Why Didn't the American Indians Domesticate Sheep?

CHRISTOPHER CARR

In The Origins of Agriculture, edited by Charles A. Reed, pp. 637-691. Mouton, The Hague. 1977

One of the striking differences between the Neolithic Revolutions in the Old and New Worlds is in the degree to which animal domestication occurred. While in western Eurasia, sheep, goats, cattle, pigs, and horses all played important roles in the change to Neolithic ways of life, in North and Middle America, the domesticated animals were apparently limited to the dog and turkey, both of which were secondary in importance to plant domestication in this life change. As wild sheep occur in both the New and Old World, the question arises, "Why didn't prehistoric man domesticate sheep in the New World?"

For several reasons, however, this innocent question is somewhat misleading. First, investigation of opportunities for DOMESTICATION is too narrow a perspective. When we talk of domestication, we are speaking of only the final stage of a process: a process of changing man-animal relationships. Domestication is commonly defined as that man-animal relationship in which animals are removed from their natural living area and breeding community, and are controlled in their breeding habits for profit (Bökönyi 1969). There are a number of man-animal relationships, however, which do not fit this definition, but which do achieve the same RESULTS for man: increased efficiency in the exploitation of animal resources. Wilkinson (1972: 112) has defined three ways by which man may increase his efficiency of animal exploitation, none of which necessarily involves domestication: (1) previously inaccessible resources may be exploited through the development of new man-animal relationships; (2) the productivity of the relationship with a pre-exploited resource may be increased by either reducing the energy involved in exploiting the resource, or by increasing the productivity of the resource; and (3) the

development of new man-animal relationships may permit, on one hand, localization or concentration of the animal resource near the area of human settlement, or on the other hand, allow human occupation in previously marginal or uninhabitable localities. Zeuner (1963) has also described numerous man-animal relationships which do not fall within the range of the definition of domestication, but which do increase man's efficiency in animal exploitation.

A second reason for the misleading nature of the question, "Why didn't prehistoric man domesticate sheep in North America?" is its processual viewpoint. Many man-animal relationships need never develop into a relationship of animal domestication; they need not be part of a conscious PROCESS OF DOMESTICATION. Finally, the question is misleading because it implies the singularity of the process of domestication. As Zeuner (1963) has pointed out in detail, there may be numerous paths to domestication.

Therefore, it is perhaps somewhat misleading to take the viewpoint from the END of A PROCESS and ask, "Why didn't prehistoric man domesticate sheep in North America?" Instead, the viewpoint of ORIGINS should be taken, and one may ask, "What prehistoric man-sheep relationships did exist in North America?"; "Did these relationships afford man the opportunity to domesticate sheep?"; and, finally, "If so, why didn't man take advantage of the opportunity?"

GENERALIZATIONS

It is the first question, "What prehistoric man-sheep relationships existed in the New World?" which is the most crucial. It is also the most difficult to answer because of the nature of existing archaeological data. In the first place, there are no cultural indicators, such as particular tool types, which might be used to suggest the type or intensity of management of sheep prior to domestication. While grinding stones, manos, and types and frequencies of metates are often used to reconstruct the presence, absence, or degree of use of maize agriculture in the New World, there are no tools which are specific to the development of sheep management and which might, equivalently, be used to indicate such relationships. Only the faunal evidence, the archaeological contexts, and the cultural complexes and continua as a whole are available for study. These, however, are not sensitive indicators of the type or intensity of the relationship. Osteological changes in the social ruminants, for instance, do not become apparent until well after domestication occurs. Prior to domesti-

cation, not even the quantity of sheep bones found in the refuse may be used to suggest the type of social relationship, for large quantities of bone from one animal resource may result from selective hunting (Zeuner 1963: 59).

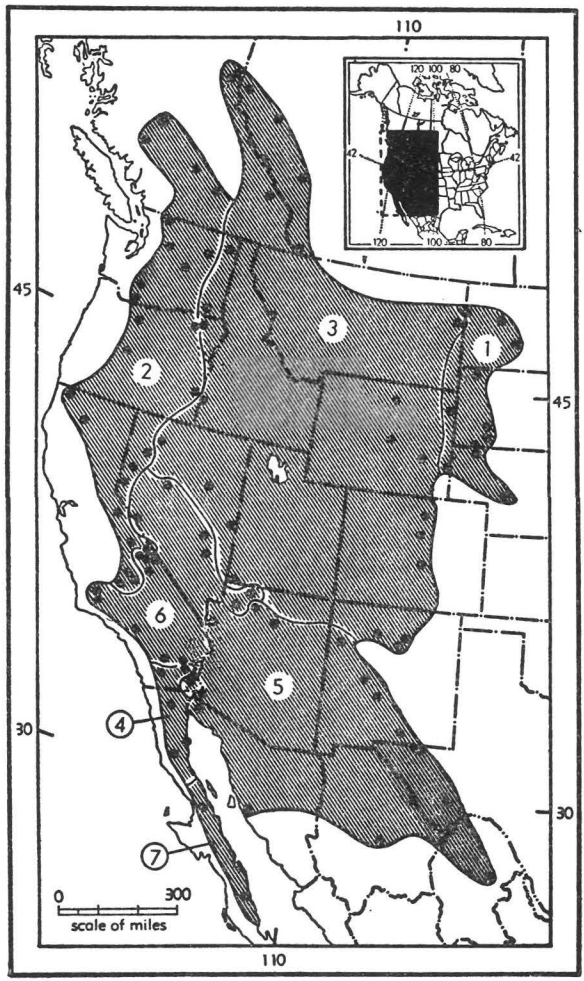
The seriousness of the matter becomes very clear when we take a modern example of experimental man-animal relationships. Wilkinson (1972: 108) has described an experiment in which European elk (*Alces alces*) were "attached" to a particular location by teaching them to associate the area with food. The tamed animals were exploited for their milk, but allowed to interbreed with their wild counterparts. This was a particularly profitable and stable arrangement, as the tame elk drew the wild elk to the man-made feeding ground, providing a continuing renewal of the stock of elk. It would take a shrewd archaeologist to unravel such a circumstance from the archaeological evidence.

In view of this lack of sensitive indicators which might be used to discover prehistoric man-sheep relationships in the New World, I began this study with a broad comparison of the habits and distribution of sheep of the Old World and the New in light of the location of prehistoric centers of early sedentism and domestication of plants. By doing so, I hoped to discover some of the significant variables in man-sheep relationships and in the processes which did, in the Old World, lead to domestication of sheep. The working assumption which I made in this comparison, as well as in the remainder of this study, is that the processes leading toward domestication of sheep were most likely to have occurred in those areas in which man was sedentary. As Zeuner (1963: 62) has concluded:

> The advanced state of domestication, in which movement [and thereby the breeding habits] of animals was completely controlled by man, was clearly impossible in pre-Neolithic times, ... [while] man was moving with the animals. ... But to proceed to the stage of confining animals to restricted spaces, man would have had to change his economic system, for the sake of an experiment the outcome of which would have been extremely uncertain. It is most unlikely ... [he] would have ever been willing to do this.

There are several important differences in the distribution and habits of sheep of the New World and Old World which are immediately apparent. In the Old World the centers of early sedentism, plant domestication, and sheep domestication all occur in the same general area — the foothills and inter-mountain valleys of the Zagros and Tauros Mountains — which lies within the geographic distribution of that population of wild sheep (*Ovis orientalis*) which archaeologic, genetic, and systematic evidence indicates was the ancestor of domestic sheep (Nadler, et al. 1973).

In the New World the situation differs; the distribution of wild sheep does not now reach and never has reached the Mexican centers of plant domestication and early sedentism. *Ovis canadensis*, the American bighorn sheep, ranges south only into central Sonora, Chihuahua, and Coahuila, the northernmost of the states of Mexico (Figure 1). In the most



Guide to subspecies
1. *O. c. auduboni*
2. *O. c. californiana*
3. *O. c. canadensis*
4. *O. c. cremnobates*
5. *O. c. mexicana*
6. *O. c. nelsoni*
7. *O. c. weemsi*

Figure 1. Geographical distribution of the wild American bighorn sheep, *Ovis canadensis* (copied from Hall and Kelson 1959: 1031)

general terms, then, the possibility exists in the foothills and intermountain valleys in the Near East, where both hunting and gathering were important subsistence activities in pre-agricultural and incipient agricultural times, that the domestication of plants and sheep might have developed, perhaps separately at first and then together, into a unified economic system. In the New World, on the other hand, only sedentism and plant domestication could develop together. Before the domestication of sheep became a possibility, plant domesticates, and the opportunity they offered for sedentary life, first had to diffuse northward, into the home of the mountain sheep. But in pre-sedentary times the Cochise lived in eastern Arizona, western New Mexico, and north-central Mexico along the mountainous pathway by which plant domesticates diffused northward. These Cochise were gatherers of plants and hunters of small game, whose techno-economic system was pre-adapted only to the development of agriculture and not intensive social relationships with sheep. The apparent lack of social relationships between the bighorn sheep and those Cochise who found themselves in the pathway of the diffusing plant domesticates made less likely the development of man-sheep relationships which might have led to domestication.

Although this is a greatly over-simplified view of complex developmental processes involving diffusion and exchange of fragments of economic systems over discrete periods of time rather than diffusion and exchange of economic systems as a whole, it does suggest the different relationships between sedentism, plant domestication, and animal domestication in the Near East on the one hand, and in the New World on the other. I will elaborate upon these processes and differences later.

While the American bighorn seems as SOCIABLE and is probably as tamable as the Asian sheep (Geist 1971: 41), there are differences in the ECOLOGIC habits of the New and Old World sheep which suggest differing opportunities for the development of social relationships between man and sheep in the two continents. The sheep of southwestern Asia (Asiatic mouflons) prefer open, rolling mountains and foothills. Within intermountain regions, they often follow the river valleys, not hesitating to descend to the lower, rolling, open foothills to graze and drink (Clark 1964: 6). The American sheep, on the other hand, are generally (although not always) found on higher, more precipitous mountains (Geist 1971: 4), often above the timberline (Bailey 1931). One hypothesis (Geist 1971: 4) for this difference is that in southwestern Asia, the goat (*Capra hircus aegagrus*) occupies that ecologic niche of the more precipitous terrain. Asiatic mouflons have seemingly specialized in the gentler terrain in the

face of this competitor. In North America, no serious competitors existed in the rocky zone when sheep entered the continent during the Pleistocene. They have, therefore, been able to exploit the niches equivalent to those of BOTH the goat and the sheep in the Old World. This difference in the ability of the Old World and New World sheep to use the more rugged mountainous zones may have resulted in a difference in the opportunities for the development of prehistoric man-sheep relationships on the two continents. In North America, when sheep were hunted, they could retreat into the more rugged country, just as they have in historic times, limiting man-sheep contact. In the Old World, however, sheep could not successfully withdraw into the more precipitous parts of the mountains as this niche was already filled by the goat. Relationships between sheep and hunters therefore had more opportunity to develop in the Old World. As economic dependence upon a hunted animal is one of the common bases from which more intensive social relationships are developed (Zeuner 1963: 15), this potential difference of opportunity must not be underestimated.

By the same line of reasoning, when human populations began to settle down and increase in number in the Near East, exploiting land and floral resources previously used by Asiatic mouflons, the sheep could not have withdrawn to the more rugged uplands. Sheep in the Near East, then, may have developed a symbiotic relationship with man, in which the browse of exhausted, fallow, and wintering fields was eaten by sheep, while man exploited them. In North America, however, sheep had the opportunity to retreat to the more rugged slopes.

Adaptation to different ecologic niches has other immediate consequences. The American sheep are superb jumpers and climbers (Geist 1971: 4). They are seldom found in areas where there is not, at least nearby, a cliff with broken face or talus slopes to provide a means of escape (Stone and Cram 1902: 63). When hunted, the American sheep run for precipitous terrain (Geist 1971: 4). In contrast, Asiatic sheep frequently wander away from the foothills into gentler country, and when hunted, will avoid the cliffs. This may have made New World sheep less desirable game for prehistoric man than other animals, such as deer and antelope, while in the Old World, sheep would have been more readily available. Again, the different potentials for the hunting of sheep in the New and Old World must be recognized as a significant difference in opportunities for the development of more intensive man-sheep social relationships.

The different ecological adaptations of sheep in the New and Old Worlds are also revealed in the different manners in which the New and Old World ewes bear their young. The ewes of Asiatic mouflons bear their

lambs in open terrain or near rock piles in open landscape. They have multiple births (Geist 1971: 242). Under these conditions, the capture of a lamb is easy. In North America, ewes choose rugged cliffs as places to have their lambs, and normally bear only one lamb at a time (Geist 1971: 242), allowing less opportunity to capture the young. As it is the young, as opposed to adult, animals which are usually more easily tamed, these behavioral and biological differences further suggest the greater opportunity prehistoric man in the Old World had to develop social relationships with wild sheep.

While these differences in the ecologic behavior of the American bighorn and Asiatic mouflons do suggest differences in OPPORTUNITIES for the development of social relationships between man and sheep in the New and Old Worlds, they need not lead to a difference in the development of these relationships. Whether these ecologic variables are SIGNIFICANT FACTORS in the development of man-sheep social relationships depends on their systemic integration with a number of other ecologic and cultural variables. The desirability of a food resource for a man is weighed against the availability of all OTHER potential food resources IN HIS LOCAL ECOSYSTEM, rather than against the availability of that SAME food resource IN ANOTHER MAN'S ECOSYSTEM. Furthermore, differences in the orientation of cultural systems — toward hunting or gathering — may make the availability of plant or animal resources more or less significant. For instance, during pre-agricultural times in the Near East, where hunting as well as gathering was an important subsistence activity, animals were hunted in both rugged and gentle terrains (Perkins 1964; Braidwood, et al. 1971). In the drainage of the Upper Little Colorado River during pre-agricultural times however, the Cochise, whose economic system was oriented more toward gathering plants than hunting, do not seem to have exploited game resources in the more rugged uplands. The significance and the effect of the ecologic behavior of the New World sheep upon opportunities for the development of man-sheep social relationships, then, must be considered in the light of the ecology of local plant and animal communities and the orientation of particular cultural systems, rather than alone.

The idea should not be formed, moreover, that the niches occupied by sheep in North America and southwestern Asia do not overlap, for they do. The difference is simply that the range of the sheep in the New World extends to higher, more rugged terrain than does that of the Asiatic mouflons. Before the advent of the white hunter, mountain sheep in North America inhabited not only the higher, more rugged regions of

many of the ranges of mountains in western North America (Hall and Kelson 1959: 1031) but were also found on the foothills or lower, wherever some rugged terrain exists, such as in Death Valley, California (Welles and Welles 1961), or northwestern Nebraska (Jones 1951). In the 1880's, sheep were still plentiful in the Dakota badlands (Wister 1904: 167). Further west in the Wyoming badlands between the Yellowstone, Missouri, and Powder valleys, Lydekker (1898) reported that flocks of sheep:

> ... seek the prairie to feed at daylight, returning to the badlands at ten o'clock to rest until the afternoon, when they will again rise to feed among the badlands, often returning to the prairies in the evening and grazing until dark...

Wister (1904: 176) wrote of the sheep in Wyoming in the 1880's:

> They had not taken to the peaks exclusively then; the great tableland was high enough for them. I very well recall a drive in July, 1885, when, from the wagon in which I sat, I saw a little band of them watching us pass in a country of sage brush and buttes so insignificant as not to figure as hills upon a map. That was between Medicine Bow and the Platte River.

In the more mountainous regions, such as Yellowstone, Wister has reported (1904: 199) that the bighorn once occupied the full altitudinal range, from the sage brush and cottonwood country, up through the pines and quaking aspen, onto the high, wet meadows and the willow brush country, and finally reaching above the timberline. Bighorn sheep are still found today on the low isolated mountain ranges of southwestern Arizona (Haury 1950: 27), where they are easily hunted (Bailey 1931: 18–20).

Today, at various times of the year, depending on local conditions of weather, terrain, and flora, bighorn sheep will come down from the more rugged heights into which they have fled in historic times. Most usually in winter and early spring, when browse becomes scarce in the upland pastures, either from over-grazing or from hardening of snows over the grasslands, the sheep may come down to the lower, evergreen-forested slopes, where snow is soft and they can dig for food. In these soft snows, however, the sheep are also defenseless against capture (Bailey 1931), just as are the newborn lambs of Asian ewes, out in the open terrain.

Bighorn sheep in the more mountainous regions of North America may also migrate down through the lower conifer-forested life zones in order to move from patches of grassland on the upslopes of one mountain to patches of grassland on the upslopes of the next. During the warmer and drier Altithermal, these high-elevation grassland habitats on the upslopes once formed a much more continuous belt between mountain peaks. When the climate became cooler and moister, however, brush and forests

spread along the intermountain valleys and ascended the mountains, dividing the habitats of the sheep into smaller, isolated patches at the higher elevations. As this process occurred slowly, sheep continued their normal movements between mountains through the valleys, despite the fact that these latter were not a part of the bighorn's preferred habitat (Geist 1971: 125). These intermountain treks are predictable, and could have been utilized by prehistoric New World hunters.

There are not, then, any hard and fast generalizations that can be made concerning the different degrees of opportunity for the development of man-sheep relationships in the New and Old Worlds in terms of the ecology and behavior of the sheep. The degree to which the geographical distribution of sheep and prehistoric man overlapped in the New and Old World depended upon LOCAL CONDITIONS OF TERRAIN, WEATHER, AND FLORA. Furthermore, my generalizations of the differences in the geographic distribution of sheep in relation to the prehistoric centers of early sedentism, plant domestication, and animal domestication in the New and Old Worlds are only the most general of guides to the significant variables in LOCAL CULTURAL PROCESSES. To answer the question, "What prehistoric man-sheep relationships existed in the New World?" we must look for answers in terms of local ecological and cultural systems, not interregional, average situations which smooth out the significant variations in opportunities for the development of social relationships between man and sheep.

STRATEGY

As it was in the Greater Southwest that sedentary man and mountain sheep first had a chance to associate in North America, I have concentrated my survey of the different types of man-sheep relationships which might have existed in the New World in this smaller area. Even here, however, prehistoric man associated with sheep in a great variety of environments and at different times, during which numerous different cultural processes were at work (Haury 1950; Aikens 1970; Marwitt 1968; Lister 1966; Jennings 1966). Moreover, not only are the situations in which sedentary prehistoric man DID hunt or associate with sheep important, but also those situations in which he DID NOT. As all these different possibilities create multiple variables, it was important to design a research strategy which would narrow the survey to an examination of those local conditions in which the opportunities for the development of man-sheep

relationships were the best, yet which also included a variety of cultural and environmental conditions.

If we are to answer the question, "Why didn't prehistoric man in the New World domesticate sheep if man-sheep relationships did exist in the New World?" a logical place to begin to look for man-sheep relationships which could have led to the domestication of sheep is in those areas in which a closed ecological system existed. Only in these areas could a system of positive feedback exist in which greater exploitation of resources would result in a continual decrease in resources, and increased demand for more intensive management of those resources or the seeking out of new resources.

The division of the Greater Southwest into those regions in which plant and animal ecosystems tend to be closed and those regions in which plant and animal ecosystems tend to be open somewhat parallels the basic geomorphic division of the region into the Colorado Plateau (eastern Utah, western Colorado, northern Arizona, northern New Mexico) and the Basin-and-Range Provinces (Nevada, western Utah, southern Arizona, southern New Mexico, northwestern Mexico). The Colorado Plateau is composed of a series of high mesas and plateaus with streams entrenched in canyons, as well as numerous mountain chains with intermountain valleys. Each canyon bottom, each high mesa surrounded by cliffs (often of slick rock), and each intermountain valley tends to form an individual closed system. Floral and faunal resources in each situation are limited in amount, making over-exploitation an ever-present possibility. As Jennings (1966: 18) has pointed out in reference to the region of Glen Canyon, had man subsisted mainly on the larger game in the canyon bottoms, the limited population of each canyon in the area would soon have become depleted or dispersed. The same would have applied to isolated high mesas and smaller intermountain valleys with closed ends.

The Basin-and-Range Provinces, on the other hand, are composed of a series of isolated, parallel, north-south mountain ranges, separated by desert basins. Each local region tends to constitute an open system, in which floral and faunal resources could have flowed into the area from adjacent locales as man drained them. The exception to this situation is the intermountain valleys in the more rugged terrains, such as those of east-central Arizona and west-central New Mexico.

In light of these differences in ecosystems in the Greater Southwest, and considering the different roles which man in the various regions of the Greater Southwest has played in the beginnings of agriculture and sedentism north of the nuclear Mexican region, I chose three areas in which to investigate man-sheep relationships: the intermountain valleys of the

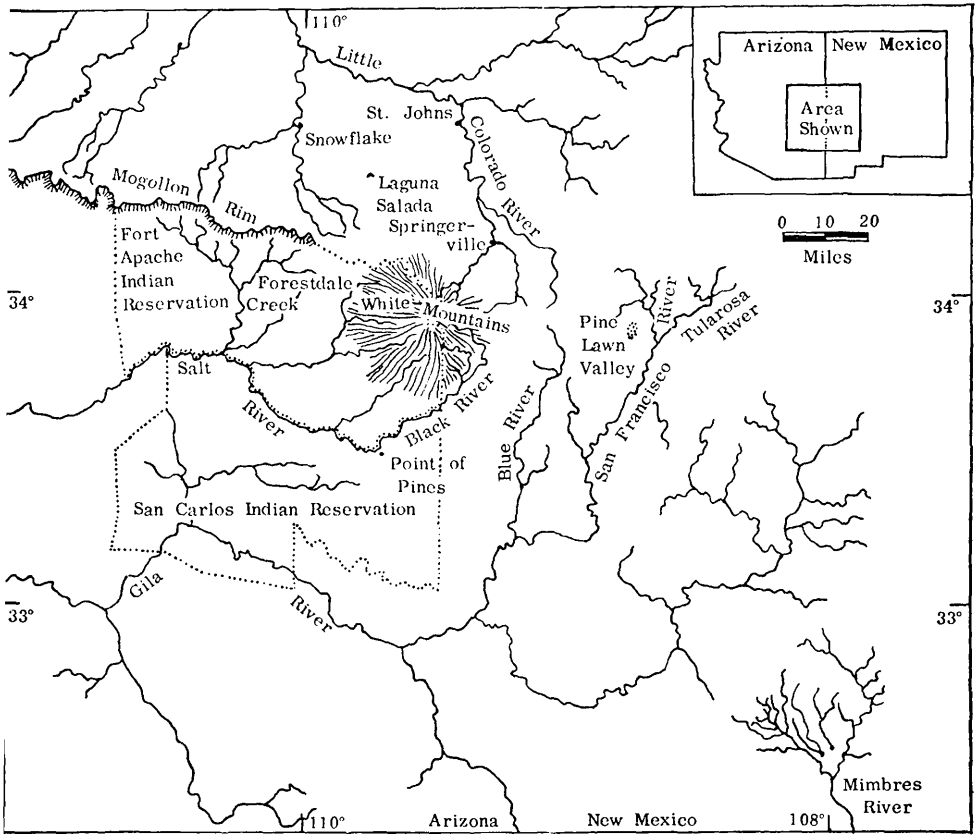


Figure 2. East-central Arizona and west-central New Mexico (adapted from Haury 1940: 11)

northern portion of the Mogollon Culture Area, in east-central Arizona and west-central New Mexico (Figure 2); the canyon and plateau regions of the Anasazi Culture Area, in south-central Utah (Figure 6); and the intermountain valleys and canyon-and-mesa country of the Fremont Culture Area, in the northeastern two-thirds of Utah (Figure 6). These areas provide the opportunity to compare a number of different relationships between sedentism, agriculture, local environment, and the social relations between man and sheep.

EAST-CENTRAL ARIZONA AND WEST-CENTRAL NEW MEXICO: THE TRANSITION TO SEDENTISM

One basic but important difference between the prehistory of man in the mountainous regions of the Mogollon Culture Area on the one hand, and in the Anasazi and Fremont Culture Areas on the other, is the role he played in the northward spread of agriculture and sedentism. North of the nuclear Mexican centers, agriculture and sedentism first appeared in the mountainous regions of the Mogollon area. These uplands, then, became a secondary center of dispersal of the new ways of life to those areas — the "frontier environments" of the Anasazi and the Fremont Culture Areas — which were environmentally unsuitable for incipient maize agriculture. As I shall reveal when the prehistories of the three areas are examined in terms of opportunities for the development of social relationships between prehistoric man and sheep, this distinction is crucial.

Environment

The environment of east-central Arizona and west-central New Mexico falls into two regions (Figure 2). To the north of the Mogollon is the Colorado Plateau, drained by the upper reaches of the Little Colorado River. To the south of the rim is a vast mountainous region dissected by the Black, Blue, San Francisco, and Tularosa Rivers, all of which flow into the Gila River.

In east-central Arizona and west-central New Mexico, I have chosen two areas in which to analyze the opportunities for the development of man-sheep relationships in terms of cultural history and local environment: (1) the region of Pine Lawn Valley of the San Francisco drainage, near Reserve, New Mexico, south of the Mogollon Rim; and (2) the canyon of the Upper Little Colorado River and the plateau to the west of it, in the region of Snowflake, Arizona, north of the Mogollon Rim. In both regions, Paul S. Martin and John B. Rinaldo have been the major contributors to archaeological research, with William A. Longacre also working on the project in the Upper Little Colorado River. For supplementary data, several reports are available on sites in the region of Point of Pines of the Black River drainage, on the San Carlos Apache Reservation (Wendorf 1950; Wheat 1954), and in Forestdale Valley, drained by a tributary of the Black River, on the Fort Apache Indian Reservation (Haury 1940; Haury and Sayles 1947). Dick's report (1965)

on Bat Cave, near the plains of San Augustin, was also used. All of these secondary areas are south of the Mogollon Rim.

Pine Lawn Valley (Figure 2) is a valley, 4.8–6.4 kilometers wide and 16 kilometers long, between the San Francisco Mountains (to the west) which rise to an elevation of 2,740 meters above sea level, and the Saliz Mountains (to the east) which rise to 2,280 meters above sea level. The floor of Pine Lawn Valley, which ranges from 1,830 to 2,130 meters in elevation, is drained by a network of intermittent streams in deep, narrow canyons which flow into the San Francisco River, east of the Saliz Mountains. From the surrounding mountains, ridges extend onto the valley floor. In places, these extensions have precipitous cliffs, but otherwise descend more gently to the valley floor. At their bases, springs may be found. The San Francisco River, itself, has a floodplain — 1.2 to 1.6 kilometers in width — near Pine Lawn Valley, but becomes hemmed in by mountains to the south for 16.0 kilometers before reaching more open country. To the north of Pine Lawn Valley, the San Francisco River becomes entrenched in a deep canyon. Along the length of the San Francisco River, overlooking the valley floor, ridges and mesas 30 to 60 meters high extend from the surrounding mountains. Branching from the San Francisco River to the northeast of Pine Lawn Valley is the Tularosa River, which is entrenched in a canyon with fairly gently sloping walls.

While the region of Pine Lawn Valley is structurally composed of horizontal strata and is therefore classified as a part of the Colorado Plateau Province, its landforms are actually transitional between those of the Colorado Plateau and those of the Basin-and-Range Provinces. Both canyons and wider, inter-mountain valleys characterize the region.

Ecologically, the region of the Pine Lawn Valley falls into the Transitional Life Zone. On the valley floors of the San Francisco and Tularosa Rivers and their tributaries are found yucca, cholla, prickly pear, beeweed, sage, poppy, thistle, and numerous wild grasses. Cottonwoods occur along the more permanent streams. The tops of the mesas and ridges which extend into the valley are covered with low grasses and open forests of pinyon, juniper, and yellow pine. The pinyon and juniper may line the edges of the mesas and ridge tops which overlook the streams, while the yellow pines extend up the higher slopes of the mountains to their tops. Other, less frequent vegetation in the region includes currants, gooseberry, mesquite, and oak. The mammals found today in the Pine Lawn Valley region include mule deer, white-tailed deer, black bear, rabbit, tree squirrel, chipmunk, prairie dog, and woodrat; common game birds are wild turkey, quail, and dove. In addition, the remains of mountain sheep, wapiti, bison (probably obtained in the more open country to

the south), American antelope, lynx, coyote, fox, muskrat, ground squirrel, and skunk have been found in the archaeological sites in the area. (The above description of the topography and environment is a compilation from Martin 1940, 1943, 1947; Martin, et al. 1949, 1950, 1952, 1956, and the United States Geological Survey topographic maps of the area.)

While bighorn sheep are no longer found in the region of the Pine Lawn Valley, they appear to have been plentiful during the mid-1800's. When a beaver trapper, J. O. Pattie, made a trip down the San Francisco River at that time, he wrote in his journal that the walls of the high and rugged mountains surrounding the San Francisco River were occupied by "multitudes of mountain sheep" (Pattie 1930). As the diet of mountain sheep in the southern portion of their geographic range in North America consists mostly of browse, and considering Pattie's remark, it is most probable that the sheep which once inhabited the Pine Lawn Valley preferred the more open-forested, lower slopes of the mountains, the ridge and mesa extensions into the valleys and canyons, and possibly the valleys and canyons themselves. As Clark (1964: xvi) remarked from a hunter's viewpoint:

> ...the best places to look for the really big rams are in the hidden basins high up in the mountains. These are usually in the form of an amphitheater surrounded by rock walls, ... through which a small stream drains the area ... Sheep are often found resting right in the center of them.

Very similar to Pine Lawn Valley is Forestdale Valley, in the Fort Apache Indian Reservation. Like Pine Lawn Valley, Forestdale Valley is geomorphically transitional between the Colorado Plateau and the Basin-and-Range Provinces. It is only 6.4 kilometers from the Mogollon Rim. The valley, drained by the Forestdale Creek, a branch of the Black River (Figure 2), is only about 300 meters wide, with near-vertical bluffs, 50 meters high, separating the floodplain from the uplands. Springs occur along the base of the bluffs. With an elevation of some 1,980 meters, Forestdale Valley, like Pine Lawn, falls within the Transitional Life Zone. The valley floor is dotted with juniper and clumps of oak and walnut. On the bluff tops are various grasses, live oak, pinyon, juniper, and dense clumps of manzanita. On the hillslopes are found dense stands of yellow pine, with some juniper and manzanita. The animals reported for Forestdale Valley include deer, wapiti, black bear, coyote, porcupine, rabbits, and turkey (Haury 1940; Haury and Sayles 1947). I found no reports of sheep explicitly within Forestdale Valley. The similarity of Forestdale Valley to Pine Lawn Valley, however, suggests that probably at one time sheep also inhabited this region.

Farther south from Pine Lawn and Forestdale Valleys, but still within the transitional zone between the Colorado Plateau and the Basin-and-Range Provinces, is Bat Cave (Figure 5). The cave is located in the cliffs of the Pelona Mountains, on the edge of the plains of San Augustin, a closed basin, 96 by 32 kilometers, surrounded by mountains. The elevation of the plains is approximately 2,140 meters, while the surrounding mountains rise another 300 to 610 meters. The basin bottom is covered with salt brush, while stickseed, stickleaf, paint brush, and mock pennyroyal form a heavier cover on the lower mountain slopes around the basin. Shrubs grow on the rockier terraces, while in the canyons and arroyos which flow into the basin, other herbaceous plants are found. From 60 meters above the basin to the surrounding mountain tops, open forests of pinyon and juniper predominate. Grasses form a continuous groundcover in this microenvironment, with herbaceous plants and cacti occurring sporadically. The present fauna around Bat Cave is not reported by Dick (1965), but the remains of mammals recovered from the excavation of the cave included mountain sheep, bison, deer, antelope, wapiti, wolf (?), badger, porcupine, jack rabbit, cotton-tail rabbit, pocket gopher, and woodrat (Dick 1965: 90–91). All parts of the full altitudinal range in the area of Bat Cave could have been equally exploited by sheep, although the open-forested mountain slopes and canyons may have been preferred for their herbaceous plants.

In contrast to Pine Lawn and Forestdale Valleys is the region of Point of Pines (Figure 4), south of the Black River and Forestdale Valley, and the upper reaches of the Little Colorado, north of the Mogollon Rim. Point of Pines lies in the gently rolling prairie between the Nantack Plateau on the south, west, and north, and the Prieto Plateau on the north and east. The Nantack Plateau, a southward extension of the White Mountains, drops to the prairie in a fault scarp. To the northwest of the grassland is the entrenched Black River. A grassland (predominantly of blue grama), 16 by 19 kilometers, occupies the area between the plateaus and the canyons at an elevation of 1,890 meters; clumps of juniper, oak, and pine are scattered throughout the grassy flats. Interfingering with the prairie are ridges which extend from the Nantack Plateau and which rise to a general level of 2,140 meters. These ridges are heavily forested with juniper, pinyon, live oak, yellow pine, and isolated Douglas fir. In the canyon bottoms of the Black River are walnut and manzanita, while on the alluvial land along the bases of the ridges occur sumac, prickly pear and other cacti, thistle, poppy, and beeweed. The current fauna reported for the area include American antelope, deer, bear, peccary, rabbit, porcupine, badger, coyote, gopher, and turkey. Bison also occurred in the

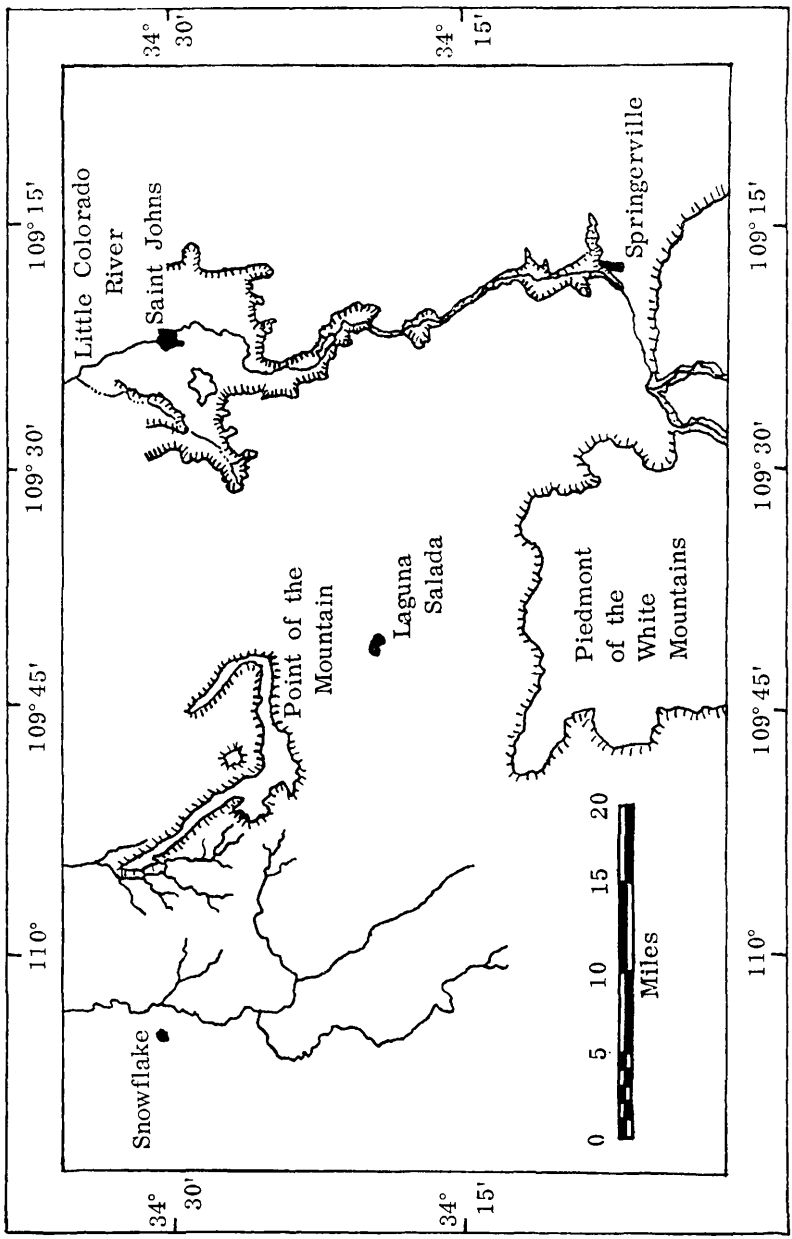


Figure 3. Upper Little Colorado drainage, east-central Arizona (adapted from Martin, et al. 1964: 202)

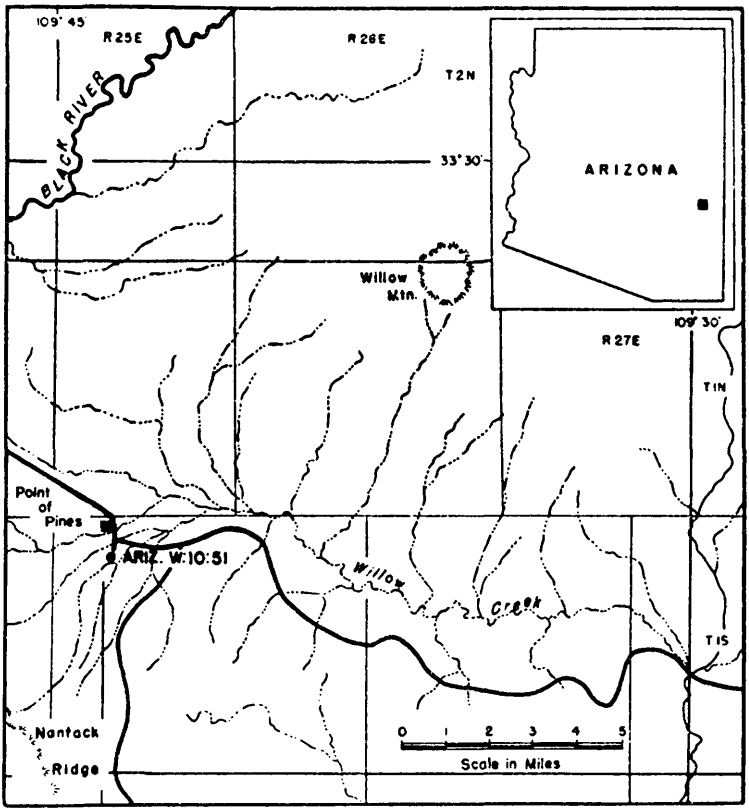


Figure 4. Region of Point of Pines, east-central Arizona (copied from Wendorf 1950: 13)

site refuse (Wendorf 1950; Wheat 1954). If sheep did occur in this region at one time, they most probably would have preferred the lower grasslands and alluvial terrain around the base of the plateaus, rather than the higher, heavily forested plateaus.

Similar to the region of Point of Pines, but north of the White Mountain Range, are the upper reaches of the Little Colorado, near Saint Johns, Arizona (Figure 3). This area is a gently rolling section of the Colorado Plateau, with the piedmont of the White Mountains to the south and southwest, the entrenched canyon of the Little Colorado to the east, and the "Point of the Mountain" mesa to the northwest. The region consists of four ecozones, only the highest of which falls within the Transitional Life Zone, the other three lying in the Upper Sonoran Life Zone. Along the edges of the entrenched Little Colorado River, which alternates between having broad alluvial valley bottoms and narrow bottoms

between canyon walls, is found desert scrub, such as rabbit brush, along with prickly pear and grama grass. Above the canyon bottoms is a plateau which has been extensively eroded by now-dry stream systems into broad, flat valleys. A few lakes, such as Laguna Salada and Little Ortega Lake, are spotted on the plateau. On this plateau and the lower mesas in the area, between 1,530 and 1,830 meters altitude, are short grasses, chenopods, and amaranths, with junipers occurring only sporadically. On the higher mesas and lower mountain slopes around the grassland occur pinyon and juniper woodlands, while farther up the slopes of the White Mountains, which rise to 3,360 meters to the south, occur forests of yellow pine and Douglas fir. The present fauna for this region is not reported in the literature which I have read, but in the refuse from the excavated sites of the Upper Little Colorado area occurred deer, antelope,

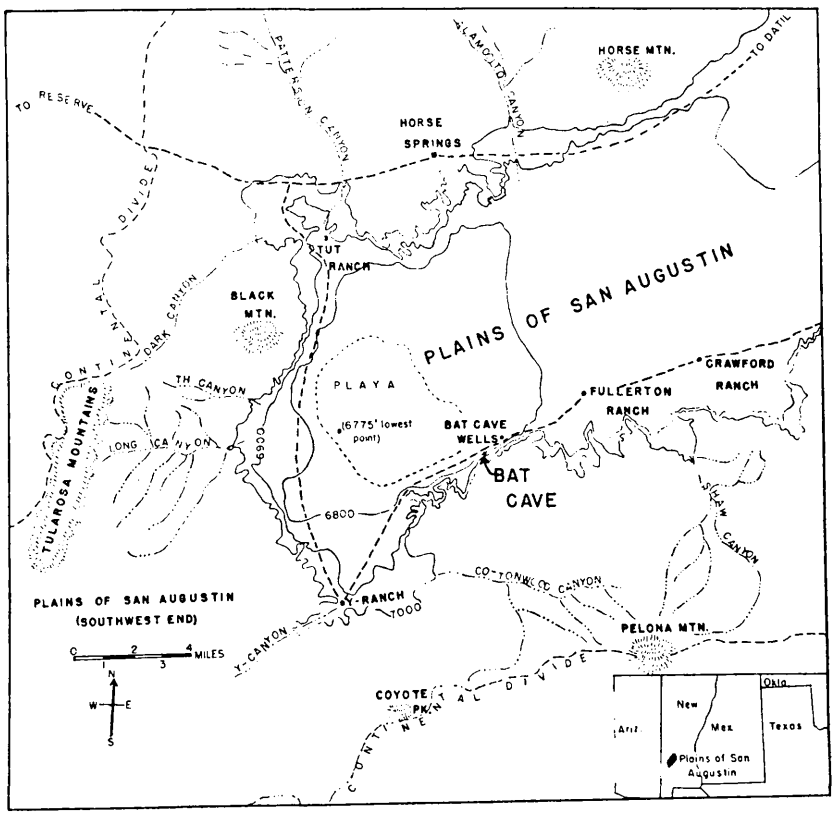


Figure 5. Topography around Bat Cave, southwestern New Mexico (copied from Dick 1965: 2)

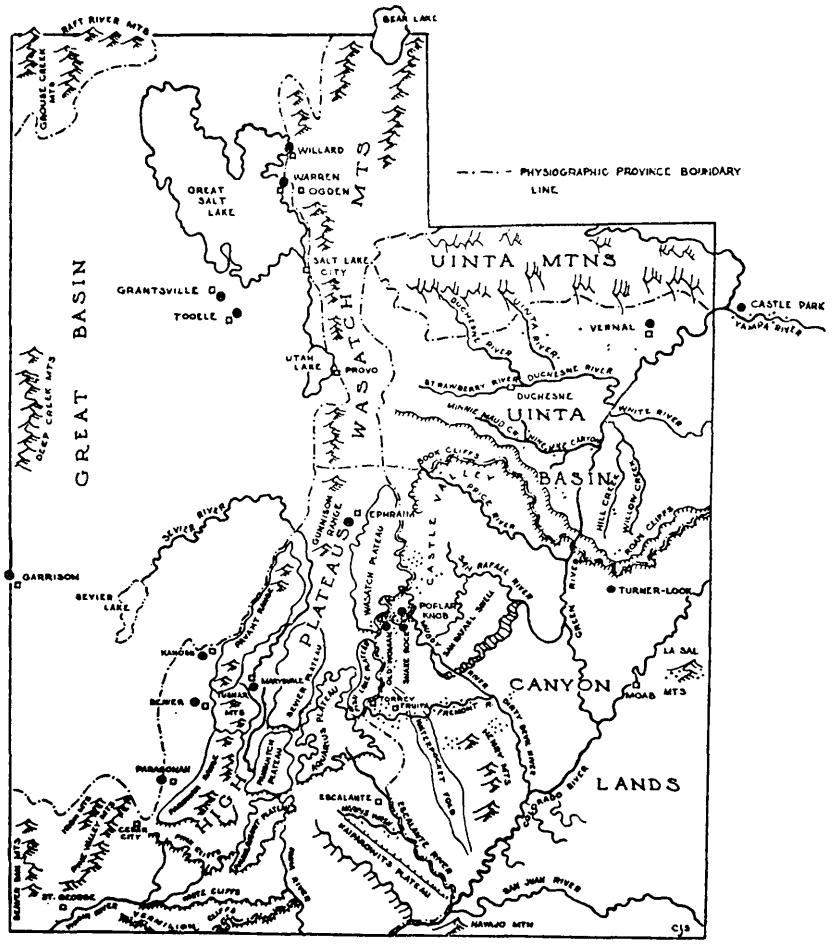


Figure 6. Topographic features in the region of Glen Canyon in the Anasazi Culture Area, and in the Fremont Culture Area (copied from Fowler 1963: xii)

rabbit, birds, and possibly mountain sheep (Martin, et al. 1962, 1964, 1967). Although there is no sure evidence that sheep inhabited this region in prehistory, the topography and vegetation are those characteristic of sheep country. Cockrum stated (1960) that in the past, wild sheep probably occurred throughout all of the mountainous regions of Arizona. If sheep did occupy the Upper Little Colorado area, their preferred habitats most likely would have been the lower mountain slopes and the rolling plateaus.

Having summarized the evironmental home of the sheep which once

inhabited at least most of the above regions in east-central Arizona and west-central New Mexico, let us now introduce man into this setting.

Man, Sheep, and the Beginning of Sedentism and Agriculture in East-Central Arizona and West-Central New Mexico

After 9000 B.P. but before the spread of maize northward from Mexico, around 4000 B.P. (Mangelsdorf, et al. 1967: 4–5), the Mogollon region was inhabited by Desert Archaic food collectors, the Cochise (Haury 1962). These people exploited numerous, scattered, plant and animal resources, shifting camps with the seasonal changes in the location of food supplies. As it is the Cochise who, with the introduction of maize, made the transition to sedentism, and thereby developed the opportunity for the development of intensive man-sheep relationships, it is crucial that we know the extent to which these people relied upon sheep, and also more generally, upon animals as opposed to plants.

From present archaeological evidence in east-central Arizona and west-central New Mexico, we deduce that the Cochise in this area, both before and after the introduction of maize, relied heavily on plant collecting, with game animals — particularly upland game — playing only a very minor role in the economy. Of the large game animals which were hunted, deer, American antelope, and bison seem to have been preferred over sheep. Evidence of the orientation of the Cochise economy toward plant collecting is revealed in at least three ways: (1) the settlement pattern of the Cochise in the Upper Little Colorado; (2) the faunal and floral remains found in the Cochise sites of the area; and (3) the delay between the time of introduction of maize and the beginnings of sedentism in the area.

The results of the survey of Martin, Rinaldo, and Longacre (1962) in the drainage of the Upper Little Colorado have shown that Cochise camps in that area were scattered sporadically on the grassland plateau with NO evidence of camps in the forested piedmont of the White Mountains. Both shelters and open-camp sites were discovered. The open sites, which are three times as numerous as the shelters, are located on the shores of dry lakes on the plateau, on knolls in the valley systems which dissect the plateau, and on flat areas on the sides of the mesas, above the plateau. The shelters occur at the base of the mesas. Such a settlement pattern has suggested to Longacre (Martin, et al. 1962) that the open sites were temporary collecting camps used during the warmer months, while seasonal rounds were made between localized plant resources, and that the shelters were used during the winter.

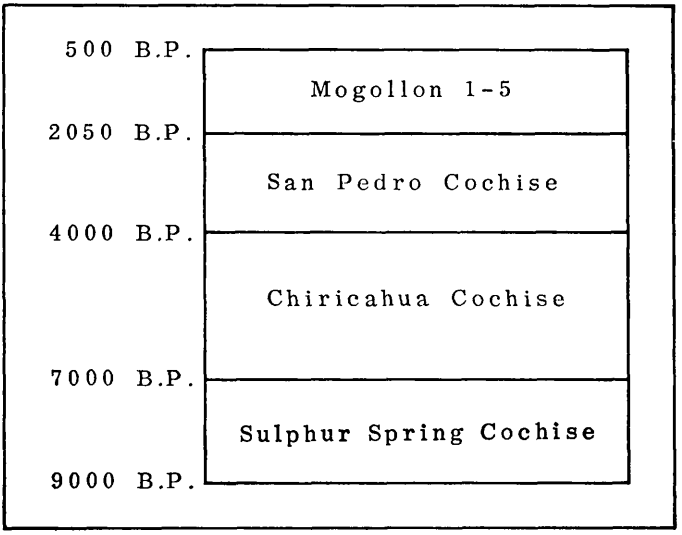
Support for this hypothesis comes from the results of the excavation of two of the lakeside sites in the grasslands: Little Ortega Lake, and Laguna Salada; the latter has a radiocarbon determination of 5230 ± 60 B.P. (Martin and Rinaldo 1960). At both of these "beach sites," Martin and Rinaldo (1960) recovered manos and metates in large proportions compared to chipped stone debris. The faunal remains which were recovered from the beach sites were limited to one bone each of white-tailed deer, bison, and turkey; the bison would indicate the presence of some grassland habitats. The evidence derived from a palynological study at Laguna Salada (R. Hevly, in Martin, et al. 1964) indicates that this lake was surrounded by amaranths and chenopods, both of which produce easily gathered seed in large quantities; the easy availability of this and other foods may have attracted the Cochise to such lake shores (Martin, et al. 1964). That the resources around the lake were of importance to the Cochise in this area is shown by their continual reoccupation of the beach sites year after year (Martin, et al. 1962).

Culturally comparable to the beach sites at Laguna Salada and Little Ortega Lake is the Wet Leggett Site (radiocarbon determination 4506 ± 680 B.P., Martin, et al. 1952), a Cochise camp located on top of a ridge with arroyos on three sides, in Pine Lawn Valley. Here, too, large quantities of grinding stones were found, in proportions similar to the debris of chipped stone at the beach sites. From his analysis of the artifactual material at Wet Leggett, Martin concluded that during the Chiricahua horizon of the Cochise in Pine Lawn Valley, food gathering was probably the principal means of subsistence (Martin, et al. 1950a). No data on the Cochise settlement pattern in Pine Lawn Valley are available, however, to check this.

Faunal and floral evidence of the Cochise economy comes from three cave sites: Tularosa Cave, on the Tularosa branch of the San Francisco River; Cordova Cave, on the San Francisco River, 1.6 kilometers south of Pine Lawn Valley; and Bat Cave. The stratigraphic sequences for all three sites begin after the introduction of maize.

Tularosa Cave was occupied more or less continually from 2300 ± 200 B.P. (Martin, et al. 1952) to around 950 to 750 B.P., while Cordova Cave was occupied fairly continually from around 2250 to 1950 B.P., and intermittently after that, until around 1050 B.P. (Martin, et al. 1952). While no level-by-level report of the faunal and floral remains found in these caves is published, Martin, et al. (1956) have reported that for both sequences combined, a total of thirty-eight cubic cartons (each 35 centimeters on a side) of plant material were recovered, in comparison to only six such cartons of faunal remains. This flora-to-fauna ratio is probably signif-

Table 1. Cultural sequence in the Mogollon culture area



Adapted from Willey 1966:188.

icantly biased in favor of the faunal remains for the Cochise horizons, as, beginning around 1450 B.P., faunal remains occur more frequently. The high ratio of remains of plants as compared to those of animals found at Tularosa and Cordova Caves, despite their locations in a mountainous, game-filled environment, suggests the large degree to which the Cochise economy in east-central Arizona and west-central New Mexico was oriented toward the gathering of plant foods even when game was at hand.

The difference in the variety of remains of animals and plants at Tularosa and Cordova Caves also reveals this orientation. From the earliest levels of the caves, only the bones of deer, and apparently pronghorn antelope and muskrat, were recovered. Deer were by far the most common. This lack of variety in game, and the fact that the habitats of the deer and antelope occurred close to the cave entrances, suggests that only the easiest game at hand was hunted. Sheep are not among the faunal remains; this is not surprising in view of the greater difficulty involved in hunting sheep as compared to deer.

The floral remains, on the other hand, had great variety; no less than thirty-eight different species of wild plants were recovered from both caves. While over half of the bulk of the recovered floral remains from the pre-pottery levels of Tularosa and Cordova Caves were domesticates, including maize, kidney beans, squash (*Cucurbita pepo*), and bottle gourd,

the wild plants came from a variety of ecozones, ranging from the canyon bottoms to the higher mountain slopes forested with yellow pine. The remains of wild plants included such foods as sunflower seeds, numerous pinyon nuts, a variety of grass seeds, walnuts, acorns, chenopods and amaranths, prickly pear, and the wild gourd. This range suggests that even though agriculture had been established, the plant-gathering economy of the earlier Cochise periods was still a major pattern of behavior of these people near the dawn of sedentism. Furthermore, the use of chenopods and amaranths at these caves strengthens the hypothesis that the Cochise at the "beach sites" were utilizing these grains.

The third site which yields evidence of orientation of the Cochise economy around plant collection is Bat Cave. The earliest levels of Bat Cave, in which domesticated maize, squash, and (slightly later) beans (*Phaseolus vulgaris*) are represented date to Chiricahua times. The people of the Cochise culture who used Bat Cave, like those who used Tularosa and Cordova Caves, were already relying upon agriculture to some degree, but continued to exploit a large variety of plants from a wide range of ecozones, extending from the bottom of the basin which the cave overlooks, through the pinyon and juniper forests. Fifty-eight species of plants were recovered, among which were edibles such as yucca, prickly pear, grass seeds, acorns, walnuts, juniper berries, and pinyon nuts. Amaranths and one species of *Chenopodium* were also found. Faunal remains occur only lightly throughout the Cochise levels of Bat Cave. In contrast to the great variety of plant resources utilized at the cave, the only large game animals represented are deer, antelope, and sheep. These only occur sporadically in the Cochise deposits, from late Chiricahua times onward. The distribution of the remains of the smaller animals over time is not reported (Dick 1965). In general, then, the faunal and floral remains from Bat Cave substantiate the indications of the strong orientations of the Cochise economy toward collecting of plant foods, indications which were suggested at Tularosa and Cordova Caves.

The third manner in which the heavy reliance of the Cochise economy upon collecting of plants is revealed is in the delay between the times of introduction of maize and the beginnings of sedentism in east-central Arizona and west-central New Mexico. For 2,000 years after the introduction of maize to the Cochise, no increase in the complexity of their culture or in the rate of cultural change occurred (Haury 1962; E. K. Reed 1964). Haury (1962: 115, 117) has explained this phenomenon by hypothesizing that before the introduction of maize to the Southwest, the Cochise may have practiced planting seeds of non-domesticated plants, such as chenopods and amaranths. Maize, then, would have been con-

sidered only one more plant added to the list of plants already cultivated. Whether or not the Cochise were actually cultivating before the introduction of maize, their economy must have been preadapted to an agricultural lifeway for the introduction of maize not to have stimulated cultural changes among them. This implies a considerable sophistication in utilization of plants by the Cochise, and their possession of a technology which was readily adaptable to the processing of introduced plant foods such as maize. The quantity and large proportions of ground stone artifacts among the assemblages found at the beach sites and Wet Leggett substantiate this viewpoint.

In sum, the present archaeological data on the settlement pattern of the Cochise, the faunal and floral remains they left behind, their stone technology, and the delay between the time of introduction of maize to the Cochise and their shift to sedentism, all suggest that the Cochise economy was heavily oriented toward the collecting of plants, not only for food but for other uses too. The large game animals which were hunted apparently were those that were more available and possibly more easily caught, particularly deer, as opposed to more evasive game such as sheep.

While sedentism affords the opportunity to intensify the management of animals, it is clear that in east-central Arizona and west-central New Mexico, the basis for such intensification was lacking: hunting did not constitute an important element in the economy of the pre-sedentary Cochise. From the Cochise plant-oriented economy, a sedentary way of life developed in which social relationships between man and animal — and particularly between man and sheep — continued to be, at best, of very minor importance. While the microenvironments utilized by man and sheep overlapped during the Cochise horizons and the initial periods of sedentism, man was busy gathering plants and hunting small game, rather than trying to catch sheep.

With a hypothesized increase in the yield of maize (Haury 1962), and the introduction of storage techniques and the idea of the pithouse (Martin, et al. 1964; E. K. Reed 1964: 178), farming villages began to develop at the end of the first millennium B.C. in the Greater Southwest. The earliest evidence of settled, village life is at Cave Creek (around 2250 B.P.), in the San Simon Mogollon Culture Area in southeastern Arizona (Willey 1966: 184). The earliest farming villages in east-central Arizona and west-central New Mexico date somewhat later: Crooked Ridge Village (Site Ariz, W:10:51, 1850? B.P.) in the region of Point of Pines (Wheat 1954), the Tumbleweed Canyon Site (around 1675 B.P.) in the drainage of the Upper Little Colorado (Martin, et al. 1962), the Bluff Site

(A.D. 287–318, dated by dendrochronology) in Forestdale Valley (Haury and Sayles 1947), and the SU Site (before 1450 B.P.) in Pine Lawn Valley (Martin 1940, 1943, 1947).

The continuity of the early village-farming economy with its Cochise base in east-central Arizona and west-central New Mexico is revealed by several kinds of evidence: (1) settlement pattern in the drainage of the Upper Little Colorado; (2) faunal and floral evidence from the excavated village sites mentioned above, and from Tularosa and Cordova Caves; and (3) artifactual data from these village and cave sites.

In the drainage of the Upper Little Colorado, clusters of two to four pithouses dating to the initial period of sedentism occur on the benches of mesa sides overlooking the grassland plateau, on knolls and ridges in the broad flat valleys dissecting the grassland plateau, and, to a lesser degree, on the bottomlands of the Little Colorado River and the edges of bluff-faced ridges extending into the valley (Martin, et al. 1962, 1964). While the bottoms of the Little Colorado provided good agricultural land for the early farmers in this region, the continued use of the possibly less well-watered lands of the rolling plateau suggests that the wild plant resources in this previously exploited microenvironment were still of importance. As during the Cochise horizons, the piedmont regions around the plateau do not yield any sites of camps or villages at this time or later. While agriculture was apparently gaining importance in the economy of these early farmers and beginning to replace, to some degree, the use of wild plant resources, exploitation of animal resources seems to have remained a minor activity.

This suggestion is substantiated by the faunal and floral remains recovered from Tularosa and Cordova Caves, and the excavated village sites. Until around 1450 B.P., the same large variety of wild plants from a wide range of ecozones is represented in the stratigraphy of Tularosa and Cordova Caves, while the quantity and variety of recovered game animals remain small, as in the Cochise horizons (Martin, et al. 1952). Despite the location of the twenty-three pithouses composing the Bluff Site in the heavily timbered environment of Forestdale Valley (which in later periods provided abundant game for pueblo peoples), very few non-human bones were found in the trash of this village. Most of the faunal remains were of deer, with a few antelope represented. The charred black walnuts recovered from the site suggest the continued exploitation of wild plants by these farmers (Haury and Sayles 1947). Similarly, at Crooked Ridge Village (Ariz W:10:51), located on one of the narrow, pine-forested ridges which extend from the Nantack Plateau and interfinger with the adjacent rolling prairie, bone refuse was scarce. Only deer

and turkey were represented in the remains, while walnuts and pinyon nuts and other unidentified seeds were present (Wheat 1954). Only at the SU Site in Pine Lawn Valley, located on one of the ridges which extend from the surrounding mountains onto the valley floor, were any variety of faunal remains recovered. Sheep, mule deer, white deer, lynx, coyote, domestic dog, turkey, jack rabbit, pocket gopher, rock squirrel and possibly sage hen were excavated from this site of 28 pithouses. The quantity of bone, however, is meager, with deer constituting most of the remains. Evidence of the continued use of wild plants in addition to agricultural activities is suggested by the charred hulls and seeds found in the refuse (Martin 1940, 1943, 1947).

The artifactual data from these early villages and caves also suggest the continuation of the Cochise technology, which was oriented toward the exploitation and processing of plants rather than animals. For example, at the SU Site (Martin 1940, 1943, 1947), most of the milling stones were of the type which are ethnographically known to be used for crushing and grinding wild seeds rather than processing maize. Mortars and pestles were also numerous. These tools, used primarily for crushing and milling seeds and nuts, greatly outnumbered all other tool types. The small number and heterogeneous, crude style of the projectile points indicated to Martin (1943) the lack of interest in hunting. Finally, out of a list of thirty-six traits for Cochise stone artifacts, thirty-five are represented at the SU Site. One-third of these traits occur at the beginning of the Cochise Culture. This retention of the Cochise technology is also documented at Tularosa and Cordova Caves.

In sum, the settlement pattern in the drainage of the Upper Little Colorado and the faunal, floral, and artifactual evidence from the early farming villages and Tularosa and Cordova Caves, all suggest a smooth economic transition in moving to a sedentary way of life in east-central Arizona and west-central New Mexico.

From the description of the microenvironments which the Cochise, and early village-farmers exploited in east-central Arizona and west-central New Mexico, and from a description and reconstruction of the microenvironments which the mountain sheep preferred in that region, it is apparent that the lack of the development of intensive man-sheep relationships once sedentism occurred was not the result of geographical factors such as non-overlapping habitats, but cultural factors instead. The Cochise and the succeeding early village-farmers did not take advantage of the opportunity to develop intensive man-sheep relationships once sedentism occurred because the cultural context in which sedentism arose

was not oriented in a direction aimed at potential development of man-sheep relationships. Furthermore, the transition from a primarily plant-gathering economy to cultivation and finally sedentism was smooth, without pressures that might have caused the searching out of new resources. The sheep were at hand, and so were the opportunities to exploit them, but there was no need.

Possibly the behavior of the bighorn made them less easy to hunt than deer and antelope the few times that men did go hunting, as the bones of these latter game mammals occur in higher proportions in the sites of this time compared to those of sheep. With a sparse human population during the Cochise horizons and the periods of early sedentism, and in view of the small amount of hunting done at those times, probably the sheep would not have retreated permanently into the higher upland forests of this region, and abandoned the lower areas with browse, any more than they did before the late 1800's. Geographically, sheep must have wandered as close or closer to Cochise and early village sites than did the deer and antelope, which prefer irregular forests and open grasslands, respectively. Also the number of sheep which lived in east-central Arizona and west-central New Mexico during the Cochise horizons and the period of early sedentism was probably not significantly fewer than when Pattie traveled through the area in the mid 1800's. Sheep, then, may have been game which was less easily killed than were deer and antelope.

But while the preference of the Cochise and early village-farmers to HUNT deer and antelope over mountain sheep may be attributed, in part at least, to the relative ease of the catch, the lack of DEVELOPMENT OF MAN-SHEEP RELATIONSHIPS in east-central Arizona and west-central New Mexico cannot be so attributed. The fact remains that the economic orientation and cultural history of man at this time and this region of the New World did not provide either a fertile context from which man-sheep relationships might develop, or the pressure on man to search for new resources outside of that context.

Comparison to the Beginnings of Sedentism, Agriculture, and Domestication of Sheep in the Near East

In contrast to the man-sheep relationships and the processes which were involved in the beginnings of agriculture and sedentism within the geographical range of sheep in the New World are the processes of the domestication of sheep and the beginnings of agriculture and sedentism which occurred in the Near East. The difference between the prehistoric

situation in the Mogollon Mountains and that on the flanks and in the intermountain valleys of the Zagros and Tauros Mountains seems to hinge on two or possibly three main factors: (1) the economic base from which sedentism arose; (2) the presence or lack of large, dense stands of gatherable food; and (3) possibly the presence or lack of pressure upon the economic system.

While the economy of the Cochise of eastern Arizona and western New Mexico was oriented toward the intensive use of plant resources with large game playing only a very minor role, in the hills around the Fertile Crescent both plants and animals — particularly the larger game mammals — were exploited just previous to the beginnings of agriculture and sedentism. The latest of the cultures of the Near Eastern Upper Paleolithic — Natufian, Zarzian, and others in the same period of time, that of the latest Pleistocene — had a strong economic dependence upon the hunting and use of all or many of the following: wild cattle, red deer, onager (half-ass), pig, gazelle, goats, and sheep (Reed and Braidwood 1960; Hole and Flannery 1967; Perrot 1968; Turnbull and Reed 1974). Of these the sheep, goats, pigs, and cattle were subsequently domesticated, and onagers were either semidomesticated or tamed for use. The gazelles, too, may for a time have entered into a closer association with man than that of merely being hunted (Legge 1972). The earliest record of domestic sheep — which is also the earliest record of a domestic ungulate — is at $10{,}750 \pm 300$ B.P. (barely post-Pleistocene) at Zawi Chemi Shanidar, northern Iraq, in one of the most rugged parts of the Zagros Mountains (Perkins 1964; Drew, Perkins, and Daly 1971); this open-air, semi-village site had a cultural overlap with the nearby Shanidar Cave, which had had a long history of peoples who depended upon the hunting of deer, pigs, goats, and sheep.

The prehistoric village of Çayönü in southeastern Turkey is probably the best illustration now known of the cultural transition from an earlier concentration upon the hunting of large mammals to dependence upon agriculture, the domestic animals being primarily sheep and goats (Braidwood, et al. 1971). The above survey could be extended, but all of the evidence indicates definitely that on the flanks and in the intermountain valleys of the Zagros and Tauros Mountains, man had already developed, prior to sedentism, a hunting relationship with large mammals, including sheep, which the Cochise never encouraged.

In addition to these two different economic contexts in the Near East and the Greater Southwest was a difference in the opportunities for settling down without the development of agriculture. Around the Fertile Crescent, massive dense stands of barley and almost pure stands of wild

einkorn wheat provided large enough yields that it would have been possible, within approximately three weeks during the late spring or early summer, for a family to gather enough grain to provide staple food for a year (Harlan 1967). Dense stands of grains such as these do not occur in eastern Arizona and western New Mexico. For example, around Laguna Salada on the plateau west of the Upper Little Colorado River, grasslands are composed of wheat-grass (not a true wheat), grama, muhly, 3-awn, and galleta, interspersed with non-grasses such as sunflower, snakeweed, pinque, fleabane, goldenweed, zinnia, and aster. On the more sandy soils grow saltbush, sage, and Mormon tea, while shadscale and greaseweed are found on alkaline soils. Shallower soils are covered by Apache plum, diffrose, serviceberry, blackbrush, and squawbush. Only by the seeps and lakes do chenopods and amaranths grow (Martin, et al. 1964). While not all of the prairies in east-central Arizona and west-central New Mexico are this heterogeneous, large dense stands of plants with harvestable grains like those around the Fertile Crescent simply do not exist in the Mogollon Mountains. As a result, the people of the Cochise culture had to gather a number of less substantial, seasonal resources in different locales, and could not settle down until the introduction of high-yield domesticates.

The difference in the distribution of plant resources in the Mogollon Mountains and the Zagros and Tauros Mountains, along with the difference in the economic bases of the Cochise and the peoples around the Fertile Crescent, resulted in a difference in the order in which the processes of sedentism, plant domestication, and animal domestication could occur. In the Fertile Crescent, the existence and exploitation of dense stands of grains allowed sedentism to occur before the domestication of plants and animals. As both hunting and gathering were important in this region, it was possible, then, for the domestication of both plants and animals to develop at approximately the same times, although not always in the same places. Sheep were merely one, even if the first, of the ungulate domesticates. With this developmental sequence, the economic orientation toward both plant and animal resources was able to continue. In eastern Arizona and western New Mexico, however, sedentism occurred at least two thousand years after the introduction of plant domesticates. Not only was the economic basis of the pre-sedentary Cochise heavily oriented toward utilization of plant resources, but the long delay between the introduction of domesticated plants and the beginnings of sedentism allowed the integration of high-yield agriculture without offering the opportunity for the domestication of those few animals which were exploited.

A third factor which may have differed in the Fertile Crescent and the

Mogollon Mountains is pressure upon the economic system. Depending on whether Binford's, Flannery's, or Braidwood's hypothesis on the development of agriculture and the domestication of animals in the Near East (Meyers 1971) is correct, pressure on the economic systems of the peoples in the Fertile Crescent may or may not have spurred on the processes of domestication of plants and animals. It is apparent, however, that in eastern Arizona and western New Mexico, no pressure accompanied the development of agriculture. The transition between the gathering and collecting economy of the Cochise and the early village-farmers was slow and smooth. The Cochise were not forced to seek new resources outside of their heavily plant-oriented economic system, and as a result, were able to integrate high-yield agriculture into their pre-adapted economy without bothering with management of animal resources.

ECONOMIC PRESSURES IN EAST-CENTRAL ARIZONA AND WEST-CENTRAL NEW MEXICO

We must not overlook the fact that the manner of the transition between a moving and a sedentary lifeway which took place in east-central Arizona and west-central New Mexico, without the development of a man-sheep relationship, influenced the change in lifeways of peoples in other areas of the Greater Southwest. The early diffusion of maize northward from the Mexican highlands followed the higher elevations of the Cordilleran spine and found its lodging in eastern Arizona and western New Mexico (Mangelsdorf and Lister 1956; Haury 1962; Willey 1966: 183). At a later time squash, gourd, red kidney-bean and improved varieties of maize probably followed a path similar to the earliest maize and also found their way to eastern Arizona and western New Mexico. It was the peoples in the Mogollon Mountains, then, who dispersed these and other domesticated plants to the rest of the people of the Southwest (Willey 1966: 183). No intensive management of sheep or other animals ever developed in the Mogollon Mountains during the transition to sedentism; the idea of exploitation of animals was not among the elements which diffused to the Greater Southwest from the core dispersal center. In those areas which were occupied by peoples whose economic systems were oriented toward plant collecting and in which the people hunted sheep little or not at all, the process of the transition to sedentism which bypassed sheep domestication, in eastern Arizona and western New Mexico was continued with the introduction of domesticated plants.

After the beginnings of sedentism in the core area of the Mogollon

then, the opportunities to domesticate sheep in the Greater Southwest were limited to: (1) those people who were hunting sheep when they received plant domesticates and settled down; and (2) those people who were already sedentary, including the Mogollon, but who found themselves in a situation in which the failure of some food resource to produce its normal yield or else a large increase in population resulted in pressure upon their economic system and the search for new resources outside of that economic system.

In the remainder of this paper, I shall focus on such possible pressures in three regions of the Greater Southwest: the Mogollon core area itself; the Anasazi canyonlands in south-central Utah; and the Fremont canyon-and-mesa lands and intermountain valleys.

In the midst of their smooth transition from plant collecting to agriculture, the Mogollon in east-central Arizona and west-central New Mexico were subjected to an economic pressure which could have led to more intensive social relationships with sheep or other, more frequently hunted animals, in the region. Beginning around 1450 B.P., as documented in Tularosa and Cordova Caves, the number of rows per ear of maize decreased from twelve to eight, with no corresponding change in size of cob or kernel being reported (Cutler 1952). The resulting decrease in maize yield would have put a fair amount of strain upon the Mogollon subsistence system, for at that time maize was an important component in their diet: one-half of all the floral remains at Tularosa and Cordova Caves from around 2250–1450 B.P. was maize (Martin, et al. 1952).

In response to this pressure on their economic system, the Mogollon shifted to more intensive use of these wild plants and animals which they had already been exploiting. At Tularosa and Cordova Caves, with the decrease in the number of rows per ear of maize, the proportion of wild plants compared to domesticates increased greatly. More intensive exploitation of a few wild plants from a single ecozone also occurred. Thistle, yucca, cacti, grasses, and wild gourds, all of which grew on the canyon floors below Tularosa and Cordova Caves, were the most numerous of the plants recovered at this time. The great variety of other wild plants from wide-ranging micro-environments were also exploited, however (Martin, et al. 1952).

The frequency of bones of hunted animals at Tularosa and Cordova Caves also increased in this period, with concentration remaining on the same few animals which had been exploited earlier: deer, and to a lesser degree, antelope (Martin, et al. 1952). In the refuse of villages, however, evidence shows that the variety of animals which were hunted was much

larger. At Turkey Foot Ridge, located on a narrow ridge extending onto the floor of Pine Lawn Valley, bones were very abundant, and included in decreasing order of frequency, deer, jack rabbit, turkey, domestic dog, cotton-tail rabbit, pocket gopher, prairie dog, quail, elk, Canadian goose, bison, and woodrat. Bones of deer outnumbered those of all the other animals combined (Martin, et al. 1950b).

At Mogollon Village, located south of Pine Lawn Valley on a mesa top overlooking the San Francisco River, large numbers of bones were recovered from the refuse, including those from a variety of animals such as mule deer, antelope, bison, mountain lion, bobcat, coyote, gray fox, raccoon, badger, jack rabbit, cotton-tail, prairie dog, woodrat, pocket gopher, turkey, great horned owl, hawk, and mud turtle. Mule deer outnumbered all the other remains of animals by a proportion of three to one, while bison was represented by only one jaw (Haury 1940). At Harris Village, located on the floodplain of the Mimbres River (Figure 2), where ten-row maize was recovered, bones were abundant and included all of the animals found at Mogollon Village, and, in addition, the pocket gopher, dog, bear, and tortoise (Haury 1936).

While the decrease in the yield of maize in east-central Arizona and west-central New Mexico put pressure upon the subsistence system of the Mogollon culture and gave the Mogollon people the opportunity to develop more intensive management of animal resources, the response ran counter to the directions leading to animal management. Part of the pressure upon the Mogollon subsistence system was relieved by intensifying the use of a few wild plants in addition to collecting the large variety of other flora which had been exploited earlier. Pressure was also dissipated by intensifying the use of the previously exploited deer and by hunting a greater variety of small game. Thus the Mogollon were able to widen their economic base in addition to intensifying their use of previously exploited food resources, and consequently the intensive management of animal resources did not become a necessity. Without the over-exploitation and depletion of game resources in the relatively closed systems of Pine Lawn Valley, Forestdale Valley, the San Francisco Canyon, and similar regions, positive feedback mechanisms leading to management of game resources were never activated.

Why sheep were not hunted at this time is problematic. One of the striking features of the list of animals which were hunted immediately following the decrease in the yield of maize is the consistency of the species which were utilized, and the consistency with which sheep were not utilized. While the six site reports I mentioned above are the only ones which I studied from this specific time period and form only a small

sample for such a large geographic area, the matter should not be overlooked. At Bat Cave (Dick 1965), where the Mogollon stratigraphy was not divided into fine units, mountain sheep occur sporadically from the San Pedro Cochise horizons to the surface (around 1000 B.P.). Mountain sheep were recovered from the SU Site, Pine Lawn Valley (Martin 1940, 1943, 1947), which dates to the period just preceding the shift in the Mogollon economy, and possibly at Carter Ranch (Martin, et al. 1964) in the Upper Little Colorado drainage, which dates to around 1000–800 B.P. As the remains of sheep are found in sites dating to periods of both low densities (before 1450 B.P.) and high densities of human population (after 1250 B.P.), retreat of sheep into higher, less convenient hunting grounds simply as a result of population increase can not explain this phenomenon. The one difference between the periods in which sheep do occur in site refuse and the period in which sheep do not is the intensity and range of Mogollon hunting. With the beginning of wide-range, more intensive hunting, sheep may temporarily have retreated to higher, more rugged ground, or dispersed to regions with fewer hunters. Only much more thorough analyses of remains of animals from Mogollon sites will reveal the exact circumstances.

In addition to the shift in the Mogollon economy, the decrease in the yield of maize also may have led to a greater dependence upon agriculture in the long run. In the drainage of the Upper Little Colorado between around 1450 and 1250 B.P., the locations of farming villages were changed from the benches of the sides of high mesas overlooking the grassland plateau to the well-watered floodplains of river valleys and locations near small streams. Occupation continued in the other areas having easy access to the stream bottoms, such as the knolls and ridges in the river valleys, and the edges of bluff-faced ridges extending into the valley (Martin, et al. 1964). In Pine Lawn Valley, the Mogollon people began to build their houses in locations closer to the bottom lands (Martin, et al. 1950a). These changes in site location were not the result of population pressures; seemingly only a slight increase in population occurred at this time (Martin, et al. 1964).

Possibly, however, with the decrease in the yield of maize at the beginning of this period, the Mogollon people of these regions, at least, may have tried to improve their techniques, land use, and the cultivation of maize in addition to shifting to more intensive use of the wild plants and animals. If this was the purpose of the change in settlement pattern in the Upper Little Colorado drainage and in Pine Lawn Valley, the experiment was apparently a success. Following around 1250 B.P., a rapid increase in

population began in the drainage of the Upper Little Colorado. From the archaeological evidence, Martin has reasoned that there was, for the first time in this region, a shift in the social organization from kin-based bands to matrilineal clans having matrilocal residence and ownership of the increasingly important agricultural lands (Martin, et al. 1964). At Tularosa and Cordova Caves, the previously high frequencies of remains of animals and wild plants decreased to the level which had occurred before 1450 B.P. (Martin, et al. 1952). While some of the variety of animals and plants which the Mogollon had exploited in east-central Arizona and west-central New Mexico during the pressure period of around 1450–1250 B.P. continued to be utilized later, the amount of food which these resources provided was small compared to that provided by agriculture (Martin, et al. 1956, 1960, 1962; Bluhm 1957). In lieu of the decreased use of wild plants, there occurred a marked decrease in the frequencies of mortars and pestles, and an increase in the frequency of types of metates and manos more suitable to grinding maize (Martin, et al. 1950a, 1950b). The subsistence system of the Mogollon in east-central Arizona and west-central New Mexico was no longer under pressure, and the need for the development of intensive social relationships with sheep and other animals had been bypassed.

After around 950 B.P., the history of the Mogollon in east-central Arizona and west-central New Mexico is that of a complex system involving diffusion of cultural traits from the Anasazi of the north (Martin, et al. 1956), change in rainfall patterns (Schoenwetter 1962; Martin, et al. 1962), and the concentration of population into towns (Martin, et al. 1964). While it would be inappropriate to consider in detail the problems of such a complex time period within the context of this paper, a few points should be noted.

During the last few hundred years before the abandonment of east-central Arizona and west-central New Mexico, around 500 B.P. (Martin, et al. 1964; E. K. Reed 1964), the economic system of the Mogollon in this area was again under pressure. With the change of the pattern of rainfall from light summer rains to heavy summer "gully-washers" around 950 B.P., the agricultural system of the Mogollon apparently began to become unreliable. Beginning around 750 B.P., hunting increased slightly in the drainage of the Upper Little Colorado at sites such as Chilcott, Thode, Rim Valley Pueblo, and Hooper Ranch Pueblo. Maize, however, continued to remain the primary food source (Martin, et al. 1962), and the Mogollon clung to their agricultural lifeways, converging into larger towns on the few waterways left which still provided suitable land for agriculture. Why did the Mogollon not turn to wild animals and plants

for food this time as they had earlier, around 1450 B.P.? Why did the Mogollon remain so committed to an agricultural system which was failing? Could it be that this time, the Mogollon relied upon the gods?

In conclusion, after the Mogollon in east-central Arizona and west-central New Mexico made the transition to sedentism, their economic system became stressed at least twice: once as a result of a genetically caused decrease in maize yield, and once as a result of an environmentally caused decrease in the yield of maize. These two circumstances provided a need for the Mogollon to seek outside of their prior, stable subsistence systems for new food resources. Among the options open to them was the development of intensive social relationships with sheep and other animals.

In the first situation, the Mogollon relieved the pressure from their economic system by intensifying the use of a few previously exploited wild plants and animals, by hunting animals not previously utilized, and possibly by changing their settlement pattern in order to exploit better their arable lands. For lack of archaeological indicators, the kind of social relationships which the Mogollon developed with their primary food animal, the deer, is unknown. The opportunity for the Mogollon to develop intensive social relationships with sheep at this time may have been restricted by the retreat or dispersal of the sheep from the more convenient hunting grounds.

In the second stressful situation, the Mogollon relieved a slight amount of the pressure on their subsistence system through an increase in hunting, at least. The Mogollon did not, however, relieve the greater portion of the pressure, for they clung to their prior, agriculturally based subsistence system. Intensive social relationships with sheep or other animals were not achieved. Because pressure upon their economic system continued to build, the Mogollon in east-central Arizona and west-central New Mexico were finally forced to abandon their homeland.

POSSIBLE ECONOMIC PRESSURES IN THE ANASAZI CANYONLANDS OF SOUTH-CENTRAL UTAH

Unlike the Mogollon region in its structural landforms, ecological systems, and prehistoric culture history is the plateau and canyon home of the Anasazi (Figure 6). The social relationships between the Anasazi and sheep, along with the possible stresses upon the economic system of the Anasazi, presented different opportunities for the development of inten-

sive man-sheep relationships in the canyonlands than in the mountains of eastern Arizona and western New Mexico.

Environment

Within the greater canyonland region occupied by the Anasazi, the area of Glen Canyon in south-central Utah (Figure 7) has been chosen for analysis of the opportunities for the development of relationships between man and sheep.

The area of Glen Canyon is a section of the Colorado Plateau which is drained by the entrenched Colorado River and its tributaries. The region can be divided into three environmental zones: the riverine environment within the canyons, which lie below 1,070 meters in elevation; the slick-rock plateau beyond the canyon rim; and the higher, wooded plateaus, which lie between 1,370 and 2,140 meters above sea level. The bottoms of the canyons are covered with a wide variety of plants, including trees such as juniper, willow, oak, elm, hackberry, redbud, ash, and salt cedar; grasses such as grama, red top, cheat, salt, and bluestem; shrubs and herbs such as joint-fir, rushes, lilies, buckwheat, chenopods, poppets, jimson weed, legumes, cliff rose, and serviceberry; composites such as sage, rabbit brush, thistles, and sunflower; and cacti. The constitution of the flora varies between the wide main canyon of the Colorado River and its narrower tributaries. Mammals in the canyon bottoms include mountain sheep, mule deer, bison, bear, lynx, cougar, coyote, red fox, raccoon, ringtail cat, weasel, badger, and spotted skunk (Jennings 1966).

Above the canyon oases, little life is supported by the slick-rock plateau. The higher plateaus which catch heavier rainfall and which harbor springs, however, again provide a rich environment. The Kaiparowits Plateau (Figure 8) which lies just west of the Colorado River, provides a good example. Kaiparowits Plateau is eighteen miles long and lies mainly at an elevation of 2,220 meters, but rises at one point as high as 2,725 meters above sea level. The northern edge of the plateau is a sheer cliff which drops 790 meters to the Escalante River, a tributary of the Colorado River. Crosscutting the plateau are ten drainages which originate close to the sheer cliffs and downcut as they progress to the south. Covering the ridges between these canyons are open forests of pinyon and juniper interspersed with sage brush and rabbit brush. On the broader ridges and headwater basins of the canyons, only sage brush and rabbit brush grow. The floors of the canyons are covered with scrub oak, cacti, and yucca. In the wetter areas of the plateau, such as near the seeps and springs at

Figure 7. Topographic sketch of the region of Glen Canyon (copied from Gunnerson 1959: 3)

the heads of the canyons, aspen and yellow pine may be found (Fowler and Aikens 1963). Mammalian life on the upland plateaus such as the Kaiparowits is similar to but more numerous than that in the canyons and includes sheep (Jennings 1966).

The outstanding ecological feature of the region of Glen Canyon is its

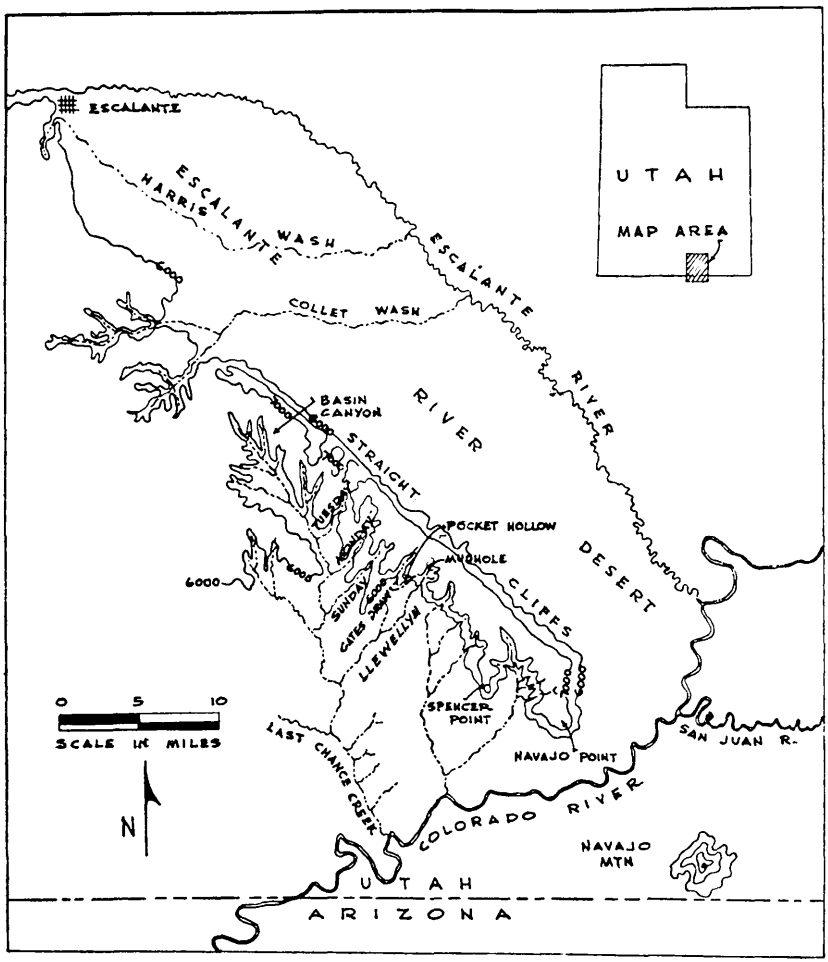


Figure 8. Kaiparowits Plateau, in the region of Glen Canyon (copied from Fowler and Aikens 1963: viii)

division by the slick-rock plateaus into a number of isolated, closed ecosystems. Each canyon tends to remain a unit unto itself, and the canyons, in turn, tend to be separated from the higher, wooded plateaus. The only animals which venture across the slick-rock are birds, bats, and the large mammals, such as sheep and deer. The megafauna, however, in their seasonal migrations, travel between only specific canyons and mesas constituting their patchy range; they belong to a limited number of ecosystems rather than wandering freely between the oases. The environment in the region of Glen Canyon, then, is a rigid and fragile structure which could easily have been upset by prehistoric man's over-exploitation

of particular resources (Jennings 1966), and therefore provided a mechanism which could have unleashed pressure upon the economic system of the inhabitants of the area.

Interpretations of Prehistoric Culture and Economic Pressures

The process of revealing pressures upon the economic system of the Anasazi in the region of Glen Canyon is deeply entangled in the interpretations of the prehistory of the greater Anasazi Culture Area. Since disagreements still exist over some basic issues in the prehistory of the greater Anasazi, and understanding of these disagreements is necessary for an evaluation of the economic system of the Anasazi in the region of Glen Canyon, I will first summarize the relevant data from the area without the overlay of interpretive frameworks which have been developed for the wider Anasazi Culture Area.

Prior to around 1050 B.P., occupancy of the region of Glen Canyon was spotty and discontinuous. During the culture periods Pueblo II and Pueblo III (around 1050–650 B.P.), however, numerous Anasazi from the Mesa Verde Culture Area to the east and Kayenta Culture Area to the south spread into and inhabited Glen Canyon and its tributary canyons (Figure 9). During their stay in Glen Canyon, the Anasazi farmed the canyon bottoms, locating their tiny gardens on the scattered patches of arable land. While domesticated maize, beans, and squash provided a major portion of their diet, the Anasazi also depended upon the numerous wild resources in the canyon. Wild amaranths, beeweed, sunflower, and prickly pear may have been cultivated, while other wild plants were gathered seasonally. A total of 110 species of plants (not all of which were edible) were recovered from the canyon sites (Jennings 1966). Wild animals also were utilized, including mountain sheep, deer, coyote, bobcat, ringtail cat, fox, beaver, badger, chipmunk, marmot, kangaroo-rat, woodrat, ground-squirrel, pocket gopher, birds, lizards, and fish (Lipe 1960; Sharrock, et al. 1961). The remains of the mountain sheep are most common, outnumbering deer, the second most common food animal, by a ratio of seven to one. While the quantity of non-human bones recovered from the canyon sites is small compared to the recovered floral remains, the relative importance of hunting to the economy of the Anasazi in the Glen Canyon region cannot be determined. Most of the canyon sites which were excavated were storage shelters for grain and were located above the canyon floor. Most of the dwelling sites in the canyon bottoms

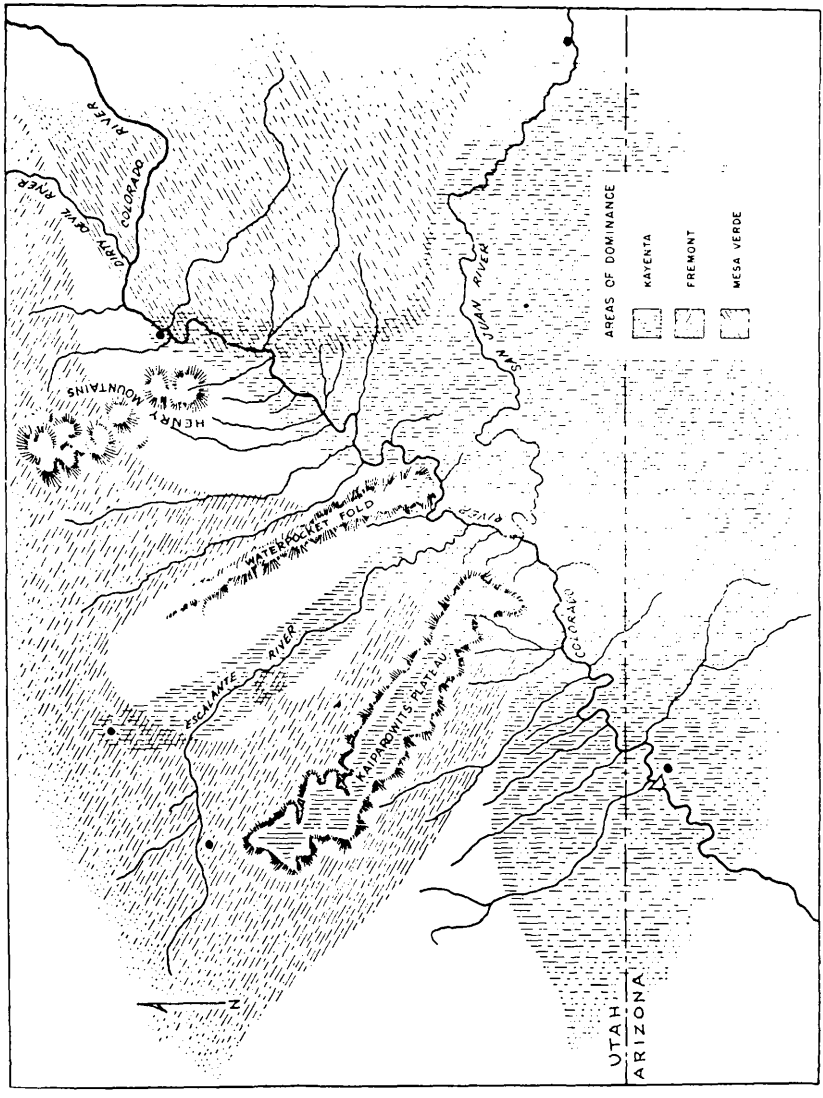


Figure 9. Cultural divisions of the region of Glen Canyon, south-central Utah (copied from Jennings 1966: 37)

have been either buried or swept away by the aggrading and downcutting cycles of the Colorado River and its tributaries (Jennings 1966).

While the riverine environment zone of the area of Glen Canyon was occupied heavily throughout the period from around 1050 to 650 B.P., evidence of occupation of the high wooded plateaus does not begin until well after the Anasazi entry into the environmental complex of Glen

Canyon. Not until around 750 or 700 B.P. does Kaiparowits Plateau show any sign of occupation. Once habitation of the upland environments began, however, the population on the wooded plateaus reached and surpassed that in the canyons (Jennings 1966). On the Kaiparowits Plateau, more than 300 sites composed of architectural units, with one to five rooms, and located a kilometer to half a kilometer apart, have been found. All these sites are located in the sage-covered basins at the head of the canyons crosscutting the plateau, where seeps, springs, and arable land were available (Fowler and Aikens 1963).

While actual occupation of the high plateaus occurred late in comparison to the time of occupation of the canyon bottoms, the upland resources were tapped from the beginning of settlement in the area of Glen Canyon. Furthermore, travel between the high plateaus and canyon bottoms continued after the upland occupation. Evidence for these activities comes from several types of shrubs, such as mountain mahogany, which only occur in the uplands, but which have been found in the remains of sites in the canyon bottoms. Further indications of travel outside of the environment of the canyons are the numerous trails which lead beyond the canyon rim and onto the slick rock. Before the occupation of the uplands, the canyon dwellers may have hunted game on the high plateaus. The fauna was not only more numerous, but also less easily depleted on the larger, high plateaus than on the areally restricted canyon floor. "[The] canyons and the uplands were aboriginally a single ecosystem and... the aboriginal occupants of the area exploited the resources on this basis" (Jennings 1966: 30–31).

During the time of Pueblo II, a great increase in population occurred in the core region of Virgin, Kayenta, and Mesa Verde Anasazi. In the traditional interpretation, this increase in population was followed by an expansion of the Anasazi into marginal environments, such as Glen Canyon. From this viewpoint, the Anasazi who inhabited Glen Canyon were an overflow population pushed into agriculturally undesirable land from Mesa Verde and Kayenta (Jennings 1966: 35), and would have found themselves in an environment to which their agriculturally based subsistence system was not as well adapted, resulting in at least some pressure upon their economic system. As the economic system of the Anasazi in the Mesa Verde and Kayenta core areas previous to and during the expansion of Pueblo II had included hunting of game similar to that found in Glen Canyon, such as mountain sheep (E. K. Reed 1958; Lister 1964, 1966; Aikens 1966a), in addition to agriculture, these migrants could have supplemented their hypothetically less productive agricultural

system with more intensive or varied use of wild resources. Among these resources were mountain sheep, the most common food animal found in the sites in the area of Glen Canyon. Here, then, is a situation in which a group of sedentary people, who already hunted and were familiar with mountain sheep, found their subsistence system under at least some stress. In circumstances such as this intensification of man-sheep relationships may occur.

While the pressure upon the economic system of the Anasazi in the areas of Glen Canyon and those adjoining could have been relieved initially through more hunting and gathering, such a solution may not have been a permanent one. With a fragile environmental structure in the area, and with more people moving into the canyons, over-exploitation of the ecosystems of the isolated canyons and plateaus may have resulted in new pressures upon the economy of the Anasazi which could not have been relieved only by more hunting and gathering. One way such a hypothetical pressure might have been dissipated was through farming of the uplands, which led to their occupancy late in the chronological sequence at Glen Canyon. The techniques necessary to farm the uplands need not have been different from some of those used in the canyons. On the Kaiparowits Plateau, for example, seeps and springs at the basinheads of the canyons crosscutting the plateau provided water sources (Fowler and Aikens 1963) such as those which had long been used in the canyons (Jennings 1966). In this way, the need to develop more intensive man-sheep relationships may have been averted.

Whether such pressures did exist, however, is questionable. Jennings believed that:

> ... in Pueblo II time the Anasazi actually specialized in gardening in "marginal" areas, and ... by understanding water and its conservation and use [and the idiosyncracies of their crops], extended their domain into areas where neither then nor now is gardening truly feasible. This would leave the Glen Canyon dwellers not so much marginal as typical backwoods Anasazi — all of whom were working agricultural miracles in an environment which is today regarded as unfavorable for cultivation of crops without irrigation (Jennings 1966: 63).

From this viewpoint, the economic system of the Anasazi who entered the canyons was not under pressure, but blossoming. Why the Anasazi suddenly settled the upland plateaus 300 years after their entry into Glen Canyon, however, is left an unanswered question: "better climate, population pressure, colonizing zeal all are [reasons] variously invoked, but one cannot be sure" (Jennings 1966: 56).

The question of whether or not pressures did exist upon the economic system of the Anasazi who inhabited Glen Canyon will probably remain

open until the pattern of the history of the larger Anasazi Culture can be untangled. Whether Pueblo II was actually a period of great population movements into previously unoccupied territories, or whether it was a period in which cultural traits were diffusing to populations which were increasing *in situ*, with only minor movements of populations by backwoods Anasazi, such as those who entered Glen Canyon, is not clear. The reasons for the late occupancy of the upland plateaus are also unclear. Opportunities for the development of intensive man-sheep relationships existed in the area of Glen Canyon; whether or not there was the need to choose between this and other options during times of economic stress, however, remains unsettled.

ECONOMIC PRESSURES IN THE FREMONT INTERMOUNTAIN VALLEYS AND CANYONLANDS

Inhabiting the northern two-thirds of Utah (Figure 6) and the adjacent portions of Colorado and Nevada between at least 1250 B.P. (Marwitt 1968) and 750 B.P. (Gunnerson 1969) were the Fremont; these people were horticulturalists who depended to a large degree on hunting as a secondary means of subsistence, plus considerable gathering (Aikens 1966b; Gunnerson 1969). The economic systems of these peoples differed from the Anasazi and Mogollon not only in the greater extent to which they relied upon game, but also in the precarious nature of their horticulture in an environment which was a marginal habitat of maize. A setting such as this provides a fruitful context in which to look for prehistoric opportunities and needs for the development of intensive man-sheep relationships.

Environment

The Fremont Culture Area may be divided into three essential ecological regions: the mountains and intermountain valleys of the Wasatch Range and the fault-block ranges to the south, which run down the middle of Utah; the canyon-and-mesa country of the Colorado Plateau east of the Wasatch Range; and the Basin-and-Range Provinces, west of the Wasatch (Figure 6). Because the Basin-and-Range Province tends to be composed of open ecological systems, the Fremont in this environment will be excluded from this study.

The environment of the mountains and intermountain valleys of the

Fremont may be exemplified by Upper Round Valley, central Utah, in which the Fremont site of Pharo Village is located. Upper Round Valley is a basin, 5 × 11 kilometers, located within the Pavant Mountains, south of the Wasatch (Figure 6). The valley floor has an elevation of 1,830 meters while the surrounding mountains rise to more than 3,050 meters above sea level. Several perennial streams which flow from the surrounding mountains drain into a marsh in the basin. The valley is semiarid, with the western portion receiving more water than the eastern. On the western edge of the valley floor grows a mixed forest of willow, oak, and box elder. To the east, the vegetation grades into juniper and sage brush and then into sage brush with rabbit brush. The mountain slope on the east side of the valley is an almost vertical escarpment with meager vegetation, while the western mountain slopes are more gentle and have small clumps of scattered scrub oak. In the refuse of the site, the bones of mule deer, jack rabbit, cotton-tail rabbit, mountain sheep, coyote, pocket gopher, bison, marmot, rock squirrel, bobcat, bear, badger, prairie dog, beaver, striped skunk, red squirrel, porcupine, muskrat, and long-tailed weasel were found, in that order of frequency (Marwitt 1968).

The canyon-and-mesa region of the area of the Fremont Culture is drained by the entrenched Colorado River and its tributary canyons. Most of this area is either slick rock or covered with poorly stabilized sandy soils which separate the canyons and mesas into fairly isolated ecosystems. In the canyon bottoms, along the streams, grow cottonwood, willow, and a variety of herbaceous plants. Farther back from the rivers, shrubs such as salt brush, greasewood, rabbit brush, squaw brush, and yucca dominate. Shadscale and salt brush occur farthest from the streams. On the mesas and rolling hills above the canyons, pigmy forests of open pinyon and juniper interspersed with desert grasses prevail, while at higher, better-watered elevations, aspen and ponderosa pine occur. The fauna characteristic for the canyons and mesas include bighorn sheep, jack rabbit, cotton-tail rabbit, snowshoe hare, deer, wapiti, prairie dog, marmot, ground squirrel, pocket gopher, bison, woodrat, badger, coyote, beaver, and chipmunk, in that order of frequency as found in the Turner-Look, Old Woman, and Snake Rock sites combined (Gunnerson 1969).

In the intermountain valleys and the canyons and mesas of the Fremont Culture Area, maize horticulture is precarious today. The average annual growing season in the area is only 100 to 160 days. Of the 15–25 centimeters of precipitation which fall in the canyon-and-mesa country, and of the 37.5 centimeters, or less, of precipitation which fall in the higher intermountain valleys, only 65 percent falls within the growing season (Gunnerson 1969).

Fremont Economy and Economic Shift

The beginnings of agriculture and sedentism in the Fremont area are still obscured in the origins of the Fremont, who were the first sedentary horticultural people to occupy this environment. Prior to the time of Fremont occupation, the intermountain valleys and the canyons and mesas supported a scattered population of hunters and gatherers (Gunnerson 1969). Whether the Fremont Culture was a development *in situ* from these peoples (Jennings and Norbeck 1955), a manifestation of Virgin Anasazi who freely migrated north during the postulated expansion of Pueblo II (Gunnerson 1969), or, in part, a manifestation of the Great Plains Indians who migrated to the south and adopted many Southwestern elements (Aikens 1966b, 1970) is still unknown. Whatever its origin, the Fremont Culture had its roots in hunting-and-gathering peoples, and retained many of the characteristics of their economic systems.

"The Fremont never became irrevocably committed to horticulture as a means of subsistence" (Gunnerson 1969: 196); they always depended to a large extent upon the wild faunal and floral resources. While Fremont village sites in the intermountain valleys and canyon-and-mesa country hardly ever occur above 2,130 meters in elevation, at which point the growing season becomes too short for maize horticulture, throughout the Fremont area in the higher forests of pinyon and juniper occur numerous small hunting and gathering camps, of which the only evidence may often be a few flakes, a mano, or a metate. The Fremont exploited a number of animal resources (see above), of which mountain sheep and rabbits were the most common. Remains of animals occur abundantly in the horticultural village sites (Ambler 1966; Aikens 1967; Sharrock and Marwitt 1967; Marwitt 1968; Gunnerson 1969). West of the Wasatch Mountains around Great Salt Lake, the Fremont MAY have made seasonal rounds between their farmsteads (where they grew maize, beans, and squash) and hunting camps, where they subsisted upon migrating bison and waterfowl, along with chenopods, amaranths, and bulrushes (Aikens 1966b, 1967). Such seasonal sedentism may also have existed in the intermountain valleys and in the canyons and mesas (Gunnerson 1969: 136). Wild plants were also used by the Fremont to supplement their diet, although possibly not as much as were the animals. At Mantles Cave in the canyon-and-mesa country were found the seeds of Indian millet, pinyon nuts, lilies, wild sunflowers, chenopods, and juniper and the bulbs of lilies (Gunnerson 1969).

Agriculture may not have been a dependable means of subsistence for some of the Fremont in the higher intermountain valleys and in the area

of the canyons and mesas. Evidence for this supposition comes not only from the abundant faunal remains found in the village sites, but also from the settlement patterns. Fremont villages and their associated farmlands at higher elevations nestled close to the mountain slopes where the air stays warmer at night and prevents frost, rather than occupying the valley bottoms, where the coldest air accumulates. By locating their farmlands in this manner, the Fremont may have been trying to extend their growing season a few extra, crucial weeks (Gunnerson 1969); presumably, a tight scheduling in horticulture was necessary to produce a fair yield at such higher elevations. During years of early winter, these Fremont may not have been able to produce their expected yields, and periodically may have had to exploit wild resources more heavily. The location of the higher Fremont villages in this manner cannot be attributed only to dependence upon mountain-slope runoff; at lower altitudes, where the growing season is longer, Fremont sites were not gathered by the edges of the valley bottoms but occurred along creeks in the valley bottoms (Sharrock and Marwitt 1967; Marwitt 1968; Gunnerson 1969).

While unexpected seasons of short growth were a continuing threat to the crops of the farmers at higher elevations, water supply was a critical environmental factor to the horticultural system of all the Fremont:

> Throughout the Fremont area, there is relatively little land that would have received adequate natural subirrigation, and in most areas where Fremont sites are found, no such land is apparent. Thus, farming would have depended heavily upon some sort of irrigation or utilization of runoff (Gunnerson 1969: 134).

The use of ditch irrigation by the Fremont has been documented in widespread areas, from northeastern to central and south-central Utah.

In sum, the economy of the sedentary or semi-sedentary Fremont of the intermountain valleys and mesa-and-canyon country was approximately as dependent upon horticulture of maize, beans, and squash as it was upon hunting with some gathering (Gunnerson 1969: 136). The most commonly hunted game animal was the mountain sheep. Because of the marginal location of the Fremont in terms of length of growing season and water supply necessary for maize cultivation, the agricultural component of the Fremont economic system was fragile.

While their dependence upon sheep for food gave the Fremont the OPPORTUNITY to develop intensive man-sheep relationships throughout their history if they had so chosen, the NEED to develop intensive methods of exploiting animals such as sheep and aiso wild plants might not have

come until late in Fremont history. Sporadically occurring short or dry summers may periodically have led to more extensive USE of wild animals and plants through increasing the frequency of hunting and gathering. "Since the Fremont area is precariously marginal as far as precipitation is concerned, it is reasonable to suppose that reductions in moisture so slight that they would not be obvious in the tree-ring record could [have affected] farming adversely" (Gunnerson 1969: 181). During such times of temporary stress, however, development of more intensive METHODS of using wild foods would not have been necessary. Long-term pressure upon the Fremont economic system which could have been relieved in one way by the development of more intensive methods of resource utilization did not occur until the end of the Fremont record. Between A.D. 1150 and 1166 and again between A.D. 1215 and 1299 (dated by dendrochronology), drought (Gunnerson 1969) or shifts in the rainfall pattern from winter-dominant rains with gentle summer rains to summer-dominant "gulley-washers" (Schoenwetter 1962; Jennings 1966) upset the delicately balanced horticultural system of the Fremont (Gunnerson 1969).

At the beginning of these climatic changes, the Fremont may have been able to respond to a decrease in the yield of maize as they may have done in other bad years, by hunting and gathering more frequently. As the conditions worsened and the length of time since the beginning of the climatic change increased, however, in the more heavily populated areas such as Ivie Creek (Figure 10a), Ferron Creek (Figure 10a), and Nine Mile Canyon (Figure 10b), more extensive hunting may have resulted in a depletion or dispersal of the game resources (Gunnerson 1969). Under these conditions, a simple increase in the frequency of hunting and gathering would not have relieved the pressure on the Fremont economic system. One of the options open to the Fremont in order to regain a stable subsistence system would have been to intensify the management of their game resources, the most commonly exploited of which was the mountain sheep.

Evidence for such pressures which could have led to more intensive social relationships between man and sheep comes from the Fremont's alternative solution to their problem. Unable to continue their farming, the Fremont apparently scattered out over the countryside (Gunnerson 1969: 182), exploiting environments which were less depleted of game.

The economic circumstances of the Fremont near the end of their way of life probably offered the most likely of all the situations which I have analyzed in this paper, in which intensive social relationships between man and sheep could have developed. Not only did the Fremont hunt

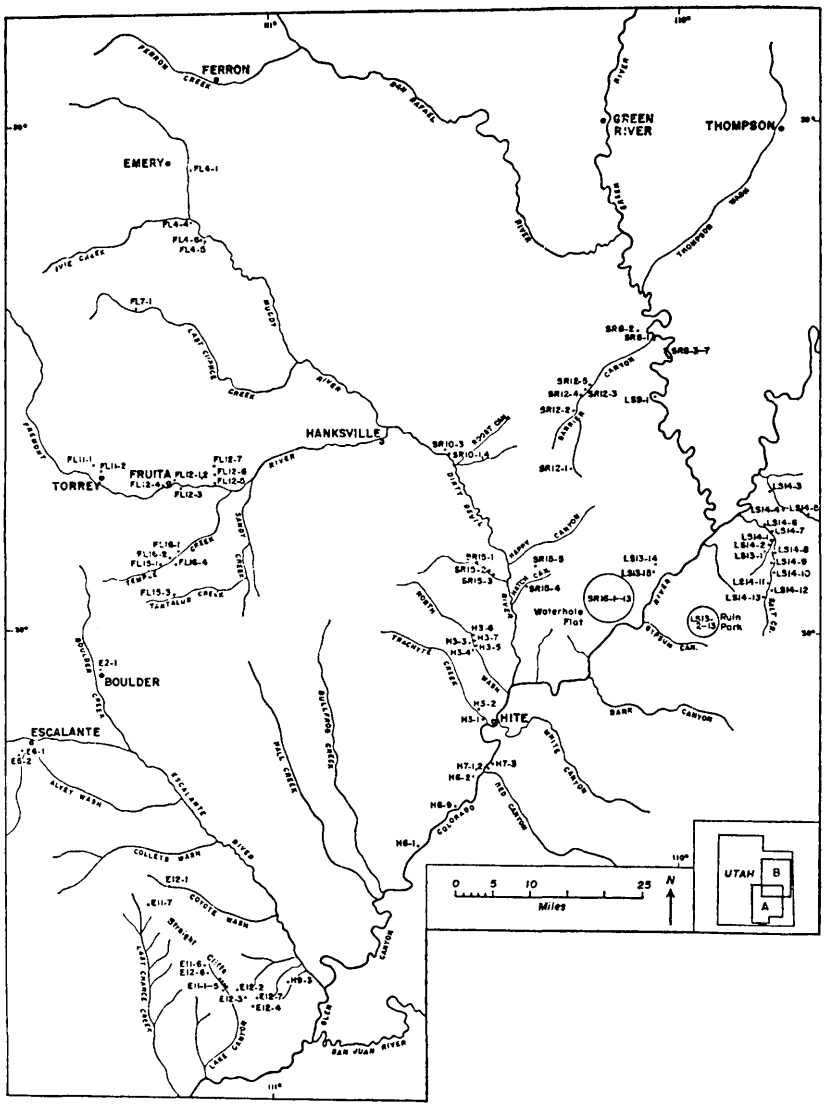


Figure 10a. Location of Fremont sites in the canyon-and-mesa country, Utah (copied from Gunnerson 1969: 28)

mountain sheep extensively; they also were so little committed to their horticultural system that the solutions to their economic troubles, in the final analysis, could be found among their wild resources. While the Anasazi and Mogollon retreated southward during this period of climatic change to better-watered lands where they could continue to practice

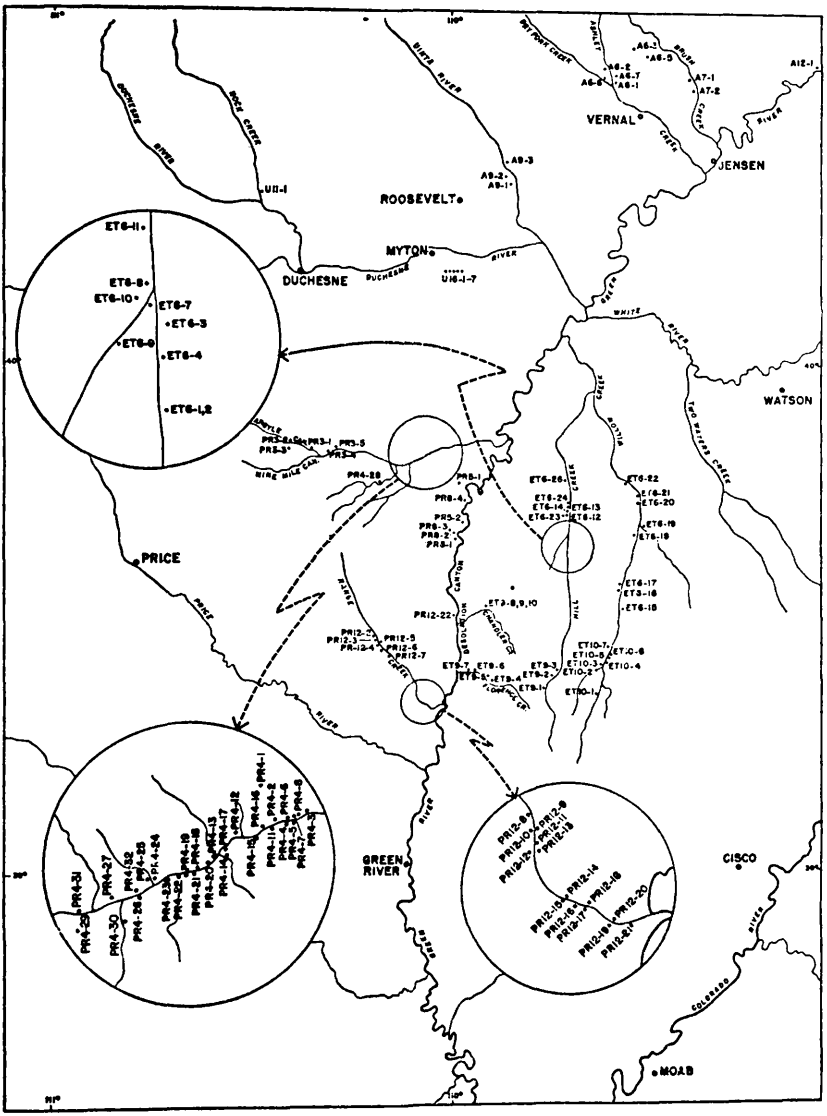


Figure 10b. Location of Fremont sites in the canyon-and-mesa country, Utah (copied from Gunnerson 1969: 29)

their agriculture (E. K. Reed 1964), the Fremont gave up their agriculture and turned to the resources of the wild animals and plants around them for help. Why the Fremont communities chose to break their social bonds and scatter over the countryside rather than look for new economic tech-

niques to manage their game resources remains an unanswered question. Perhaps it was as simple a reason as a lack of the change of attitude of the Fremont towards the mountain sheep from that of an animal to be hunted to that of an animal to be managed (C. A. Reed, this volume). Perhaps they had never kept lambs as pets. One cannot be sure.

CONCLUSION

I began by asking three questions: (1) "What prehistoric man-sheep relationships existed in the New World?" (2) "Did these relationships afford man the opportunity to domesticate sheep?" and (3) "If so, why didn't man take advantage of the opportunity?" To the first question, it may be answered that in at least several areas of the Greater Southwest, sedentary agricultural peoples hunted sheep. The economic system of the Fremont even depended upon mountain sheep. In neither the Fremont nor the Anasazi nor the Mogollon Culture Areas, however, do I know of any archaeological evidence to demonstrate that sedentary peoples were doing anything more than hunting sheep. Not even a good case may be made for intensive, selective hunting of sheep, as would be indicated by large quantities of bones of sheep with few bones of other animals in these areas, let alone incipient management of sheep.

Prehistoric man in the Greater Southwest did have opportunities to develop intensive social relationships with mountain sheep which might have led to domestication. In the Mogollon Mountains from around 1450 to 1250 B.P. and from 750 to 500 B.P., possibly in the region of Glen Canyon of the Anasazi Culture Area around 1050 B.P. and again around 750 B.P., and in the Fremont Culture Area around 750 B.P., sedentary agriculturalists who were familiar with the habits of sheep found their economic systems under pressure. One of the options open to these peoples to relieve this pressure was to begin to manage more intensively those food resources, including sheep, which they had already exploited. Instead, in these particular situations, prehistoric man either widened the base of his economy to include previously unexploited wild resources, augmented the frequency with which he utilized previously exploited wild resources, moved to new environments where his previous economic system could again be stabilized, or scattered into smaller groups in order to live off the land.

Why didn't prehistoric man domesticate sheep in North America as he did in the Near East? In part, the answer may be found in the different ecological habits and biological processes of the Asiatic mouflon and the

American bighorn. In part, it may be found in the different geographical distributions of sheep in relationship to the areas of origins of agriculture and sedentism. In part, it may be found in the relative ease with which a shift to management of wild resources, as opposed to other options, could have been made in times of economic pressure. But it also should not be forgotten that we are dealing with men: men who may have had different attitudes toward their environment and how it was to be used, however similar were the resources around them and the pressures upon them.

REFERENCES

AIKENS, C. MELVIN

1966a *Virgin-Kayenta cultural relationships.* University of Utah Anthropological Papers 79.

1966b* *Fremont-Promontory-Plains relationships.* University of Utah Anthropological Papers 82.

1967* *Excavations at Snake Rock Village and the Bear River No. 2 Site.* University of Utah Anthropological Papers 87.

1970* *Hogup Cave.* University of Utah Anthropological Papers 93.

AMBLER, RICHARD J.

1966* *Caldwell Village.* University of Utah Anthropological Papers 84.

BAILEY, VERNON

1931 Mammals of New Mexico. *North American Fauna* 53:1–412.

BLUHM, ELAINE A.

1957 The Sawmill site, a Reserve Phase village, Pine Lawn Valley, western New Mexico. *Fieldiana: Anthropology* 47:1–86.

BÖKÖNYI, S.

1969 "Archaeological problems and methods of recognizing animal domestication," in *The domestication and exploitation of plants and animals.* Edited by P. J. Ucko and G. W. Dimbleby, 219–229. London: Duckworth.

BRAIDWOOD, ROBERT J., HALET ÇAMBEL, CHARLES L. REDMAN, PATTY JO WATSON

1971 Beginnings of village-farming communities in southeastern Turkey. *Proceedings of the National Academy of Science USA* 68:1236–40.

CLARK, JAMES L.

1964 *The great arc of the wild sheep.* Norman: University of Oklahoma Press.

COCKRUM, E. LENDELL

1960 *The recent mammals of Arizona: their taxonomy and distribution.* Tucson: University of Arizona Press.

CUTLER, HUGH C.

1952 A preliminary survey of plant remains of Tularosa Cave. *Fieldiana: Anthropology* 40:461–479.

* Indicates archaeological papers reporting the excavation of remains of wild sheep.

DICK, HERBERT W.
1965* *Bat Cave.* School of American Research, Monograph 27.
DREW, ISABELLA M., DEXTER PERKINS, JR., PATRICIA DALY
1971 Prehistoric domestication of animals: effects on bone structure. *Science* 171:280–282.
FOWLER, DON D., C. MELVIN AIKENS
1963* *1961 excavations, Kaiparowits Plateau, Utah.* University of Utah Anthropological Papers 64.
GEIST, VALERIUS
1971 *Mountain sheep.* Chicago: University of Chicago Press.
GRINNELL, JOSEPH
1912 The bighorn of the Sierra Nevada. *University of California Publications in Zoology* 10:143–153.
GUNNERSON, JAMES H.
1959* *1957 excavations, Glen Canyon area.* University of Utah Anthropological Papers 43.
1969* *The Fremont Culture: a study in culture dynamics on the northern Anasazi frontier.* Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University 59(2).
HALL, EUGENE RAYMOND, KEITH R. KELSON
1959 *The mammals of North America.* New York: Ronald Press.
HARLAN, J. R.
1967 A wild wheat harvest in Turkey. *Archaeology* 20:197–201.
HAURY, EMIL W.
1936 *The Mogollon Culture of southwestern New Mexico.* Medallion Papers 20.
1940 Excavations in the Forestdale Valley, east-central Arizona. *University of Arizona Bulletin* 11:1–147.
1950* *The stratigraphy and archaeology of Ventana Cave, Arizona.* Tucson: University of Arizona Press.
1962 "The Greater American Southwest," in *Courses toward urban life.* Edited by Robert J. Braidwood and Gordon R. Willey, 106–131. New York: Viking Press.
HAURY, EMIL W., E. B. SAYLES
1947 An early pithouse village of the Mogollon Culture, Forestdale valley, Arizona. *University of Arizona Bulletin* 18:1–93.
HOLE, FRANK, KENT V. FLANNERY
1967 The prehistory of southwestern Iran: a preliminary report. *Proceedings of the Prehistoric Society* 33:147–206.
JENNINGS, JESSE D.
1966* *Glen Canyon: a summary.* University of Utah Anthropological Papers 81.
JENNINGS, JESSE D., EDWARD NORBECK
1955 Great Basin prehistory: a review. *American Antiquity* 21:1–11.
JONES, J. KNOX, JR.
1951 Another record of a mountain sheep (*Ovis canadensis*) from Nebraska. *Natural History Miscellanea* 91:1.

LEGGE, A. J.
1972 "Prehistoric exploitation of the gazelle in Palestine," in *Papers in economic prehistory: studies by members and associates of the British Academy Major Research Project in the Early History of Agriculture.* Edited by E. S. Higgs, 119–124. Cambridge: Cambridge University Press.

LIPE, WILLIAM D.
1960* *1958 Excavations, Glen Canyon area.* University of Utah Anthropological Papers 44.

LIPE, WILLIAM D., FLOYD W. SHARROCK, DAVID S. DIBBLE, KEITH M. ANDERSON
1960* *1959 excavations, Glen Canyon area.* University of Utah Anthropological Papers 49.

LISTER, ROBERT H.
1958 *Archaeological excavations in the northern Sierra Madre Occidental, Chihuahua and Sonora, Mexico.* University of Colorado Studies Series in Anthropology 7.
1964* *Contributions to Mesa Verde archaeology: I, Site 499.* University of Colorado Studies Series in Anthropology 9.
1966* *Contributions to Mesa Verde archaeology: III, Site 866.* University of Colorado Studies Series in Anthropology 12.

LYDEKKER, R.
1898 *Wild oxen, sheep, and goats of all lands.* London: Rowland Ward.

MANGELSDORF, PAUL C., HERBERT W. DICK, JULIÁN CÁMERA-HERNÁNDEZ
1967 Bat Cave revisited. *Harvard University, Botanical Museum Leaflets* 22:1–31.

MANGELSDORF, PAUL C., ROBERT H. LISTER
1956 Archaeological evidence on the evolution of maize in northwestern Mexico. *Harvard University, Botanical Museum Leaflets* 17:151–178.

MARTIN, PAUL S.
1940* *The SU Site: excavations at a Mogollon village, western New Mexico, 1940.* Anthropological Series Field Museum of Natural History 32: 1–97.
1943* *The SU Site: Excavations at a Mogollon village, western New Mexico, 1941.* Anthropological Series Field Museum of Natural History 32: 98–271.
1947* *The SU Site: Excavations at a Mogollon village, western New Mexico, 1946.* Anthropological Series Field Museum of Natural History 32: 272–382.

MARTIN, PAUL S., WILLIAM A. LONGACRE, JAMES N. HILL
1967 Chapters in the prehistory of eastern Arizona, III. *Fieldiana: Anthropology* 57:1–178.

MARTIN, PAUL S., JOHN B. RINALDO
1950a Sites of the Reserve Phase, Pine Lawn Valley, western New Mexico. *Fieldiana: Anthropology* 38:397–577.
1950b Turkey Foot Ridge Site, a Mogollon village, Pine Lawn Valley, western New Mexico. *Fieldiana: Anthropology* 38:233–396.
1960 Excavations in the Upper Little Colorado drainage, eastern Arizona. *Fieldiana: Anthropology* 51:1–127.

MARTIN, PAUL S., JOHN B. RINALDO, ERNEST ANTEVS
1949 Cochise and Mogollon sites, Pine Lawn Valley, western New Mexico. *Fieldiana: Anthropology* 38:1–232.

MARTIN, PAUL S., JOHN B. RINALDO, ELAINE A. BLUHM, HUGH C. CUTLER
1956 Higgins Flat Pueblo, western New Mexico. *Fieldiana: Anthropology* 45:1–218.

MARTIN, PAUL S., JOHN B. RINALDO, ELAINE A. BLUHM, HUGH C. CUTLER, ROGER GRANGE, JR.
1952 Mogollon cultural continuity and change: the stratigraphic analysis of Tularosa and Cordova Caves. *Fieldiana: Anthropology* 40:1–528.

MARTIN, PAUL S., JOHN B. RINALDO, WILLIAM A. LONGACRE, CONSTANCE CRONIN, LESLIE G. FREEMAN, JR., JAMES SCHOENWETTER
1962 Chapters in the prehistory of central Arizona, I. *Fieldiana: Anthropology* 53: 1–244.

MARTIN, PAUL S., JOHN B. RINALDO, WILLIAM A. LONGACRE, LESLIE G. FREEMAN, JR., JAMES A. BROWN, RICHARD H. HEVLY, M. E. COOLEY
1964* Chapters in the prehistory of eastern Arizona, II. *Fieldiana: Anthropology* 55:1–261.

MARWITT, JOHN P.
1968* *Pharo Village*. University of Utah Anthropological Papers 91.

MEYERS, J. THOMAS
1971 "The Origins of agriculture: an evaluation of three hypotheses," in *Prehistoric agriculture*. Edited by Stuart Struever, 101–121. Garden City, N.Y.: Natural History Press.

NADLER, C. F., K. V. KOROBITSINA, R. S. HOFFMAN, N. N. VORONTSOV
1973 Cytogenetic differentiation, geographic distribution, and domestication in Palearctic sheep (*Ovis*). *Zeitschrift für Säugetierkunde* 38:109–125.

PATTIE, J. O.
1930 *The personal narrative of James O. Pattie, of Kentucky*. Edited by Timothy Flint. Chicago: R. R. Donnelley and Sons.

PERKINS, DEXTER
1964* The prehistoric fauna from Shanidar, Iraq. *Science* 144:1565–1566.

PERROT, J.
1968 La préhistoire palestinienne. *Supplément au Dictionnaire de la Bible* 8:286–446.

REED, CHARLES A., ROBERT J. BRAIDWOOD
1960 Toward the reconstruction of the environmental sequence of northeastern Iraq. *Studies in Ancient Oriental Civilization* 31:163–173.

REED, ERIK K.
1958* *Excavations in Mancos Canyon, Colorado*. University of Utah Anthropological Papers 35.
1964 "The Greater Southwest," in *Prehistoric man in the New World*. Edited by Jesse D. Jennings and Edward Norbeck, 175–191. Chicago: University of Chicago Press.

RINALDO, JOHN B.
1959 Foote Canyon Pueblo. *Fieldiana: Anthropology* 49:145–298.

SCHOENWETTER, JAMES
1962 The pollen analysis of eighteen archaeological sites in Arizona and New Mexico. *Fieldiana: Anthropology* 53:168–209.

SHARROCK, FLOYD W., KEITH M. ANDERSON, DON D. FOWLER, DAVID S. DIBBLE
1961* *1960 excavations, Glen Canyon area.* University of Utah Anthropological Papers 52.

SHARROCK, FLOYD W., KENT C. DAY, DAVID S. DIBBLE
1963* *1961 excavations, Glen Canyon area.* University of Utah Anthropological Papers 63.

SHARROCK, FLOYD W., JOHN P. MARWITT
1967* *Excavations at Nephi, Utah, 1965–1966.* University of Utah Anthropological Papers 88.

SPICER, EDWARD H., LOUIS P. CAYWOOD
1936 Two Pueblo ruins in west central Arizona. *University of Arizona Social Science Bulletin* 10:1–115.

STONE, WILMER, WILLIAM EVERETT CRAM
1902 *American animals.* New York: Doubleday, Page.

TURNBULL, PRISCILLA F., CHARLES A. REED
1974 The fauna of Palegawra, a late Pleistocene Zarzian site in northeastern Iraq. *Fieldiana: Anthropology* 63:81–146.

WELLES, RALPH E., FLORENCE B. WELLES
1961 *The bighorn of Death Valley.* Fauna Series of the National Parks of the United States 6.

WENDORF, FRED
1950 A report on the excavation of a small ruin near Point of Pines, east-central Arizona. *University of Arizona Social Science Bulletin* 19:1–150.

WHEAT, JOE BEN
1954 Crooked Ridge Village. *University of Arizona Social Science Bulletin* 24:1–183.
1955 *Mogollon culture prior to A.D. 1000.* American Anthropological Association Memoir 82.

WILKINSON, PAUL F.
1972 "Current experimental domestication and its relevance to prehistory," in *Papers in economic prehistory.* Edited by E. S. Higgs, 107–118. Cambridge: Cambridge University Press.

WILLEY, GORDON R.
1966 *An introduction to American archaeology,* volume one. Englewood Cliffs, N.J.: Prentice-Hall.

WISTER, OWEN
1904 "The mountain sheep: his ways," in *Musk-ox, bison, sheep, and goat.* Edited by Caspar Whitney, 167–222. London: Macmillan.

ZEUNER, FREDERICK E.
1963 *A history of domesticated animals.* New York: Harper and Row.