level groups into the surrounding marginal environments. Adding this idea to Lightfoot's hypothesis gives another possible mechanism for the origin of nomadic pastoralism in the Near East.

However it began, nomadic pastoralism certainly did not emerge with the full suite of technology seen in modern nomadic pastoralists. Because the tent is made of animal hair, a secondary product, and because it cannot be carried easily by people alone, caves and brush shelters are more likely to have been the first habitation types of nomadic pastoralists. The donkey, domesticated around the same time as the secondary products revolution, allowed further mobility and

tractive ability. Based on interpretation of herd composition, ancient nomadic pastoralist groups relying on foot power and donkeys could not wander more than 30 km from a permanent water source (Khazanov, 1994). As discussed earlier, the camel's desert-specialized physiognomy revolutionized nomadic pastoralism with the advent of its domestication (Kohler-Rollefson, 1993, 1996). It is not until this time that the nomadic pastoralists similar to modern Bedouin type are seen in the archaeological record.

Conclusion

The origins of pastoral nomadism in the Near East and its associated technology are difficult to uncover. The idea of a "secondary products revolution" beginning around 6000 BP helps provide some basis for understanding these origins. While animal husbandry and meat pastoralism had been practiced for at least 4000 years prior to this revolution, pastoral nomadic specialization could not occur without exploiting secondary animal resources. While this may be the condition that allows nomadic pastoralism to be a worthwhile occupation, the exact political, cultural, or other mechanism that initiated nomadic pastoralism in the Near East is still unknown.

Many aspects of modern nomadic Bedouin technology reflect the unique relationship with their herd animals. Most important among these are the technology associated with dairying and weaving. Other aspects of modern Bedouin technology have been adapted from previously existing technology, but specialized to fit the needs of nomadic pastoralism. Important among these are skin

bags, wells, and storage facilities. As a whole, the technology of modern Bedouin nomadic pastoralists is specialized by two processes: maintaining the ecological needs of their herd animals, and dealing with the environmental and climatic conditions of their marginal habitat.

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